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Assessment Methods for Undergraduate Research Programs

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Undergraduate research programs in mathematics are more and more widely acknowledged as a valuable part of the total mathematics education and research community. In order to secure long-term funding for such projects and to increase even further the support for such programs in the mathematics community, directors of undergraduate research programs bear a responsibility to provide concrete evidence of the effectiveness of their programs.

This article summarizes some of the methods used by various programs to assess their own effectiveness. We have collected information not just on undergraduate research programs but also on related programs for undergraduates.

Participant databases. The most common assessment method is to maintain an on-going database of former participants. Typically, the database tracks undergraduate and graduate degrees as well as employment history. It can also include more specific information such as scholarships and fellowships received. Over time, these databases provide a good summary of what happens to students after they participate in a research program. One example of such a student database is [**1**].

Maintaining contacts with many former participants can be very difficult and time-consuming. Some program directors choose to stop tracking former participants when they leave academics for another type of career (but to record what career they adopted). For those former participants who end up in academic careers, it probably makes sense to never stop tracking.

Encouraging networking amongst former participants is valuable in many ways, including for assessment. Maintaining contacts with former participants becomes much easier. Direct conversations also provide additional anecdotal evidence of the effectiveness of undergraduate research programs. As one example, some programs organize reunions annually at the Joint Mathematics Meetings.

Evaluation forms and surveys. Some programs ask participants to complete evaluation forms immediately at the end of their active participation in the program. A few programs use a coordinated set of surveys, one of which occurs at the beginning of the program or even before it starts. This approach shows how students' perspectives change over the course of a research experience.

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Program directors can create evaluation forms on their own. However, it is also possible to pay for formal evaluations that are designed and administered by outside professionals. Depending on the anticipated value of the data and also depending on budgets, the extra cost may be well worth it. Outside evaluators are experts at phrasing questions that encourage useful responses.

Evaluating the mathematics. The methods described above are mostly intended to assess the social impact of undergraduate research programs. However, program directors should also pay attention to assessing more directly the mathematical output of their programs.

One way to measure this is to consider student activities that are directly linked to a recent research experience. These include writing or publishing an article, giving a talk at a conference, giving a colloquium lecture at the student's home institution, or presenting a poster in a poster session. Another example is applying for or receiving funding for research activities; many institutions have funds to support their own local students. Some programs require that students perform some or all of these activities. In addition to providing a chance to hone communication skills, such activities also provide some validation of the quality of the mathematical research.

It is difficult for traditional summer program directors to enforce requirements of this nature. One possible solution is to solicit the cooperation of a faculty member from a student's home institution. For local students working on year-round projects, these requirements are easily enforced.

Summer programs compared to year-round programs. Although it is impossible to fit all types of undergraduate research activities into clean categories, most such activities either are part of a summer program involving multiple students (e.g., NSF-funded REUs) or are year-round activities involving at most a few local students and a local faculty member. These two types of research activities require different approaches to assessment.

The document [**2**] provides reporting guidelines for NSF-funded REUs; this serves as a guide for data collection for all summer programs. The basic idea is to provide evidence of progress towards the goal of a "diverse, internationally-competitive, and globally-engaged workforce".

The NSF requests information on each student participant, including year of schooling completed, home institution, gender, ethnicity, race, disability status, and citizenship. Also requested is information on research, such as project titles, specific examples of research results, publications, presentations, and participation in conferences. NSF is also interested in other kinds of information, such as the impact and nature of mentoring; the impact of the REU experience on career choices; findings from formal evaluations; and details of the recruitment and selection process, especially with respect to diversity.

Assessment for year-round research is much more flexible. Since the number of students is so low, formal evaluations are probably not relevant. Still, research mentors can meaningfully measure whether or not a project was mathematically successful; they can also maintain a database of former students as described above.

Sample evaluation questions. To give program directors an idea of suitable evaluation questions, we provide the following samples. They are suggested by

questions from actual surveys of the Summer Institute in Mathematics for Undergraduates (SIMU) at the University of Puerto Rico – Humacao.

The first set of questions is designed for students who participated in a research program in the previous year.

1. Before our program, had you seriously thought about attending graduate school?

2. Did your experience in our program increase or decrease your desire to attend graduate school?

3. Before our program, had you worked on an undergraduate research project in mathematics? After our program, have you worked on an undergraduate research project in mathematics? Will you participate in a research program this year? If so, where?

4. Since the end of the program, with which other students and program staff have you communicated?

5. After our program, have your grades in mathematics courses changed significantly? How?

6. List any conferences at which you have presented a poster based on your work in our program. Also, list all talks which you given based on your work in our program. Have you won any awards for these presentations?

7. List the titles of any papers that you have written based on your work in our program. Have you submitted any for publication? If so, to which journals?

8. Have you already applied to graduate schools? If so, list the universities and departments to which you applied. Do you feel that your participation in our program helped you in the application process?

The following questions are intended for former students who participated in a research program several years ago.

9. Are you currently enrolled in a graduate program? If so, at which university and in which field? When did you start this program? What graduate degree are you currently pursuing? Do you hold a national fellowship? Do you feel that your participation in our program helped you to be accepted?

10. Have you completed a graduate degree? If so, at which university and in which field? What degree did you receive, and when did you receive it? Do you feel that your participation in our program helped you to succeed in graduate school? If you are employed, describe your current position.

11. Did you start a graduate program but subsequently leave without obtaining a degree? What university did you attend? Why did you leave? If you are employed, describe your current position.

12. Have you never attended graduate school? Why not? Did you apply to graduate school, or do you plan to apply in the future?

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References

[1] http://www.d.umn.edu/~jgallian/partnew.html
[2] http://www.nsf.gov/pubs/2001/nsf01124/nsf01124.html

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