

involve

a journal of mathematics

Papers, posters, and presentations as outlets
for undergraduate research

Aparna Higgins, Lewis Ludwig and Brigitte Servatius



Papers, posters, and presentations as outlets for undergraduate research

Aparna Higgins, Lewis Ludwig and Brigitte Servatius

(Communicated by Darren A. Narayan)

Presented in this paper are the findings of the panel entitled *Outlets for undergraduate research* as delivered at the Trends in Undergraduate Research in Mathematical Sciences (TURMS) in Chicago on October 27, 2012. We specifically discuss venues and best practices for student papers, posters, and presentations.

1. Introduction

With the dramatic increase in the number of undergraduate students conducting research, there are more opportunities than ever for students to share their work with others. We focus on preparing students for three such outlets: papers, posters, and presentations. While most readers are familiar with a wide variety of opportunities for student presentations, we also provide a number of venues for posters and written publications. Additional information on these topics can be found in [Gallian and Higgins 2007].

2. Papers: Brigitte Servatius

Print publication is to date the most lasting outlet for (student) research. Our times put immense pressure on researchers to publish their work. Publications in refereed journals are considered more important, because quality is typically better, and publications reviewed on MathSciNet are of even greater weight. Another easy measure of impact is the number of citations an article receives. However, citations usually take longer to appear than the span of an undergraduate career.

To prepare an article for publication it is important to choose an appropriate journal. Most student researchers need help from their advisor in doing this, because students do not normally read research journals. To foster student research and encourage students to publish their work, it is a good idea to have students read published papers early on. Journals such as the *Pi Mu Epsilon Journal* or *The*

MSC2010: 00-01.

Keywords: student papers, student posters, student presentations.

College Mathematics Journal, whose target readership is an undergrad math major or a faculty member at a primarily undergraduate institution, could be kept in a student lounge. A problem-solving group can be used for good writing exercises. Solving problems from the current issue of a journal is a good exercise in reading, writing, and using math. Members of a problem-solving group act simultaneously as researchers and peer reviewers and there is a natural time pressure set by the deadline for submission of solutions. The *Pi Mu Epsilon Journal*, for example, publishes student solutions to its posted problems. Such a published solution is a very nice and fast first publication. Students can also submit problems for solution to appear in the problems column of a journal. Again, this is an excellent mathematical writing exercise and fast publication.

Advisors of student research may gain valuable experience by serving as referees for research in their specific field and for student research in a broader context. Refereeing is, without doubt, additional work. Since blind or even double-blind refereeing is customary it is a bit tricky for young faculty to have this activity counted appropriately among annual activities toward tenure. However, most journals will send a “thank you” that can be used as documentation of your service to the profession.

Preparing research results for publication is a serious step beyond obtaining the results. The introduction should be directed to the main readership of the journal. If it is a journal for undergraduate students, the introduction should be of broad interest and also understandable to the mathematically inclined advanced undergrad. If it is a research journal in topology, a metric space need not be defined. The introduction and bibliography are of fundamental importance. The journal editor will select a referee whose research interest matches the topic of the paper. The editor will therefore scan the introduction as well as the bibliography for ideas for referees. Misleading introductions as well as missing or wrong citations can have a devastating effect even before the paper is read. Before a paper is sent to a journal it should be meticulously proofread. It is not the responsibility of a referee to check proofs or to correct spelling and grammar. Once the editor has sent the paper to the referees, no changes or corrections are possible until the editor receives the referees’ reports and asks for specific changes. Never send off a paper before you think it is absolutely perfect. Once the paper is ready, make sure you are aware of the journal’s instructions for authors. Some journals require paper submission and want your manuscript in triplicate; some journals accept email submission of files of a certain format; some journals require web submission; and some allow more than one option. In all cases, you are expected to write a cover letter. Make sure it is dated, contains your permanent address and email, the title of your paper, and the name of the journal in which you want your paper to appear. Some editors are editing several different journals simultaneously. They may receive a flood of

mail, and might misplace your article if this information is not apparent. If possible, also put that on the cover page. If your journal has double-blind review, put this information on top of a cover page with author information removed.

MathSciNet is a great research tool. It enables even a novice undergrad to find publications using a set of key words. These hits produce a reading list. The reviews together with the paper abstracts will give a good idea of the usefulness of the paper toward the research goal. The citations point toward other venues. The number of hits a particular key word produces gives a first idea about the importance of the concept. Writing reviews for MathSciNet is about as time consuming as refereeing, but is easier to highlight on your annual report. I recommend it highly to potential advisors of student research.

3. Posters: Aparna Higgins

A poster session is an efficient way for a large number of researchers to showcase their work simultaneously. Many institutions have poster sessions associated with an annual celebration of student work, and there are regional opportunities for poster sessions as well. For example, the Mathematical Association of America (MAA) section meetings frequently have poster sessions for undergraduates, and several of the MAA–National Science Foundation (NSF) sponsored Regional Undergraduate Mathematics Conferences hold similar such sessions. The MAA website (www.maa.org) provides information on both of these opportunities.

National meetings of the professional societies in math also organize poster sessions; the biggest of these is at the Joint Mathematics Meetings (JMM), held annually in January. Started in the early 1990s, the poster session had a dozen to fifteen posters. By the late 1990s, there were forty posters. Sixty posters were presented in 2000, eighty posters were presented in 2002, and over 250 posters were presented in 2012. The 2013 JMM in San Diego had over 320 posters. More information on the subject of posters can be found in [Martelli 2002].

The poster session at the JMM is always exciting—the room is humming with energy from enthusiastic students explaining the results of their research to faculty, some of whom are judges for the posters. Under an initiative of Joe Gallian, MAA President 2007–2008, travel support is available to students who present posters (see maa.org/programs/students/meetings-conferences/student-travel-grants). For many years, several monetary prizes were awarded based on judging conducted by attending faculty. In recent years, the monetary prizes have been discontinued, but faculty continue to judge posters in an organized and formal manner, providing valuable feedback to the student researchers on their work and presentations. The poster session is always in need of judges; see <http://www.maa.org/students/undergrad/judges.html>.

It is important for research directors to help students understand the differences between preparing posters, presentations and papers for publication. Some advice on this matter can be found in [\[Hammarling and Higham 2013\]](#). Additionally, here are some suggestions that I make to students who are preparing posters under my direction.

- Keep in mind who your audience is, and how little time they will be at your poster.
- It is very helpful for your audience if your poster indicates clearly what kind of objects are being studied (groups or manifolds or graphs or knots, for example), and what aspect of these objects is being studied (for example, a particular invariant or a product of two of these objects or a mapping between two of these objects). It helps the viewer if the poster presenter explains why this work may be interesting (for example, the sharpening or realization of a previously known bound).
- The font size used should be large enough to be legible from two or three feet away.
- The poster should contain the title of the project, the names of the researchers and their affiliations, the name of the program that sponsored this research (as in an REU), and the names of the advisors of the project, if they have not already been included as coresearchers.
- The poster should contain many pictures to help illustrate concepts. It is helpful to have both examples and nonexamples listed so that the contrast is evident and helps to clarify any definitions used.
- If abbreviations for techniques or objects are used, it is helpful to indicate, in a footnote, say, what the abbreviation stands for.
- If a proof is provided, it is better to provide broad strokes of the idea of the proof, rather than all the technical details. If the result is proved by breaking down the problem into many cases, it suffices to present the proof of only one case.
- Students should create a two-minute-or-less guided tour of the work that the poster illustrates. It is best to script this ahead of time and practice it.
- Have a handout ready with the names and email addresses of the researchers and the name of the organization where the work was done, name and date of the meeting, and a couple of the main results. This handout is a useful tool for networking, and can be given to anyone who is interested in the work presented by the student.

Posters can serve as vehicles of dissemination of results, but they can also serve as ways of getting feedback on partial results.

4. Presentations: Lew Ludwig

For over ten years I have been instructing students on ways to improve their oral communication skills. Not only has this work made for a number of successful student presentations, some winning national awards, but it has also prepared my students for life beyond my classroom. Whether my students attend grad school or join the work force, communication skills are a critical asset towards their success. Indeed, in the National Association of Colleges and Employers (NACE) *Job Outlook 2013* report [NACE 2013], employers rank “ability to verbally communicate with persons inside and outside the organization” as the number one candidate skill/quality they seek in future hires. As we prepare our math majors to present their senior project or summer research for that sectional meeting or department colloquium, we need to keep in mind that we are not only helping them convey their work to others, but we are helping them develop a life skill that will reach far beyond that one presentation experience.

In addition to preparing students to present their research, I have taught seven sections of the Technical Communication class at Denison University, where students improve their oral communication skills by delivering three mathematical presentations. It is safe to say that through these experiences, and by attending a number of regional and national presentations, I have seen hundreds of student presentations. Interestingly, when a particularly strong or weak talk stands out in my memory, it is not the student’s name I recall, but that of the school. We might bear in mind that not only are we better preparing our students for the work force; through proper training of our students in oral communication skills, we are bettering the name of our own institutions.

Many readers will be familiar with Joe Gallian’s *Advice on giving a good PowerPoint presentation* article through the MAA website [2006]. In this article, Joe provides a detailed checklist of dos and don’ts for delivering a good presentation including things like font size, use of color, refraining from animations, etc. This article served as a springboard for my NSF-funded website *Technically Speaking* (techspeaking.denison.edu), which provides a video on how to give a good presentation. While such resources have been a great help to students, I find that there are some finer points students often overlook in their presentations, and these can prevent a good presentation from being a great one. Here are a few things to consider.

Know the material well so your audience doesn’t have to. During a recent tenure-track search to replace a retiring colleague, my colleague Michael Westmoreland commented how he placed a good deal of emphasis on the research statement. Coming from a national liberal arts college with a high emphasis on teaching, I initially found his focus misplaced, but he further explained. He argued that if

someone really knew her research well enough, she could explain it to a nonexpert audience, much in the same way that quality instructors should be able to explain difficult mathematical concepts at a level appropriate for their students. So in a sense, my colleague was using the research statement to inform him about a candidate's ability to teach.

I think the same can be said for student presentations. If a student has a good understanding of the material contained in the presentation, then he should be able to deliver the concepts to a variety of audiences. Often students make too many assumptions about the audience. They automatically think everyone knows about the mosaic number of a knot, the chromatic number of a graph, or the genus of a surface. The student should know the audience and their limitations. It helps to use simple examples or even props to convey technical ideas. In a 10–15 minute talk, it is enough to convey the main ideas, without all the nitty-gritty details.

Play it again Sam. Why do the refrains of songs or jingles stick in our heads? Not only are they catchy, but they are repeated numerous times — the very definition of refrain. Often I see students deliver a well crafted presentation, but they do not repeat the important things. Everything is given the same weight, it is said once. Just like that jingle, students need to repeat the important parts of their message. This can be done when the idea is first introduced or throughout the presentation or both. If something is important, it bears repeating. When the audience hears something repeatedly, it will begin to take notice. A good gauge of understanding is whether an audience member can state the three most important things from the presentation. Don't forget, if it is important, repeat it.

Read less, talk more. Giving a presentation before a live audience can be nerve-racking. It is natural to get nervous and possibly forget what you want to say. To overcome this, many students print everything, or most everything, they want to say on their slides. Some go so far as to script complete sentences or even paragraphs. While this may lessen the student's anxiety, it is counterproductive for the audience. Any cognitive psychologist will tell you we cannot multitask. We cannot text and drive. We cannot tweet and study. And we surely can't listen to someone speak and read. It is human nature to start reading along with the speaker. More often than not, the audience will begin to read ahead in the written material, thus nullifying the effectiveness of the speaker, who would have done just as well to provide a handout and sit down.

To prevent your student's "talk" from becoming a "read," be sure she uses only keywords or short phrases on the slides. These notes should be cues to the presenter of what needs to be said, not a substitute for listening to the speaker. Most mathematicians are "thrifty" by nature. Encourage your students to embrace their

inner mathematician and be thrifty with the numbers of words per slide. I tell my student each word cost 25 cents.

I offer one more word of advice, as a continuation with the “talk more” theme above. The more often students present in front of a group, the more comfortable they will become. If you plan to have a student present a mathematical topic at a conference, consider having them give a few short warm-up talks just to get used to standing before an audience. This could be as simple as a two-minute presentation on their favorite mathematician or why they chose to attend their school. The content is not as important as shaking out the nerves and gaining confidence. Once this is established, then it is time to focus on the details in Gallian’s article or on the *Technically Speaking* website.

References

- [Gallian 2006] J. A. Gallian, “[Advice on giving a good PowerPoint presentation](#)”, MAA, 2006, see <http://www.maa.org/sites/default/files/pdf/students/undergrad/Gallian.pdf>.
- [Gallian and Higgins 2007] J. A. Gallian and A. Higgins, “[Helping students present their research](#)”, pp. 273–278 in *Proceedings of the Conference on Promoting Undergraduate Research in Mathematics*, edited by J. Gallian, AMS, 2007.
- [Hammarling and Higham 2013] S. Hammarling and N. J. Higham, “[How to prepare a poster](#)”, SIAM guidelines, SIAM, 2013, see <http://www.siam.org/meetings/guidelines/poster.php>.
- [Martelli 2002] M. Martelli, “[The undergraduate student poster session: history, present and future](#)”, Mathematical Association of America, 2002, see http://www.maa.org/news/student_poster.html.
- [NACE 2013] National Association of Colleges and Employers, “[Job outlook 2013](#)”, employment survey, 2013, see <http://goo.gl/ZaCaK>.

Received: 2013-01-24

Revised: 2013-05-22

Accepted: 2013-10-27

Aparna.Higgins@udayton.edu

Department of Mathematics, University of Dayton,
Dayton, OH 45469-2316, United States

ludwigl@denison.edu

Department of Mathematics and Computer Science,
Denison University, Granville, OH 43020, United States

bservat@math.wpi.edu

Department of Mathematics, Worcester Polytechnic Institute,
100 Institute Road, Worcester, MA 01609-2280, United States

EDITORS

MANAGING EDITOR

Kenneth S. Berenhaut, Wake Forest University, USA, berenhks@wfu.edu

BOARD OF EDITORS

Colin Adams	Williams College, USA colin.c.adams@williams.edu	David Larson	Texas A&M University, USA larson@math.tamu.edu
John V. Baxley	Wake Forest University, NC, USA baxley@wfu.edu	Suzanne Lenhart	University of Tennessee, USA lenhart@math.utk.edu
Arthur T. Benjamin	Harvey Mudd College, USA benjamin@hmc.edu	Chi-Kwong Li	College of William and Mary, USA ckli@math.wm.edu
Martin Bohner	Missouri U of Science and Technology, USA bohner@mst.edu	Robert B. Lund	Clemson University, USA lund@clemson.edu
Nigel Boston	University of Wisconsin, USA boston@math.wisc.edu	Gaven J. Martin	Massey University, New Zealand g.j.martin@massey.ac.nz
Amarjit S. Budhiraja	U of North Carolina, Chapel Hill, USA budhiraj@email.unc.edu	Mary Meyer	Colorado State University, USA meyer@stat.colostate.edu
Pietro Cerone	La Trobe University, Australia P.Cerone@latrobe.edu.au	Emil Minchev	Ruse, Bulgaria eminchev@hotmail.com
Scott Chapman	Sam Houston State University, USA scott.chapman@shsu.edu	Frank Morgan	Williams College, USA frank.morgan@williams.edu
Joshua N. Cooper	University of South Carolina, USA cooper@math.sc.edu	Mohammad Sal Moslehian	Ferdowsi University of Mashhad, Iran moslehian@ferdowsi.um.ac.ir
Jem N. Corcoran	University of Colorado, USA corcoran@colorado.edu	Zuhair Nashed	University of Central Florida, USA znashed@mail.ucf.edu
Toka Diagana	Howard University, USA tdiagana@howard.edu	Ken Ono	Emory University, USA ono@mathcs.emory.edu
Michael Dorff	Brigham Young University, USA mdorff@math.byu.edu	Timothy E. O'Brien	Loyola University Chicago, USA tborie1@luc.edu
Sever S. Dragomir	Victoria University, Australia sever@matilda.vu.edu.au	Joseph O'Rourke	Smith College, USA orourke@cs.smith.edu
Behrouz Emamizadeh	The Petroleum Institute, UAE bemamizadeh@pi.ac.ae	Yuval Peres	Microsoft Research, USA peres@microsoft.com
Joel Foisy	SUNY Potsdam foisyjs@potsdam.edu	Y.-F. S. Pétermann	Université de Genève, Switzerland petermann@math.unige.ch
Errin W. Fulp	Wake Forest University, USA fulp@wfu.edu	Robert J. Plemmons	Wake Forest University, USA rplemmons@wfu.edu
Joseph Gallian	University of Minnesota Duluth, USA jgallian@d.umn.edu	Carl B. Pomerance	Dartmouth College, USA carl.pomerance@dartmouth.edu
Stephan R. Garcia	Pomona College, USA stephan.garcia@pomona.edu	Vadim Ponomarenko	San Diego State University, USA vadim@sciences.sdsu.edu
Anant Godbole	East Tennessee State University, USA godbole@etsu.edu	Bjorn Poonen	UC Berkeley, USA poonen@math.berkeley.edu
Ron Gould	Emory University, USA rg@mathcs.emory.edu	James Propp	U Mass Lowell, USA jpropp@cs.uml.edu
Andrew Granville	Université Montréal, Canada andrew@dms.umontreal.ca	József H. Przytycki	George Washington University, USA przytyck@gwu.edu
Jerrold Griggs	University of South Carolina, USA griggs@math.sc.edu	Richard Rebarber	University of Nebraska, USA rrebarbe@math.unl.edu
Sat Gupta	U of North Carolina, Greensboro, USA sngupta@uncg.edu	Robert W. Robinson	University of Georgia, USA rwr@cs.uga.edu
Jim Haglund	University of Pennsylvania, USA jhaglund@math.upenn.edu	Filip Saidak	U of North Carolina, Greensboro, USA f_saidak@uncg.edu
Johnny Henderson	Baylor University, USA johnny_henderson@baylor.edu	James A. Sellers	Penn State University, USA sellersj@math.psu.edu
Jim Hoste	Pitzer College jhoste@pitzer.edu	Andrew J. Sterge	Honorary Editor andy@ajsterge.com
Natalia Hritonenko	Prairie View A&M University, USA nahritonenko@pvamu.edu	Ann Trenk	Wellesley College, USA atrenk@wellesley.edu
Glenn H. Hurlbert	Arizona State University, USA hurlbert@asu.edu	Ravi Vakil	Stanford University, USA vakil@math.stanford.edu
Charles R. Johnson	College of William and Mary, USA crjohnso@math.wm.edu	Antonia Vecchio	Consiglio Nazionale delle Ricerche, Italy antonia.vecchio@cnr.it
K. B. Kulasekera	Clemson University, USA kk@ces.clemson.edu	Ram U. Verma	University of Toledo, USA verma99@msn.com
Gerry Ladas	University of Rhode Island, USA gladas@math.uri.edu	John C. Wierman	Johns Hopkins University, USA wierman@jhu.edu
		Michael E. Zieve	University of Michigan, USA zieve@umich.edu

PRODUCTION

Silvio Levy, Scientific Editor

See inside back cover or msp.org/involve for submission instructions. The subscription price for 2014 is US \$120/year for the electronic version, and \$165/year (+\$35, if shipping outside the US) for print and electronic. Subscriptions, requests for back issues from the last three years and changes of subscribers address should be sent to MSP.

Involve (ISSN 1944-4184 electronic, 1944-4176 printed) at Mathematical Sciences Publishers, 798 Evans Hall #3840, c/o University of California, Berkeley, CA 94720-3840, is published continuously online. Periodical rate postage paid at Berkeley, CA 94704, and additional mailing offices.

Involve peer review and production are managed by EditFlow[®] from Mathematical Sciences Publishers.

PUBLISHED BY



mathematical sciences publishers

nonprofit scientific publishing

<http://msp.org/>

© 2014 Mathematical Sciences Publishers

involve

2014

vol. 7

no. 3

Preface	245
DARREN A. NARAYAN	
Undergraduate research in mathematics with deaf and hard-of-hearing students: four perspectives	247
HENRY ADLER, BONNIE JACOB, KIM KURZ AND RAJA KUSHALNAGAR	
Challenges in promoting undergraduate research in the mathematical sciences	265
FERYAL ALAYONT, YULIYA BABENKO, CRAIG JACKSON AND ZSUZSANNA SZANISZLO	
Undergraduate research as a capstone requirement	273
HANNAH L. CALLENDER, JAMES P. SOLAZZO AND ELIZABETH WILCOX	
A decade of undergraduate research for all East Tennessee State University mathematics majors	281
ARIEL CINTRÓN-ARIAS AND ANANT GODBOLE	
The MAA undergraduate poster session 1991–2013	295
JOYATI DEBNATH AND JOSEPH A. GALLIAN	
Nonacademic careers, internships, and undergraduate research	303
MICHAEL DORFF	
REU design: broadening participation and promoting success	315
REBECCA GARCIA AND CINDY WYELS	
Papers, posters, and presentations as outlets for undergraduate research	327
APARNA HIGGINS, LEWIS LUDWIG AND BRIGITTE SERVATIUS	
ISU REU: diverse, research-intense, team-based	335
LESLIE HOGBEN	
AIM's Research Experiences for Undergraduate Faculty program	343
LESLIE HOGBEN AND ULRICA WILSON	
Institutional support for undergraduate research	355
KATHY HOKE, ALESSANDRA PANTANO, MAZEN ZARROUK AND AKLILU ZELEKE	
Experiences of working with undergraduate students on research during an academic year	363
JOBBY JACOB	
The role of graduate students in research experience for undergraduates programs	369
MICHAEL A. KARLS, DAVID MCCUNE, LARA PUDWELL AND AZADEH RAFIZADEH	
An unexpected discovery	373
ERIKA L. C. KING	
Alternative resources for funding and supporting undergraduate research	377
ZACHARY KUDLAK, ZEYNEP TEYMUROGLU AND CARL YERGER	
Academic year undergraduate research: the CURM model	383
TOR A. KWEMBE, KATHRYN LEONARD AND ANGEL R. PINEDA	
Information for faculty new to undergraduate research	395
CAYLA MCBEE AND VIOLETA VASILEVSKA	
Promoting REU participation from students in underrepresented groups	403
HEATHER M. RUSSELL AND HEATHER A. DYE	
The Center for Industrial Mathematics and Statistics at Worcester Polytechnic Institute	413
SUZANNE L. WEEKES	
Nontraditional undergraduate research problems from sports analytics and related fields	423
CARL R. YERGER	