The**INNOVATOR**

The Voice of the PSM

Articles In This Issue

Message from the Editor

While the pandemic changed plans during the past year, the PSM community responded with creativity and flexibility. This issue of The INNOVATOR, shares the contributions of PSM students and alumni to help solve COVID issues. Travel and meeting restrictions have changed recruitment efforts, so explore how virtual graduate fairs can help recruit PSM students (Kuter). An opinion article challenges us to consider PSM Externships for undergraduates (Chubin and Tobias). Helpful to PSM directors, learn about the changes and improvements to the PSM affiliation process (Freer, Friedman and Hoobler) and research on communications skills in PSM students (Egan Warren). Enjoy!

The INNOVATOR is NPSMA's peer-reviewed publication that shares best practices and other relevant information with the PSM community.

FEATURE ARTICLE

PSM Students and Alumni
Meet Challenges from the Pandemic

THE SARS CoV-2 PANDEMIC HAS PRESENTED A SEEMINGLY NEVER ENDING NUMBER OF SCIENTIFIC CHALLENGES REQUIRING SOLUTIONS FROM DIVERSE SCIENTIFIC DISCIPLINES. PSM programs cover a wide variety of scientific fields and specialties. Since, in addition to scientific expertise, the calling cards for PSM students and alumni are teamwork, problem-solving abilities, and flexibility, it comes as no surprise that they are rising to meet these challenges. A few examples follow.

Rutgers University Externship Students Help a Small Town

Externships (small, collaborative, multidisciplinary team projects) have always been a part of the experiential learning component of the Rutgers Master of Business and Science Program (MBS). In the spring of 2020, Bianna Cruz was the team leader in an MBS externship project to redesign the website for the small town of New Wilmington, Pennsylvania. When the pandemic hit, Cruz and her team had a decision to make: would they complete the partially finished website redesign or would they pivot to another way to help the town in light of the impacts of COVID-19? "There was no other choice, to be honest," said Cruz. "The point was to help the town in some way; now you have [COVID-19] that's not only impacting the town, but the whole country and world. In my mind, it's 'what do you need me to do?'"

Cruz and her teammates launched an all-hands-on-deck effort to assist New Wilmington's residents, especially its small businesses. The team researched and short-listed grants, helped strategize and implement a curbside pickup system for restaurants, and helped develop and implement an idea for online "shop local" baskets – ultimately creating an internet ordering system that allowed consumers to purchase items from multiple stores and then have items shipped or delivered in one convenient bundle. The town is still using the students' research and marketing ideas, and the project is ongoing.

University of Connecticut PSM Students & Alumni Advance State's SARS-CoV-2 Testing

In a pre-pandemic world, Sema4 was a patient-centered health intelligence company focused on improving the diagnosis and treatments in reproductive health and oncology. However, when cases of COVID19 surged across the country exposing a desperate need for increased molecular virology testing, Sema4 quickly pivoted and deployed many of its resources and highly skilled team members to support the Connecticut public health response to the SARS-CoV-2 pandemic.

Matthew Capozziello, a 2013 graduate of the University of Connecticut's Professional Science Master Program in Applied Genomics and a scientist on the Sema4 Clinical Test Innovations (CTI) team, quickly volunteered to help drive the COVID19 testing development at Sema4 Genomics. "It was never even a question, of course I am going to do whatever I can to help with the public health response," Matt said when asked by friends and family why he volunteered. Matt, and the rest of the CTI team that stepped up, routinely worked 12+ hour shifts 6-7 days a week to support the implementation and validation of a high-throughput molecular virology laboratory in a matter of weeks. Even after the new laboratory was completed and validated, Matt and the CTI team volunteered again to run patient samples while training other members of Sema4's lab staff on the test protocol. Through his and many other peoples' efforts, Sema4 expanded its capacity for COVID19 testing from 0 to 15,000 tests/day in a matter of weeks in support of Connecticut's COVID19 response.

The University of Connecticut's PSM in Health Care Genetics (HCG) is intended for those interested in using genomic information to improve health. Eric Carrano (B.S. UConn) and Trevor Hunter (B.S. Hofstra University) joined the Health Care Genetics Program in the fall of 2019. Eric's academic preparation and 3-years of work experience in Yale University School of Medicine's Cytogenetics Laboratory led to an offer of a graduate teaching assistant position as an instructor of record for two HCG courses in fall 2019-spring 2020. After successfully completing professional development modules in learning systems and teaching and mentoring, Trevor was also hired as an instructional assistant for two sections of a laboratory in diagnostic molecular techniques. In spring 2020 Eric and Trevor provided 24 senior high school students from the Health Careers Opportunity Program with a Saturday workshop including hands-on laboratory training with DNA extractions and microarrays. Then the summer of 2020 brought an unexpected change in focus for both Eric and Trevor when a need arose for qualified technologists to help with the ramp up of clinical testing for the SARS CoV-2 virus across the state of Connecticut. Eric and Trevor both applied for temporary technologist positions in Connecticut laboratories to help in the efforts to meet testing demand. Trevor was hired at the HCG program workforce partner's laboratory, SEMA4, in Branford, CT. Eric was hired with the HCG program partner, the Jackson Laboratory of Genomic Medicine. While completing online courses for the fall 2020 semester, Trevor and Eric will continue to contribute to the efforts of these companies to bring fast and quality testing to various populations across Connecticut.

Rice University PSM Student Designs an Inexpensive Classrom Protective Barrier

In the summer of 2020, Rice University's Department of Mechanical Engineering Chair Laura Schaefer received an email from a Houston elementary school teacher asking for a cheap protective barrier that the teacher could use in her classrooms as they did not have the funds to purchase barriers offered by outside vendors. Schaefer forwarded the request to all mechanical engineering juniors and seniors. Answering the call was Loren Young, a PSM student in the Rice University M.S. Space Studies program, Class of 2022. Loren explains: "The barriers were to be used on 4-person school desks such that students would not need to wear masks while during class and maintain proper physical-distancing. As such, that morning I designed such a barrier and sent the design/assembly document to the teacher in need. She said she would forward the design to her fellow teachers to help them formulate other creative ideas for erecting such structures." (Figure 1)
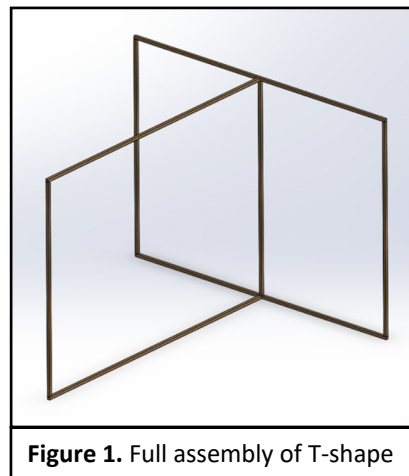

**Figure 1.** Full assembly of T-shape

Loren's design for a simple desk barrier was lightweight, affordable, easy to assemble, and transparent for students to see through. At a cost of about $8 per 2-student barrier, the design employed a balsa wood frame and plastic wrap physical barrier that provided an easily replaceable sanitary shield.

University of Illinois at Urbana-Champaign PSM Students Join Teams to Develop Web Applications to Track COVID-19 and to Facilitate Ordering Fresh Food

As the pandemic unfolded, researchers at the University of Illinois' CyberGIS Center for Advanced Digital and Spatial Studies organized a team of graduate students and postdocs to develop a web application to track COVID-19 cases and visualize the impact on different geographic scales. PSM student Yong Liang, a Geographic Information Science major, was part of the WhereCOVID-19 Platform team for his summer internship experience. (Figure 2) Different than other tracking apps, this team included social vulnerability and healthcare facility accessibility throughout Illinois in the app. Through the project Yong participated in real-world application of his GIS skills, and coordinated with other University of Illinois departments and the Illinois Department of Public Health for the development and continuation of the information. "This experience gave me a new perspective to explore the application of GIS in the field of healthcare, which might have a promising future due to the increasing demand for health facilities and supplies," said Yong. The team received accolades from other researchers throughout the world and in the U.S. popular press. To view the team's work, visit: *https://wherecovid19.cigi.illinois.edu/*

The pandemic had a different kind of effect on the Meat Science Laboratory at the University of Illinois that serves a dual purpose of research outcomes of livestock grown for food, while providing an outlet for surplus fresh meat, meat products, and eggs. While the research schedule continued in March as COVID precautions were put in place, the freezers were quickly reaching capacity and the lab's staff needed to devise a way to allow meat sales that would protect the health of both the staff and the public. For her summer internship, Alexis Remmers, a PSM student studying Animal Production, was on the team to develop an online ordering system, inventory and market available products, answer questions from the public, pack orders, devise a customer pick up system, and safely deliver the order to the customers' vehicles in the parking lot. Alexis created a new database of product photos for the website, maintained the Facebook page and produced marketing content to push new inventory or flash sales as needed as part of her responsibilities. "I believe that this internship allowed me to explore different areas and help determine that I enjoy engaging with customers and helping them with their needs. Overall, this taught me that sales is an area that I would like to go into as a long-term career," Alexis explained. The lab continues to use the ordering system and marketing techniques.

Figure 2: Screenshots from the University of Illinois WhereCOVID-19 Platform.
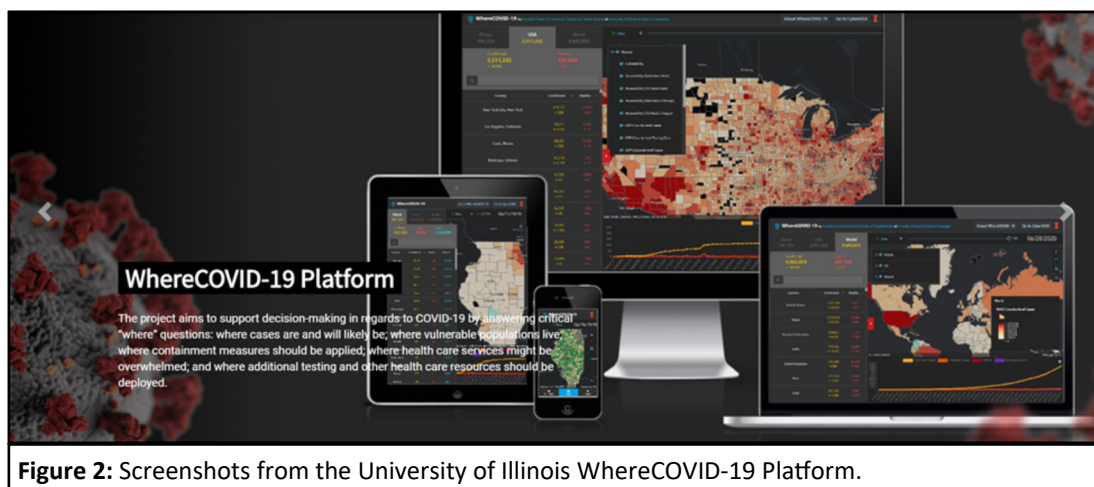
IN PRACTICE ARTICLE

A Streamlined Process for Program Affiliation
Seema Freer, Elizabeth S. Friedman, Ray J. Hoobler

N 2019, THE NPSMA RESTRUCTURED THE AFFILIATION PROCESS WITH SEVERAL GOALS, INCLUDING:

- decreasing the cost of affiliation to NPSMA members
- Elucidating the role of the NPSMA in the affiliation process
- Proving streamlined guidelines for affiliation / reaffiliation

The NPSMA created a streamlined, online format to facilitate submission of information needed to grant PSM affiliation. This new format creates an efficient means for reviewers to access the material. Since launching the new initiative, the NPSMA has evaluated 15 programs. It has realized its goals of decreasing the cost for individual programs while significantly improving the process of affiliation / reaffiliation.

Introduction
The new NPSMA affiliation process requires that applicants specify the STEM content, the professional competencies, foundational and transferable skills, research/work-based learning component, composition of the external advisory board, and program's contact information. We have found that when universities are required to provide these details on their website, their professional science master's program is more robust. It shows that it is well thought out and, in all likelihood, will meet the required criteria. On the application form, directors also mark their engagement with the PSM community and provide a letter of support from senior administration.

The New Affiliation Process
The new streamlined affiliation process aligns PSM programs with the National Academies of Sciences, Engineering, and Medicine (NASEM) consensus study report: *Graduate STEM Education for the 21st Century* (2018). Specifically, the NPSMA seeks

greater than 50% STEM content, a clear transferable skills component, evidence of an active External Advisory Board, and opportunities for real-world training (Figure 1).
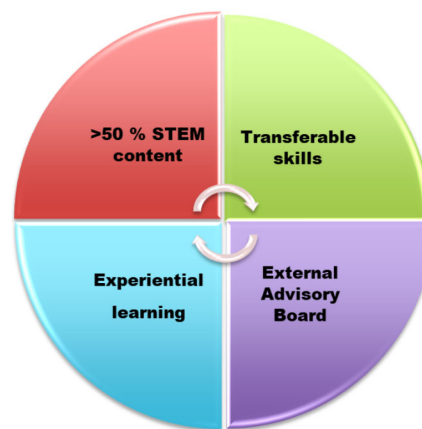
Figure 1: What Makes a Master's Program a Professional Science Master's?

The new application process relies on the program's website for general information and, in many cases, the university's catalog for detailed course descriptions. Information regarding the program of study, breakdown of required and elective courses, and an explanation of the experiential learning component should be easily accessible on the program's website. At some universities, the program director has control of their website and is able to update information quite easily. However, there are many schools where the requests to update information go through the marketing and communication office, so changes may take longer to implement. In either case, it is the program director's responsibility to make sure the information is accurate and comprehensive.

The affiliation committee relies heavily on the institution's completed application for accurate information. The committee strives for a quick turnaround time and is readily available to provide guidance and answer questions regarding the process.

Although the reaffiliation process requires an individual application for each program, it is easy to store the redundant information in text form for subsequent copying and pasting. Additionally, the new process significantly reduces the quantity of demographic data requested.

Program Review Process

After the affiliation committee receives an application, three members of the NPSMA Affiliation Committee are selected to review the request. The turnaround time is generally two weeks. If all three committee members agree that the program meets the affiliation guidelines, the committee chair will notify the program director of the decision within a week's time (Figure 2). If the committee has questions, the affiliation committee chair contacts the program director for additional information or clarification. If the program does not meet the guidelines, the committee chair will extend advice on how best to go forward and resubmit. We have found that this is also an opportunity to advocate for our well-established best practices. For example, a proposed advisory board may be primarily composed of internal administrators and faculty. In this case, we would recommend that the program direc-

tor reach beyond their university to form an external advisory board that includes representatives from the workforce: business, industry, and government, as these are essential for building a sustainable PSM program.

Program applications may not be approved due to lack of clarity about STEM content, or how the foundational and transferable skills are incorporated, or what the work-based project looks like, or even the distribution of credit hours. In this case, the affiliation committee chair will send notification to the program director detailing the information that is missing or not clearly visible on the website.

If there are remaining questions after the second submission, the entire committee will review the application to determine whether the program, as represented by the application materials, meets the NPSMA guidelines and standards. It is a very straightforward and transparent process. The NPSMA is committed to its member institutions and strives to make affiliation a painless and transparent process. Let's get started!

PSM Program Director
- **Submits online application**

NPSMA Affiliation Committee Chair
- **3 members of committee assigned to review - outcome approved or resubmission requested**
- **After resubmission, full committee review - outcome approved or denied**

PSM Program Director
- **Notified of Decision**

Figure 2: Affiliation / Reaffliation Workflow

The NPSMA invited University of Utah and Temple University, whose PSM programs underwent recent affiliation/ reaffiliation, to share their experience.

University of Utah

The University of Utah's Professional Science Master's programs completed their reaffiliation applications in the spring of 2020. The five programs include Biotechnology, Computational and Data Science, Earth Resource Management, Environmental Science, and Science Instrumentation. The University of Utah manages these five programs as "tracks" within a single department in the Graduate School—the Professional Master of Science and Technology. Four of these tracks were PSM affiliated programs while the fifth track, Earth Resource Management, was established in 2019.

The University of Utah website clearly displays much of the information requested for affiliation. However, the NPSMA asks for additional information that is not readily available on the program web pages, such as the list of advisory board members and letter of support. Program director Dr. Ray Hoobler of the University of Utah did not see the request for this information as an onerous task. He found it quite easy to upload the document describing his external advisory board and the letter of support from the dean of the graduate school. For the University of Utah's five programs, Dr. Hoobler estimates the entire affiliation process took less than a day —not counting the time needed to secure the "sign-off" letter from the dean.

Temple University

Temple University's College of Science and Technology expanded its PSM programs from five to seven. The University added two new programs, High Performance Computing for Scientific Applications and Cyber Defense and Information Assurance, to the existing programs: Biotechnology, Bioinnovation, Bioinformatics, Forensic Chemistry, and Scientific Writing.

Dr. Seema Freer, the managing director of PSM programs in the College of Science and Technology at Temple University, stated that the affiliation of these programs was significantly simpler than the previous process. In one case, a detailed website and completed list of external advisors were not submitted at the time of application. In the review, the NPSMA affiliation committee reached out to Dr. Freer to ask for the missing details before they approved affiliation. Dr. Freer added that the NPSMA Affiliation Committee chair, Dr. Avril Robertson, was readily available and provided helpful guidance throughout the process. Overall, the affiliation application process was fundamentally streamlined and less arduous than the original process. The turnaround time for affiliation, including the request to provide additional information, was less than two months.

References

National Academies of Sciences, Engineering, and Medicine. 2018. Graduate STEM Education for the 21st Century. Washington, DC: The National Academies Press. https://doi.org/10.17226/25038. Chapter 4. The Master's Degree
https://npsma.wildapricot.org/resources/Affiliation/
PSM Affiliation Application Information.pdf

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FEATURE ARTICLE

Examining PSM Students' Confidence and Competence with Presentation Skills

Sarah Egan Warren

"Those who misjudge their competence, talent, or character may meet with disaster.
To the extent that they misjudge their knowledge and learning, they may not perform to
the best of their potential or reach the goals they set for themselves—in the classroom
as well as in the transition to clinic, conference room, or corporation" (Dunning, 2006, p.1).

COMMUNICATION, INCLUDING THE ABILITY TO DELIVER A PRESENTATION, IS ONE OF THE TOP SOFT SKILLS DESIRED BY EMPLOYERS BECAUSE POSSESSING TECHNICAL ABILITY ALONE IS not sufficient for employees to succeed in the 21st-century workplace. The demand for soft skills can be problematic for technically-minded graduate students who may be lacking these skills, because soft skills, and communication skills in particular, can be challenging to teach and difficult for students to master. Industry demand for soft skills like communication influences graduate education—specifically, professional science master's (PSM) programs. PSM programs may refer to courses that teach soft skills or transferable skills as PLUS courses. David King described these courses as being designed to "provide STEM graduates with job-related skills to prepare them for supervisory or management positions." These PLUS courses, or more commonly called transferable skills courses, include courses on communication as well as ethics, leadership, management, teamwork, and many other specialized topics.

Graduates from STEM PSM programs are expected to be able to communicate technical concepts and results to a wide variety of audiences. Some students avoid communication, and presentations in particular, because they may not recognize the ultimate importance of communication skills; some may lack confidence in their presentation skills; some may experience public speaking apprehension or anxiety. Whatever the cause, students may be missing opportunities to develop the presentation skills necessary for the workplace.

Even when students do engage in developing their communication skills, students' self-reported level of confidence with their presentation skills do not always match their instructor-assessed competence. The mismatch of confidence and competence can make it difficult for students to develop and improve the presentation skills that are needed for their future careers. If students are overconfident, they can miss the chance to improve their skills and may make poor decisions. Students who underestimate themselves could be at risk for imposter phenomenon (IP). Pauline Clance and Suzanne Imes introduced the idea of IP, which refers to the feeling of phoniness despite accomplishments. Although the original research about IP focused on women, both men and women can experience it, and it is common in university settings. Either overestimation or underestimation provides an opportunity for improvement because accurate self-assessment can play an important role in learning. In David Dunning's book, *Self-insight*, he indicates that knowing strengths and weaknesses in a certain domain can be beneficial to improving them.

About This Study

Inspired by Justin Kruger and David Dunning's 1999 study about incompetence and self-assessment, a study was conducted to examine how PSM Analytics students' self-reported confidence with their presentation skills relates to instructor-assessed competence of those students' presentation skills. Data was collected from 215 (out of a possible 230) PSM graduate students from a PSM program at a southern public land-grant research university. The data came from ungraded student reflection responses and three instructors' assessment

ratings (not grades). Two measurements were used: (1) student reflection responses collected four times over the span of five months consisting of ratings of one to five to indicate confidence with presentation skills and (2) instructors' ratings of one to five to indicate the students' competence with presentations skills. For students, the rating of one indicated "Not Confident" and the rating of five indicated "Very Confident." Instructors used the range of one to five for competence ratings with one labeled as "Novice," two labeled as "Beginner," three labeled as "Average," four labeled as "Proficient," and five labeled as "Expert."

The Dunning-Kruger Effect (DKE) provided a framework to consider presentation confidence and competence in PSM graduate students. In short, the DKE was named for Kruger and Dunning's 1999 study that found those who were incompetent in a skill were more likely to overestimate their ability because of a lack of metacognition. In addition, those who were highly skilled tended to underestimate their expertise. The main take away is that those in the bottom quartile tend to overestimate their performance while those in the top quartile tend to underestimate their performance.

Students' Self-Reported Confidence

To determine students' self-reported confidence, median, mode, and percentages were used to analyze the confidence ratings from each of the four points of collection. The four points of collection show that overall, most students rated their confidence as a three or four. A rating of one for confidence was the least likely rating. Not a single student selected a rating of one at the fourth point of collection. In Figure 1, all four points of confidence collection are shown next to each other for comparative purposes.

Digging in a little deeper, students' confidence ratings over time show that almost a quarter of the students entered the same confidence rating at all four points of collection. The highest number of students entered the same confidence rating for point two and point three. The most students selecting increased confidence ratings occurred between point three and point four. The most students entering decreased confidence ratings occurred between point one and point two.

Figure 1. Percentages for all four points.

Three Instructors' Competence Ratings for Students' Skills

Median, mode, and percentage were used to analyze the three instructors' competence ratings for the students' presentation skills. For both median and mode, the competence ratings for all 215 students was a three. A more detailed picture of the competence ratings can be seen in Figure 2.
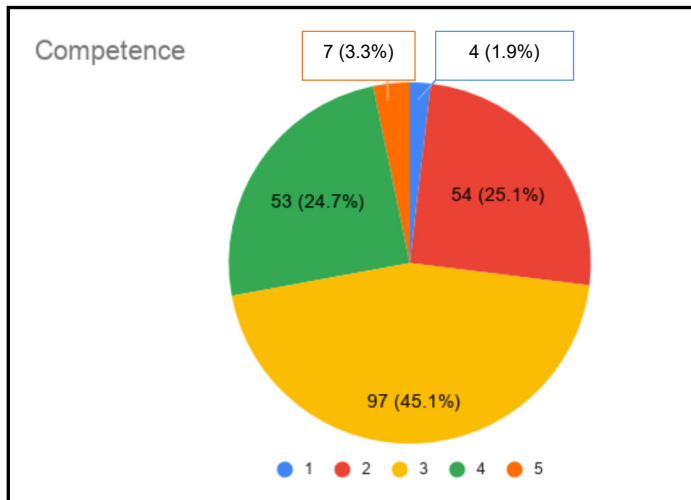

Figure 2. Percentages of competence ratings.

Figure 2 shows that most of the students received a rating of three. About a quarter of the students received a rating of a two or a four. On the extreme ends of the rating continuum, the remaining students received a rating of one or five.

Comparing Students' Confidence and Instructors' Ratings of Competence

At each point of collection, students' confidence ratings were compared to the instructors' competence ratings of their presentation skills. The results shown in Figure 3 indicate the percentage of students whose confidence ratings were equal, overestimated, or underestimated the instructors' competence ratings.

The frequency of equal estimation rose from point one to point two and topped out at point three before dropping to its lowest at point four. Overestimation dropped at point two and again at point three before rising at point four. The highest underestimation frequency occurred at point two. It is important to note that the point one collection of confidence ratings happened before students began their PSM program. Point two occurred shortly after orientation. Some calibration in ratings seems to have oc-
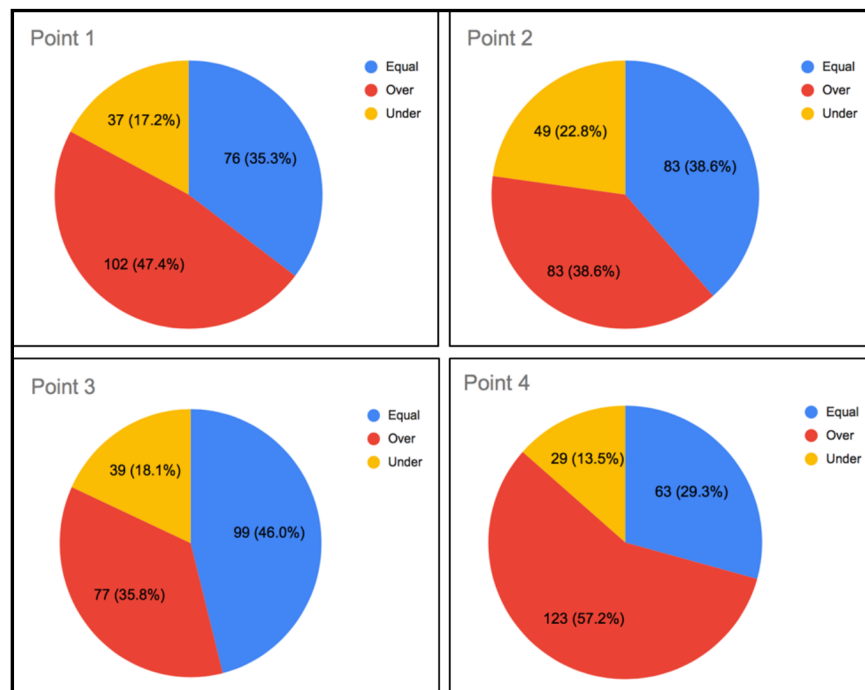

Figure 3. Rating comparisons for all four points of collection.

curred after students met their classmates. Point three occurred after two presentation experiences and feedback from the main instructor. Here we see the most agreement between confidence ratings and competence ratings. The last point of collection for confidence occurred at the end of an intensive presentation training workshop. The overestimation at point four does not necessarily indicate a problem. Instead, the increase in confidence ratings align with the goals of the presentation training workshop—providing instruction and an opportunity to practice presentation skills to improve students' confidence.

All four points of confidence collection showed the pattern of the lowest performers (the incompetent) overestimating and the highest performers (competent) underestimating. However, the findings from point four is the strongest support for the DKE pattern as shown in Figure 4.

Significance of Relationship Between Confidence and Competence

Spearman's correlations were calculated to determine whether a statistically significant relationship existed between students' self-reported confidence with presentation skills and instructors' rating of their presentation competence. Using McHugh's categories for interpreting the correlation coefficients, the findings show only a moderate positive correlation (with points one and two falling on the lower end of the moderate scale). If using different researchers' categories, points one and two could be considered low or weak. The examination of Spearman's correlation shows a generally positive moderate correlation. It implies that competence ratings increase when confidence ratings increase. The findings also indicate that the highest correlations occurred at point three and point four when students had been interacting with the instructors the longest.
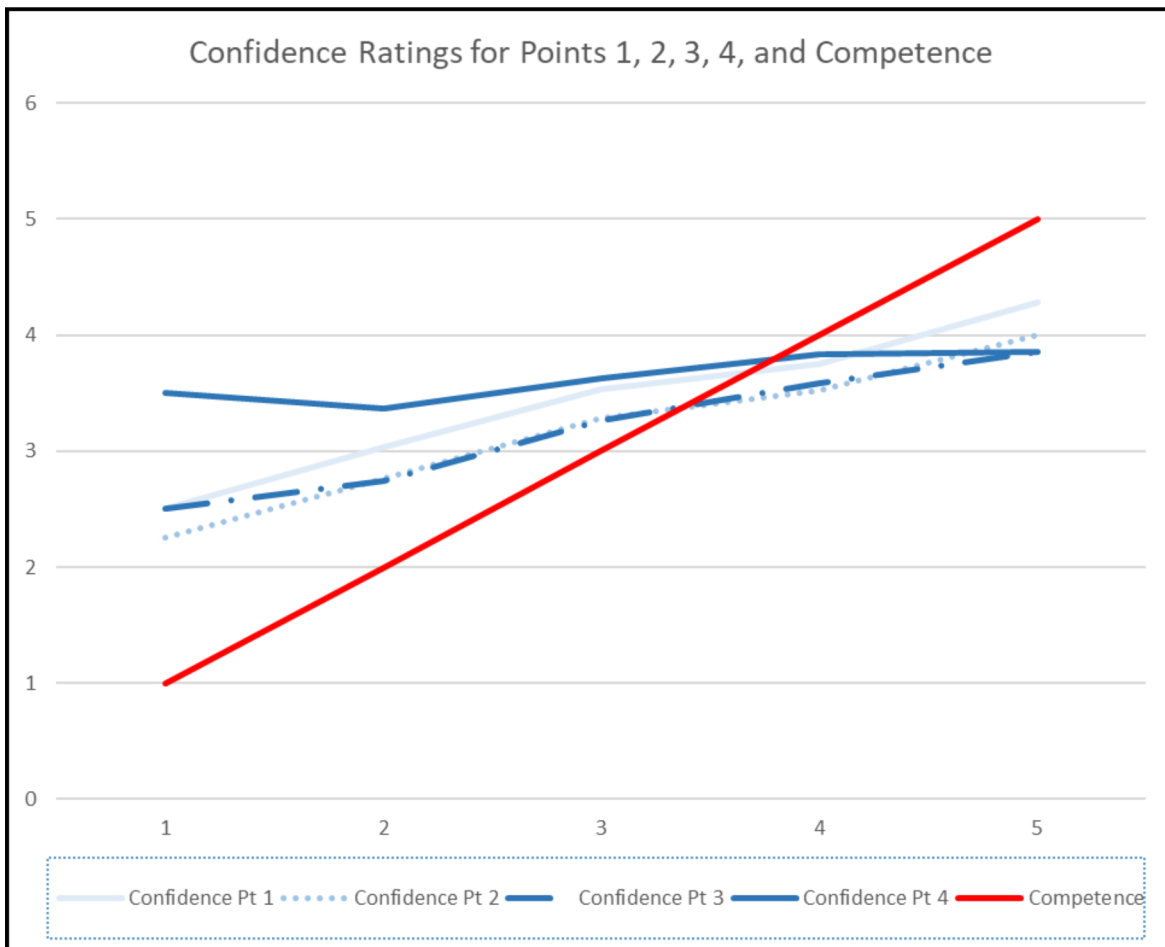

Figure 4. Confidence rating for all four points compared to competence.

Sex and Age

Descriptive statistics and regression were used to determine whether the students' sex or age significantly influenced students' self-assessed presentation confidence ratings. A p-value of 0.05 was used to determine significance. The population in this study was relatively balanced in terms of sex (men = 57.21% and women = 42.79%). Note that this study used biological sex or sex assigned at birth, and not gender or gender expression, because that was how the data was collected at the time of student application. The age variable was converted into the binary categories of older and younger by taking the students' median age of twenty-four and separating students into older (meaning 24 years and above) and younger (meaning 23 years and below). The results of the multiple linear regression indicated that neither of the two variables (sex and age) influenced the confidence ratings. In addition, interactions between sex and age did not indicate any influence on confidence ratings.

Applying Results to Practice

The findings from the study can help inform approaches to teaching and supporting presentation skills for PSM students. The want/need presentation matrix shown in Figure 5 can be used to categorize students using the results from the confidence and competence ratings analysis. Even without a formal study, PSM instructors may find the matrix categories in Figure 5 useful when considering ways to support students' development.

The Rookie quadrant is labeled needs help and wants help, which means that these students are open to feedback in order to improve. The Rookies include the students receiving a rating of one, two, or three in competence who did not overestimate or underestimate their confidence ratings by more than one point. To support these students, instructors can follow Adam Persky and Jennifer Robinson's instructional tips for novices: students need clear directions, feedback, and practice.

The Underconfident quadrant is for students who do not need help but want help. The Underconfident include students rating a four or five in competence who consistently underestimated, especially those who underestimated by two points. Students in the Underconfident quadrant present well but doubt their abilities despite being told they are doing well. They seek out extra attention and support. Another label for this quadrant could be students experiencing imposter phenomenon (IP). Underconfident students can be supported by teaching them about IP and encouraging them to apply some of Sindhumathi Revulari's strategies to combat IP such as focusing on accomplishments, avoiding comparisons, and accepting feedback. In addition, providing specific feedback, using video, and offering opportunities for practice can help the underconfident students improve their presentation skills. Students in the Rookie quadrant and the Underconfident quadrant could benefit from working together to develop and hone presentation skills in a low-stakes environment.

Figure 5. Want/need matrix for presentation skills with findings from study.
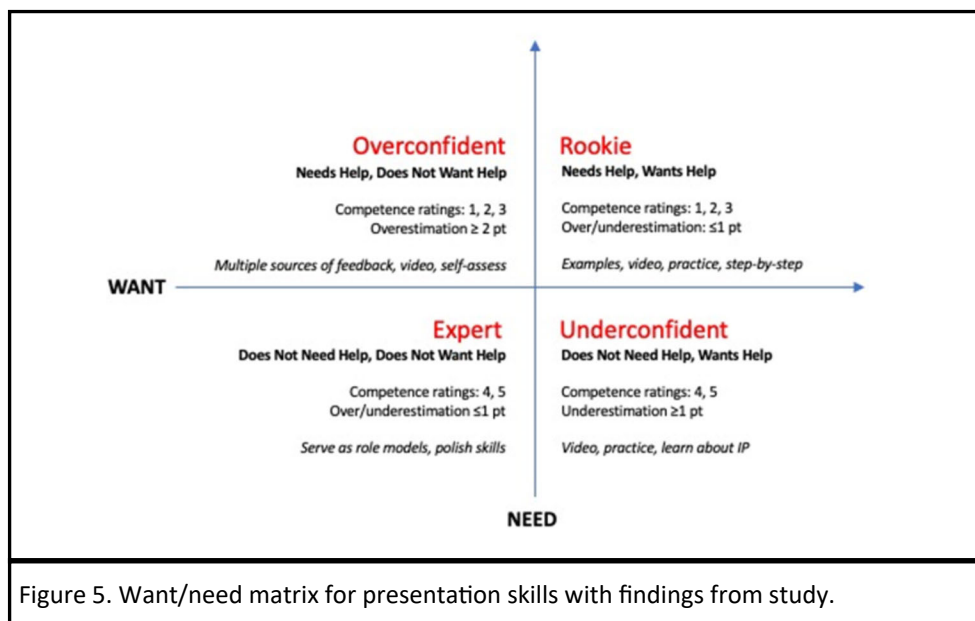
The Expert quadrant of students do not need help and do not want help. The Experts include students receiving a competence rating of four or five who did not underestimate by more than one point. These students are not resistant to feedback, rather they are not actively looking for feedback, because they have confidence in their established presentation skills. However, these presenters can be open to recommendations for improvement and are able to apply feedback rather easily. The Experts do not seek out or need intervention from the instructor, but they still need support. The feedback about what was done well must be explicit and the Experts must be encouraged to continue to grow and improve their skills—even if it is just to polish already strong presentation skills. Experts could be encouraged to be role models for the Rookie, Underconfident, and Overconfident students.

As PSM programs work to develop and hone transferable skills courses that serve the needs of the graduate students during their studies as well as in their future careers, examining students' confidence and competence may be revealing. Accurate self-perception is important in developing communication skills.

The Overconfident quadrant includes students who need help, but do not want help. The Overconfident are ignorant of their own incompetence. Overconfident students are students who overestimated by two or three points. These students present the biggest challenge because of their misconception of their skills. They can be resistant to feedback about areas of improvement that are greatly needed. Kruger and Dunning would call this a miscalibration of confidence and competence. Whatever the case, the students in the Overconfident quadrant are in need of improvement but are blind to their deficiencies, even when explicitly told. Despite feedback from instructors and peers, students in the Overconfident quadrant fail to calibrate their confidence ratings. In *Self-insight*, Dunning warns that "many poor performers push back. They rebel against the advice; they argue points of view that contradict their own" (p. 286). To overcome the challenge of teaching the Overconfident student, providing multiple sources of feedback including self-assessment, peer assessment, and instructor assessment can help highlight areas of improvement. The use of video and the opportunity to self-assess performances allows the overconfident student a chance to calibrate. Using the want/need matrix, the researcher can more systematically support students in the development of their presentation skills during their PSM program. PSM instructors could also use this want/need matrix along with other recommendations for policy and practice.

Best Practices Recommendations

Based on the findings from the study, the following three best practice recommendations are suggested for PSM practitioners and policy makers.

- **Develop opportunities to practice and improve self-assessment.**
  Having students watch, assess, and reflect on recordings of their presentations has the potential to bolster both their presentation and self-assessment skills. For students in the Overconfident quadrant, the recording of their presentation could highlight problems in a more powerful way than written or verbal feedback from instructor or peers. Video of students from the Underconfident quadrant can show that the presentation was actually better than the student thought it was. A common response from students in the Underconfident quadrant is: "it doesn't look as bad as I felt giving that presentation."

- **Ensure that transferable skills courses in communication provide appropriate individualized feedback for presentation skills.**
  Feedback is particularly challenging because PSM programs take different approaches to teaching PLUS/transferable skills courses. Heidi Harkins and Linda Strausbaugh reported that it is common to have internal faculty and external

professionals jointly teach transferable skills. Having a policy that encourages best practice in providing feedback could be helpful. Feedback norming activities with instructors, especially those outside the university, could provide students with consistent feedback.

- **Analyze data about students' soft skills confidence ratings and competence ratings to develop a clearer picture of students' abilities.** It is one thing to have a hunch about students' assessment of their own skills. However, actually analyzing the data provides valuable insights. After analyzing the results, use the want/need matrix to identify the ways that students could be supported in their efforts to develop their presentation skills.

> ...examining students' confidence and competence may be revealing.

Limitations

The first limitation of the study was the use of self-assessed Likert-scale data because students may not have interpreted the scale the same way. Another concern for the interpretation of the Likert data is that relying on expert judgement can be problematic. To address that concern, three expert instructors determined the ratings for competence. However, just like the students' potential differential use of the scale among other students, the three instructors and the students may not have used the scale the same way. In addition, the honesty of the students' rating is a limitation of any self-assessment. Students may have overrepresented or underrepresented their ratings for a variety of reasons including their personality, upbringing, and culture.

The second limitation of this study is that it looked at only two variables to determine if they influenced students' confidence ratings. Although limited, the choice of the two variables of sex and age was intentional. This study was inspired in part

by Kruger and Dunning's findings in their 1999 study that indicated that gender did not influence overestimation or underestimation. Kruger and Dunning's participants were undergraduate students. Therefore, for this study, it was important to add age as a variable to determine if older or younger men and women rated themselves differently on the confidence scale. Additional variables could provide a different picture of PSM students' confidence and competence. However, that was outside the scope of this particular study, but it does provide inspiration for future studies.

Conclusion

As PSM programs work to develop and hone transferable skills courses that serve the needs of the graduate students during their studies as well as in their future careers, examining students' confidence and competence may be revealing. Accurate self-perception is important in developing communication skills. As Dunning indicates in *Self-insight*, "people need to know what their strengths are... They need to be aware of their weaknesses so that they can improve upon them" (p. 2). The study has unveiled important information for the researcher and for other PSM programs about confidence and competence with presentation skills. Although this study focused on presentation skills, it is possible that similar studies could be used for other transferable skills courses.

References

Clance, P. R., & Imes, S. A. (1978). The imposter phenomenon in high achieving women: Dynamics and therapeutic intervention. *Psychotherapy: Theory, Research and Practice*, *15*(3), 241–247. https://doi.org/10.1088/0022-3727/32/16/312

Dunning, D. (2005). *Self-insight: Roadblocks and detours on the path to knowing thyself*. New York: Taylor & Francis Grpup. Retrieved from https://ebookcentral.proquest.com/lib/ncsu/reader.action?docID=199801&ppg=165

Dunning, D. (2006). Not knowing thyself. *The Chronicle of Higher Education*, *52*(35), B24.

Harkins, H., & Strausbaugh, L. D. (2017). 20 years and counting: How has PSM training in "transferable skills" changed? *The Innovator: The*

Voice of the PSM, *10*(3), 4299–4312. Retrieved from https://www.professionalsciencemasters.org/sites/default/files/the_innovator_curated_issues_fall_2017_vol_10_issue_3.pdf

King, D. (2012). Developing professional science master's degree programs. In *PSM Pre-Conference Workshop*. Council of Graduate Schools Annual Conference.

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, *77* (6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

McHugh, M. L. (2018). Spearman correlation coefficient. In B. B. Frey (Ed.), *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation* (pp. 1555–1558).

Persky, A. M., & Robinson, J. D. (2017). Moving from novice to expertise and its implications for instruction. *American Journal of Pharmaceutical Education*, *81*(9), 72–80. https://doi.org/10.5688/ajpe6065

Revuluri, S. (2019). How to overcome impostor syndrome. *The Chronicle of Higher Education*.

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IN PRACTICE ARTICLE

Virtual Graduate Fairs for PSM Programs
Kristin Kuter

I N OCTOBER 2019, BEFORE WE KNEW WHAT 2020 WOULD BRING, WE HELD THE FIRST PROFESSIONAL SCIENCE MASTER'S VIRTUAL Fair. Following up on the marginal success of the first fair, we planned another one for April 2020, which ended up being quite timely given current events and resulted in a very successful event. In this article, we will provide an overview of virtual graduate fairs, including the platform we have used, what the benefits are, and the price of participation. We will also go over the results of the events already hosted and tips for promoting and marketing the event as we prepare for the next PSM virtual fair, scheduled for April 16, 2021.

So, first of all, what is a "virtual graduate fair?" It is just like an on-campus open house that prospective students would attend to learn more about a specific program, only now the visit is virtual – done entirely in an online space – and the participants can learn about multiple PSM programs at once. The event is free to prospective students and they get the chance to interact with admissions personnel, faculty, and possibly even current PSM students or alums depending on which of its representatives an institution chooses to participate in the virtual fair.

While individual institutions might consider organizing their own virtual recruitment events via Zoom, or other web conferencing programs, that could require more resources than some PSM programs have available to them. To address that limitation, we partnered with CareerEco to help design, promote, and host our events, which are open to all PSM-affiliated programs. This way, CareerEco handled all the technical aspects of the virtual meeting and the cost for individual institutions is held to a manageable level. For our events, the cost has been

> A virtual graduate fair is like an on-campus open house - where prospective students learn about a specific program…—done entirely in an online space…

$295 for each institution, regardless of how many PSM programs that institution has or will be recruiting for during the event. At that price, participating in the event is worthwhile even if it yields just one enrolled student at your institution. That was the case for Grand Valley State University (GVSU) following the October 2019 fair, and as Tim Born, Past President of NPSMA, put it, "For an investment of about $300 and a few hours of time, we may have just pulled in about $15,000 worth of tuition."

The general set-up of a virtual fair on the CareerEco platform consists of a main page listing every institution participating in the event. The main page then links to individual landing pages for each institution. The landing page for an institution, which prospective students can visit leading up to the event, contains information about the degree programs that are offered at the institution so that prospective students can do research ahead of time. Then during the event the landing page has links to chat rooms where prospective students can talk with personnel from the institution. If an institution has multiple degree programs, separate chat rooms can be created for each program. Each institution has complete control over the content on their landing page, which can include photo and video content.

The CareerEco website lists a number of reasons for institutions to participate in one of their virtual fairs, which includes lowering admissions costs, saving time and money on travel, and the ability to more easily involve faculty and current students in the recruitment process. But perhaps the most valuable benefit is that every participating institution receives access to the list of all prospective students registered for the event, not just the ones that indicated interest in their program or that may have visited with them during the event. This allows institutions to do additional follow-up recruiting efforts

beyond the event to all individuals who attended the virtual fair, even if an individual did not specifically seek out their institution during the event.

As mentioned in the introduction, the first event held in October 2019 could be considered moderately successful. A total of 20 institutions participated and 79 prospective students registered for the event. The second event held in April 2020 saw slight growth in the number of participating institutions to 22, but overwhelming growth in the number of prospective students, which nearly doubled to 153. This growth did not continue in the third event held this past October, with the number of participating institutions dropping to 18 and the number of prospective students dropping to 81. It is not entirely clear why the October fair did not draw as large of an audience as the April fair did in 2020. Perhaps it is an indication of a growing fatigue with virtual events as the pandemic continues on, the opposite of which was true in April. However, we do note that the level of participation in the two fall events was about the same. Thus, it may be that the differences are primarily driven by timing. As such, we are planning another fair this spring on April 16, 2021, to see if the trend continues.

We are also working with a new platform, Showfloor (https://showfloor.co/), to host the upcoming event in order to hopefully draw in more PSM institutions. In moving the event to Showfloor, we will be able to reduce the cost to NPSMA members while also improving the benefit as this new platform is more modern and offers additional features. On the Showfloor platform, participating PSM institutions will create "booths" that prospective students visit during the event and interact via live video chat with the institutions' representatives. The "booths" are analogous to the landing pages on the CareerEco platform and can contain the same content, including photos, videos, links to websites, and PDF or other documents. Showfloor tailors the order in which the "booths" are presented to attendees starting with the PSM programs that are most relevant to the interests of the prospective student. Showfloor also offers a "main stage" from which presentations can be made

> For more success at a Virtual Graduate Fair, "post an announcement about virtual fairs on Facebook, Instagram, Twitter, etc. and include a '10 second teaser' video to help promote the event."

to all attendees. Participating PSM institutions will have the option to schedule time on the main stage to promote their programs during the event.

While part of the success of the April 2020 fair is arguably due to the move online for most academic and business operations, the success and level of participation in a virtual fair has depended on both the marketing that is done by CareerEco and also the marketing that is done by the individual participating institutions. If more institutions participate in an event, then more efforts toward promotion are taking place. Let's first look at what CareerEco has done to promote the event, and then discuss marketing strategies that individual institutions can adopt.

CareerEco marketed the PSM virtual grad fairs by sending promotional materials to a large list of individuals interested in STEM or somehow related to STEM. Almost 100,000 names are on this list, which includes past participants in any STEM-related virtual fairs hosted by CareerEco and contacts on purchased name lists such as GRE takers. While many institutions already purchase lists or other name buys, what CareerEco also adds to their list are contacts in career services or advising offices at colleges and universities across the country. PSM institutions can bolster these efforts by utilizing their own career center offices and marketing to other academic institutions and employment agencies in their region. With the switch to Showfloor, we will lose this aspect of marketing offered by CareerEco and so we will encourage participating PSM institutions to adopt the strategy into their own marketing efforts.

For institutions participating in a PSM virtual grad fair, marketing materials are provided that can be placed on program websites and social media accounts. In an "Ask NPSMA" session last March, Anirudh Chowdhary, Director of PSM programs at GVSU, suggested the following for getting the most out of social media:

- Post an announcement about virtual fairs on Facebook, Instagram, Twitter, etc., and include a

"10 second teaser" video to help promote the event. This post should send prospective students to the event page.

- Format the announcement as an "event" on Facebook or Instagram rather than just posting a flyer. This creates more hype around the virtual fair and prospective students can RSVP to the event through the social media accounts.

- Consider using the free version of Eventbrite to advertise the event, which will create another mechanism for prospective students to register for the event. The benefit of using a tool like Eventbrite is the additional notifications about the event sent through email automatically generated by the program. This also serves to increase the hype of the event and provides another avenue for advertising through the Eventbrite database.

Individual institutions should also work with any admissions or marketing personnel at their institution to reach out to prospective students who have already expressed interest in their PSM programs. Individuals in these offices should have email lists of prospective students that they contact for recruitment purposes. These lists may be obtained through name buys, like the CareerEco list, but may also consist of prospects that have visited a program's website. In short, any prospective student that an institution has contact information for should be informed either through email or social media about the virtual fair ahead of time.

Finally, get faculty involved in the promotion of the virtual fair. Faculty can help spread the word about the event to their own undergraduate students and also their colleagues at other institutions. Additionally, get faculty to participate during the fair, either to be available in the chat rooms to talk with prospective students or to give a scheduled presentation during the event, something akin to a webinar, which is an optional feature available on the CareerEco platform. Including these opportunities as part of your institution's virtual fair can help to draw more prospective students to the event, as students are often looking for opportunities to directly interact with faculty in order to discuss more technical aspects of a PSM program than is typically possible with an admissions representative.

For more information about virtual fairs and to see examples of landing pages from the most recent PSM Virtual Fair hosted on CareerEco, visit:

https://www.CareerEco.com/Events/PSM

For more tips on marketing, you can read the following blog post by Showfloor:

https://showfloor.co/2020/12/02/how-to-host-an-virtual-career-fair-in-6-easy-steps-step-4/

More details about the April 2021 fair will be in in future *PSM News* emails and "Ask NPSMA" sessions. The registration deadline is April 7.

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Next PSM Virtual Career Fair
April 16, 2021

Interested? Contact: kjehring@saintmarys.edu
Registration deadline: April 7, 2021

OPINION

The "PSM Externship" —
Enlarging Exposure to Science Careers in an Age of COVID
Sheila Tobias and Daryl Chubin

AS THE PANDEMIC CONTINUES TO SHAKE THE CONFIDENCE OF STUDENTS, FACULTY, AND INSTITUTIONS OF HIGHER EDUCATION, many are confronting the need to revisit their expectations. COVID-induced disruptions to the pursuit of an undergraduate degree have reminded students of the cost, both financial and experiential, of returning to campus. As many as 40 percent are not likely to re-enroll (Jaschik, 2020). What is to happen to them?

COVID has imposed another burden as well, one that presents an opportunity for students to reconsider their major, their financial goals, and their career path. Specifically, alternatives to a linear progression from the baccalaureate to professional or graduate school, and even from traditional disciplines to hybrid programs should be, if they are not already, entertained. In the hierarchy of academic credentials, the baccalaureate is the gateway to a science career.

Meeting the Challenge

Due especially to Sloan's investment (Carpenter, 2012; Teitelbaum, 2006) and the endorsements of the Council of Graduate Schools and the National Research Council, the Professional Science Master's grew—exponentially first in PhD-granting, and later in Master's-granting institutions—to 300 in 2014 (Tobias and Strausbaugh, 2018). Required for entry was a bonafide four-year degree in a STEM field and an interest in pursuing a wider range of employment options than just research. To date, over 10,000 (Tobias and Strausbaugh, 2018) PSM graduates have entered the US workforce.

As the National Professional Science Master's Association (NPSMA) explains, the four components common to PSM programs—disciplinary and interdisciplinary knowledge, professional competencies, foundational and transferable skills, and research—graduate "professionals who are workforce-ready without compromising scientific expertise" (Strausbaugh, 2019).

> COVID-induced disruptions to the pursuit of an undergraduate degree have reminded students of the cost, both financial and experiential, of returning to campus.

What was new two decades ago is arguably still competitive: a market-driven course of study meant to impart a skill set, a credential, and a competitive advantage. In today's environment, STEM undergraduate students struggling with partially closed campuses, and more and more uncertain and undefined futures, deserve to be apprised of both alternate career paths in STEM and exposed to companies, agencies, and PSM alumni who are pursuing those options. History repeats: as the National Research Council (2008) affirmed over a decade ago, master's programs support educational and career goals, and master's level professionals in the natural sciences indeed contribute in the workplace.

With institutions of higher education today adapting their business models to increase their online offerings (Seltzer, 2020), and non-degree credentials (e.g., certificates earned in months, not years) gaining appeal during the pandemic (Fain, 2020), the potential appeal to students who "stop out" during their undergraduate experience

(typically due to financial strain) becomes more urgent. An undergraduate PSM experience is one disruption that should be welcomed.

PSM Externship as Career Exposure

A PSM externship, configured at the advanced undergraduate level, would serve as a scholarship that retains students on a science-based career path instead of losing them temporarily, if not permanently, from the workforce. The cost of the student externship would vary with the "work" and "work setting," but include separate stipends for faculty and workforce advisers. Each PSM's Workforce Advisory Board could assist in identifying and negotiating sources of funding support.

Our inquiries suggest that many PSMs could serve as pilot sites for the undergraduate curricular experimentation we envision. A leading candidate is New Jersey, both for the size of its state university and the range/variety of the 33 master's PSM programs (and faculty) located and long-established at Rutgers University (e.g., the Masters of Science and Business, https://mbs.rutgers.edu/). A multitude of other states are also attractive, notably the 19 PSM programs in Florida (Florida State, Miami, South Florida, Central Florida, Florida Atlantic, Florida International, and West Florida. Other robust clusters (should the experiment succeed and other sponsors wish to replicate) are: New York, Pennsylvania, North Carolina, Ohio, and Massachusetts, which collectively host over 125 programs (https://www.professionalsciencemasters.org/psm-programs-state).

These potential sites are favored not just for having in place mature PSM programs in a wide variety of fields, but also because Census data indicate a robust pool of minority student talent under-accessed by most science programs nationally. These states also have a rich supply of employment possibilities for their externs and their graduates, e.g., New Jersey with its dominant petrochemical and pharmaceutical industries, and Florida with its marine and agricultural industries.

Next Steps

COVID presents challenges and an opportunity: as a disruptor, it jars once again our recognition that students depart science as undergraduates for reasons unrelated to their ability or interest. Life intrudes. Alternatives to the conventional path remain obscure. The proposal sketched here is founded on a model of professional education that extends and enlarges the applications of science.

Just as the PSM was initially framed—"a fundamentally different option tailored to the student who is more career-oriented and seeks knowledge of, and acclimatization to, the workforce environment" (Strausbaugh, 2019)—today we must adapt knowledge and skills to a variety of workplaces that are not campus-based. Virtual tools, now necessarily embraced due to the pandemic, will become a common delivery mechanism to support students with science aspirations not limited to research alone.

If enlarging the contributions of science-based professionals to the US workforce is more than rhetoric about credentials, then the time is right, once again, for PSM-like programs to supply the country (if not the world) with this unique human resource. If not NPSMA to lead the way, then who?

References

Carpenter, Siri, 2012. "Does a Professional Science Master's Degree Pay Off?" *Science* (March 30, 2012), https://www.sciencemag.org/careers/2012/03/does-professional-science-masters-degree-pay

Fain, Paul. 2020. "Alternative Credentials on the Rise," *Inside Higher Ed*, Aug. 27, https://www.insidehighered.com/news/2020/08/27/interest-spikes-short-term-online-credentials-will-it-be-sustained

Jaschik, Scott. 2020. "Nervous Freshmen, Nervous Colleges," *Inside Higher Ed,* Aug. 10, https://www.insidehighered.com/admissions/article/2020/08/10/survey-40-percent-freshmen-may-not-enroll-any-four-year-college

National Research Council, 2008. *Science Professionals: Master's Education for a Competitive World*. National Academy Press.

Seltzer, Rick. 2020. "Moody's: Coronavirus Drives New Business Models, Disruption for Higher Ed." *Inside Higher Ed,* Aug. 27, *https://www.insidehighered.com/quicktakes/2020/08/27/*

moodys-coronavirus-drives-new-business-models-disruption-higher-ed

Strausbaugh, Linda. 2019. "The PSM is an Ideal Master's Degree: It Embodies the Council of Graduate Schools' and National Academies of Sciences, Engineering and Medicine's recommendations for core elements*The Innovator,* Fall, https://npsma.wildapricot.org/resources/Publications/INNOVATOR/The_INNOVATOR_Curated_Issue_Fall_2019_FINAL.pdf

Strausbaugh, Linda. *2020. Personal Communication to Sheila Tobias, based on unpublished NPSMA estimates, August 28.*

Teitelbaum, Michael S. 2006. "A New Science Degree to Meet Industry Needs." *Issues in Science and Technology* 23 (Fall), https://issues.org/p_teitelbaum/**.**

Tobias, Sheila, Daryl Chubin, and Kevin Aylesworth, 1995. *Rethinking Science as a Career: Perceptions and Realities in the Physical Sciences.* Research Corp.

Tobias, Sheila, and Linda Strausbaugh, 2018. "The Professional Science Master's Degree at Twenty," *Journal of College Science Teaching 47* (March-April): 9-10.

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