Discussion on How to Evaluate Summer Mathematics Programs

Deborah Nolan *University of California, Berkeley*

Summary of Discussions Led by:

Toni Bluher, *National Security Agency*
Barbara Deuink *National Security Agency*
Svetlana Katok *Pennsylvania State University*
Robby Robson *Oregon State University*

Introduction

One of the organized discussions at the conference on summer mathematics programs focussed on how to evaluate these programs. The discussion included ideas on: how to conduct evaluations to improve program operation and to address the needs of students while they are participating in a program; how to measure whether the goals and objectives of a program are being met; and how to evaluate the effectiveness of summer math programs in general as opposed to the effectiveness of a particular program. These ideas for evaluation are summarized here.

Program evaluation

The working and living environment of the program–whether students enjoy their work, have healthy living conditions, and interact well with each other–are important aspects of any summer mathematics program. These aspects are important because they play a role in determining a student's happiness and performance, and in the ultimate success of the program. When the quality of the program environment is assessed during the program, actions can be taken, if necessary, to improve the situation while the program is in progress. The same holds for the quality of the research program; if assessed during the program, adjustments can be made as needed.

There are several avenues for obtaining information on the quality of life and the quality of the research experience in the program. For example, program personnel can meet one-on-one with students, where the student has the opportunity to raise his or her concerns in private. Alternatively, groups of students can be asked to brainstorm together to provide an assessment of how the program is going, or anonymous mid-program evaluations can be collected. Meeting with students outside of the work area, such as in a dorm, cafeteria, or coffee shop, provides a safe place for students to freely express their concerns. To further encourage open feedback, you might consider using someone who is not directly involved in the program, such as a returning student or a former instructor, to conduct interviews with the students.

End-of-program evaluations can provide a lot of information for improving your program in the future. To obtain the most useful information, questions need to be worded so that they elicit meaningful responses, not just yes/no answers. Also, anonymous evaluations encourage honest responses, and conducting evaluations before students leave the program should increase the response rate. You may want to offer students an incentive for completing a questionnaire before leaving the program.

An end-of-program questionnaire should solicit feedback on operational specifics such as the program pace and schedule, extracurricular activities, quality and diversity of visitors, difficulty and suitability of the research problem, how the program met or fell short of expectations, and accuracy of preprogram advertising. The questionnaire should also attempt to discern the effect of the program on a student's plans for next year, plans for after graduation, and understanding of what it is to be a mathematician. Baseline questions asked on the first day of the program can help document changes in a student's plans and perspectives.

Goals and Objectives

The conference participants were asked to consider how to evaluate a program to determine how well it has met its goals and objectives. The discussion focussed on evaluation of the goals and objectives that were set forth at the conference in an earlier organized discussion.

Provide a mathematically rich and professional environment

To measure the richness of the mathematics environment that students are introduced to in a summer mathematics program, student and program activities can be assessed.

With regard to students, you can: enumerate student output, such as oral presentations, poster presentations, and written reports; describe the problems, papers, and books that students used in their summer work; quantify the amount of time students spent communicating mathematics; and have students describe the areas of mathematics which they were exposed to in the program. To make these measures of student activities more meaningful, they need to be compared to preprogram activities or to a typical undergraduate experience.

The mathematical richness of the overall program can also be evaluated by examining students' exposure to professionals, and by providing a description of the facilities available to students in the program.

Raise the mathematical maturity of students

To evaluate how well a program has performed in raising the mathematical maturity of its participants, the change in the student must be measured. Change can be measured in the following ways: the participants themselves can provide a self-evaluation one year or more after the program; the faculty who recommended the students to your program can be asked for their opinion and observation of the change in the student; program visitors can serve as witnesses to in-program change in students' abilities; and a panel of experts can evaluate the quantity and quality of students' technical reports and students' presentations at conferences. These experts would need to see student improvement, possibly through multiple presentations or written documents.

Diversity

Many programs have as a goal to increase the number of students from traditionally underrepresented groups who enter and successfully complete graduate school. Many programs also attempt to assist mathematically talented students (from all groups) whose mathematical preparation for graduate school may be insufficient.

To measure how effective your program is in achieving these goals, long term tracking is needed. Not only does one need to keep track of the number of students who apply to and get accepted to graduate school, students also need to be followed through graduate school to determine how many obtain advanced degrees. Additionally, a study of the demographics of the participants in your program will help indicate how well your program is meeting these goals.

Prepare students for graduate school

Many of the items discussed previously can be used to evaluate a program on its success at preparing students to apply to and succeed in graduate school. Determining how many students apply to, get accepted at, receive fellowships for, and attend graduate school are all different measures of how well this goal is achieved. A comparison to mathematics majors at the participant's home institution would be most informative in documenting success. Student self evaluations may also be informative. Students can describe their knowledge about graduate school before and after the program. Once in graduate school they can attest to whether the program has had an impact on their research, instruction, and knowing what to expect. To see the long term effect of the program, long term tracking is needed. Although following students in time is important, a balance must be struck between keeping track of the students and annoying them with requests for feedback. A few key points in their careers can be identified, and they can be contacted at these times.

Build community

To measure the utility of this community, past participants may be questioned on the number of post-program contacts they made and whether they were student to student, student to faculty, or student to graduate student. Program faculty may be asked how many letters of recommendation they have written for former students. Gatherings at conferences, repeat applications to the same or other programs, and interviews with returning students may provide evidence of community and its value. Anthropologists could possibly provide assistance for designing an evaluation of the mathematics community built by the program.

Global evaluation

The discussants pointed out the need to look at the effectiveness of summer mathematics programs overall to determine the general usefulness of such programs. Suggestions were made to track students in graduate programs in the mathematical sciences, and to compare the success of those who had attended summer mathematics programs to those who had not had such an experience. A large scale evaluation of summer mathematics programs would be very labor intensive. The mathematics community needs to develop and carry out such a study.

Conclusions

Many outcomes of a summer mathematics program are intangible, and there may be more than one standard to measure success for different programs. For example, a program may be healthy, even if no research papers are published from it, and a good evaluation must distinguish the quality of research from the quality of research experience.

Student assessment of a program is one source of evaluation, but not the only source. We have discussed many avenues for collecting information that would be useful in evaluating summer mathematics programs. Both factual data and subjective impressions should be sought. For example, non-questionnaire evaluations such as observation by non-program faculty can provide valuable information on a program's effectiveness.

The evaluation task is not insignificant, and it is advisable to set aside funds for evaluation and to seek advice on your evaluation plan. Questionnaires can be shared across programs, students can assist in pinpointing useful information to be collected, and evaluation specialists can be consulted. Evaluation is important to the future of all summer mathematics programs.