Following in the Footsteps of Distinguished Leaders in Science, Technology, Engineering, and Mathematics (STÈM): Narratives of the Next Generation of Young People Preserving key Oral Histories of our Societal History

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Kelsey Irvin is a Clinical Psychology Ph.D. Candidate at the University of Missouri, Columbia. She is studying youth emotion dysregulation and how its physiological presentation correlates to depression.

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Elizabeth graduated from the University of Pennsylvania in May 2015 with a degree in Systems Engineering. During two of her undergraduate years, she worked with Dr. Lanzerotti and Kelsey Irvin on the Oral History Project. Elizabeth currently works as an Associate Consultant at Bain & Company.

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Prof. Michael Geselowitz, IEEE History Center at Stevens Institute of Technology
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Geselowitz holds B.S. degrees in electrical engineering and in anthropology from the Massachusetts Institute of Technology, and M.A. and Ph.D. degrees in anthropology from Harvard University. His focus has been on the role of history and social relations of engineering and technology at all levels. He has worked as an electronics engineer for the Department of Defense and held teaching and research positions relating to the social study of technology at M.I.T., Harvard, and Yale University, including a stint as assistant collections manager/curator at Harvard’s Peabody Museum of Archaeology and Ethnology. Immediately prior to joining IEEE in 1997, Geselowitz was group manager at Eric Marder Associates, a New York market research firm, where he supervised Ph.D. scientists and social scientists undertaking market analyses for Fortune 500 high-tech companies. He is also a registered Patent Agent.

Dr. MaryAnn C. Hellrigel, IEEE, IEEE History Center

Since January 2016, I have been the Institutional Historian and Archivist at the IEEE History Center based at Stevens Institute of Technology in Hoboken, New Jersey. Before joining IEEE, I held faculty post teaching history of technology, science, and medicine as well as U.S., European, and world history courses at research universities and liberal arts colleges. I earned a doctorate from Case Western Reserve University’s Program in the History of Technology and Science (Ph.D., 1997).

Dr. Gregory Alan Good, American Institute of Physics

BS in Physics, MA and PhD in History of Science. I taught history of science at West Virginia University for 25 years. I am now Director, Center for History of Physics, at the American Institute of Physics.
Following in the Footsteps of Distinguished Leaders in Science, Technology, Engineering, and Mathematics:
Narratives of the Next-generation of Young People
Preserving Key Oral Histories of our Societal History

Kelsey Irvin, Liz Hiteshue, Hannah Bech, Samantha Swanson, Caroline Wochnick, Amanda Kapetanakis, Mary Lanzerotti, Derrick Langley, Michael Geselowitz, Gregory Good

Abstract

This project chronicles the oral histories of living female leaders in science, technology, and mathematics in the early part of the 21st century by female students at the very early stages of their careers. It is important to chronicle the histories of these leaders because they are identified by our students as role models in the careers the students are considering. The value that their perspectives bring to the field of oral history is a unique set of one-on-one conversations with students who have selected them from national databases of STEM leaders. Additionally the leaders provide previously unprecedented mentorship and perspectives into their life stories in science. Currently starting its fifth year, the goal of this project is to add to the body of knowledge of oral history by collecting oral histories of women in physics and engineering whose career paths span leadership roles in industry, government, and academia.

This project is a collaboration of six female undergraduates at four academic institutions of higher education, IEEE History Center, and American Institute of Physics (AIP) Center for the History of Physics. We are excited that in June 2015 and June 2016, the first three participating students graduated with a STEM degree. Interviews collected in this project are previously published on the IEEE Engineering Technology and History Wiki (ETHW). Following the oral history interviews, the students write reflections to answer the following three research questions (RQ). RQ#1 is “What are the key factors that led to the success of the distinguished leaders?.” RQ#2 is “What are the crucial skills that enabled their success?.” RQ#3 is “What is the impact on my career path?”

One objective of this paper is for the participating female students, who are majoring in STEM fields, to present their reflections on the three research questions. A second objective is for the students to describe the impact, if any, that carrying out interviews of distinguished STEM leaders has had on their career paths. This paper presents new contributions from three participating students as well as additional contributions from two students who have published preliminary results previously.
Introduction

This project chronicles the oral histories of living female leaders in science, technology, and mathematics in the early part of the 21st century by female students at the very early stages of their careers. The oral histories are freely available on the IEEE at the Engineering Technology and History Wiki (www.ethw.org) and at the Center for History of Physics at AIP (https://www.aip.org/history-programs/physics-history). Unique mentorship provided to the students helps motivate them to graduate in STEM fields, while simultaneously archiving original sources that are key pieces of our societal history. The interviewed leaders include CEOs at science and technology companies, members of the National Academy of Engineering and National Academy of Sciences, and faculty who hold positions at leading institutions of higher education. The enduring value created by the project is confident young women in STEM fields and the archival of the oral histories in perpetuity by the IEEE on the Engineering and Technology History Technology Wiki. The oral histories are freely available in perpetuity to scholars worldwide in science, technology, and society for research and scholarship and to motivate the next generation of young people in STEM fields. This project adds to the body of knowledge of oral history by collecting oral histories of women in physics and engineering whose career paths span leadership roles in industry, government, and academia and who have not previously provided their oral histories to oral history databases.

The overall goal of this project is to add to the body of knowledge of oral history by collecting oral histories of women in physics and engineering whose career paths span leadership roles in industry, government, and academia. Six female students majoring in STEM fields have participated in this project and published eight oral histories since the project began in 2013. Participating organizations are Air Force Institute of Technology (AFIT), IEEE, Augsburg College, and American Institute of Physics (AIP). The oral histories are stored at IEEE Engineering Technology History Wiki (ETHW) and AIP Center for the History of Physics. This paper presents first-hand narratives by underrepresented female students who are U.S. citizens majoring in STEM fields.

In this project, students select STEM leaders who are role models in careers the students are considering. Students select the leaders from national databases of STEM leaders. The value that the leaders’ perspectives bring to the field of oral history is a unique set of one-on-one conversations with students. Through these conversations, the leaders share their stories and provide previously unprecedented mentorship and perspectives into their life stories in science.
Currently starting its fifth year, this project is a collaboration of six undergraduates at four academic institutions of higher education, IEEE History Center, and American Institute of Physics Center for the History of Physics. The project started at the Air Force Institute of Technology through an NSF ADVANCE grant #0810989 to the LEADER Consortium (“Launching Equity Across the Dayton Entrepreneurial Region: Following in the Footsteps of Katharine Wright”). The IEEE History Center is a unit of IEEE, the world’s largest professional technical society, and is co-sponsored by and located at Stevens Institute of Technology. Founded in 1980, the mission of the IEEE History Center is to preserve and make known the history of engineering; The collection of oral history interviews to capture the memories and career trajectories of important engineers and scientists dates to the beginning of the Center, whose collection now includes over 800 interviews.

The student participants (Table 1) are underrepresented female undergraduates majoring in STEM fields. Through participating in the oral history project, the undergraduate students learn directly from potential mentors who are recognized leaders in their fields. Students select leaders whose careers align with the desired career fields of the underrepresented students. The IEEE History Center collaborators provide training in oral history technique, mentorship of the students, and support for posting the transcripts in perpetuity on the IEEE Global History Network. The project draws on best practices from other oral history projects, such as those collected in 2001-2003 through the “Oral History of Women in Computing Project” of Dr. Janet Abbate.

**Project Organization**

The interviews are collected according to the following process: During the course of approximately nine months, the students prepare oral history interview questions with supervision from the PI and co-PI at the IEEE History Center (The PI is trained in oral history), conduct and transcribe the interview, revise the interview with the interviewee, and post the interview transcripts with the IEEE. Interviewees are selected according to the students’ career goals. Students reached out to interviewees whose careers aligned with the students’ career goals, and the students interviewed those who responded that they were available to be interviewed.

The oral histories are freely available in perpetuity at the IEEE on the Engineering and Technology History Technology Wiki (http://www.ethw.org). The students receive training in
oral history from the IEEE History Center, which provides trained students with Oral History certificates.

A standard set of interview components includes the following sections: Introduction, Early Life/Education, Career, Awards/Honors, Gender-Related Questions, Reflection/Advice, and Conclusion. Table I (shown on the next page) shows the structure of a typical oral history interview. Excluding an introduction and conclusion, the five general sections covered in the interview are Early Life/Education, Career, Awards/Honors, Gender, and Reflection/Advice. Questions are personalized for each interviewee. Questions in the Early Life/Education section cover family background, early interests, early role models, and elementary through doctorate education. Questions in the Career section cover the general path of the interviewee’s career and the projects and accomplishments she has at each. Questions in the Awards/Honors section focus on specific honors the interviewee has and memberships in esteemed professional societies. Questions in the Gender section focus on challenges and differences that the interviewee faced due to her gender in STEM fields. Questions in the Reflection section focus on advice pertaining to the original five personal research questions and general advice that the interviewee wishes to share.

**Oral History Preservation at IEEE Engineering Technology and History Wiki (ETHW)**

The IEEE History Center’s historical material is made available through a wiki-based portal known as the Engineering and Technology History Wiki (ETHW). The oral history collection of over 800 interviews of prominent engineers and scientists in IEEE’s fields of interest is one of the most important in the world. The collection includes 52 oral histories collected by Dr. Janet Abbate Virginia Tech University. The IEEE Historians provide training to the students (2013-present) in oral history, a technique to record recollections of interviewees for posterity. The procedures in this project follow the best practices established by the Oral History Association.

Transcripts of the interviews are hosted on the ETHW, a web site developed by the IEEE History Center and maintained by the Center on behalf of a consortium of engineering associations. These are American Institute of Chemical Engineers (AIChE), American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME), American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), IEEE, Society of Petroleum Engineers (SPE), and Society of Women Engineers (SWE). This collaboration helps to enhance the IEEE’s oral history collection and insure that women are appropriately represented in the collection while also carrying out IEEE’s broader mission to excite and encourage the next
generation of engineers, particular among traditionally underrepresented populations. As a first step in this project, IEEE provides all participating students with Oral History Training.

**Oral History Preservation at American Institute of Physics (AIP) Center for the History of Physics**

AIP Center for the History of Physics supports historical research of the physical sciences. This effort is supporting the current oral history project (2015-present).

**Methodology**

In this project, we use the methodology of oral history to collect the interviews because oral history is a recognized “field of study and a method of gathering, preserving, and interpreting the voices and memories of people, communities, and participants in past events.” As the oldest type of historical inquiry, predating the written word, oral history is also the most modern current career path flowchart that is being continuously informed by exposure to today’s distinguished underrepresented leaders in science and engineering.

The methodology of the research presented in this paper is to collect personal narratives from the participating female undergraduate students (see Table 1). The three research questions of the students are: RQ#1 “What are the key factors that led to the success of the distinguished leaders?”; RQ#2 “What are the crucial skills that enabled their success?”; and RQ#3 “What is the impact on my career path?” To understand how the female interviewees are following in the footsteps of the STEM leaders, the students prepare personal narratives that presently consist of (1) reflections on the three research questions after they have carried out each oral history interview, a (2) career flowchart before and after each interview, and (3) a resume before and after each interview. The students also describe the impact, if any, that carrying out interviews of distinguished STEM leaders has had on their career paths.
Table 1. Participating Undergraduate Students who collected Oral Histories\textsuperscript{19-26}

<table>
<thead>
<tr>
<th>Student</th>
<th>Participation Dates</th>
<th>Graduation Date</th>
<th>Institution(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelsey Irvin</td>
<td>2013-2016</td>
<td>May 2016, \textit{cum laude}</td>
<td>Washington University in St. Louis</td>
</tr>
<tr>
<td>Hannah Bech</td>
<td>2014-2016</td>
<td>April 2016, \textit{summa cum laude}</td>
<td>Augsburg College</td>
</tr>
<tr>
<td>Samantha Swanson</td>
<td>2014-2015</td>
<td>Anticipated 2018</td>
<td>Augsburg College, Minnesota State University Mankato</td>
</tr>
<tr>
<td>Caroline Wochnick</td>
<td>2014-2015</td>
<td>Anticipated 2017</td>
<td>Augsburg College</td>
</tr>
<tr>
<td>Amanda Kapetanakis</td>
<td>2016-present</td>
<td>Anticipated 2017</td>
<td>Augsburg College</td>
</tr>
</tbody>
</table>

Kelsey Irvin’s Evaluation of her Personal Narrative

\textit{What led me to STEM as an undergraduate student}

“Even before I first arrived at my undergraduate university, I knew that I wanted to pursue studies and a career in STEM fields. Math and science had not only been my strong suits during grade school, but also my main interests. For example, in high school, I excelled in mathematics through my AP Calculus coursework, and continued to enjoy and do well in mathematics in standardized testing and in college Calculus coursework. However, I was unsure of what specific field I wanted to pursue until I was introduced to neuroscience and psychology during a first-year program called ‘Mind, Brain and Behavior.’ I became fascinated by the neurological underpinnings of human behavior and dysfunction.”

\textit{How and why did I initially want to participate in this project?}

“As a Dayton native and daughter to two former employees at Wright Patterson Air Force Base (WPAFB), I thought highly of the work accomplished at WPAFP, and
decided to apply to be a Southwestern Ohio Council of Higher Education (SOCHE) intern at the Air Force Institute of Technology (AFIT) to further my technological interests and education. In my STEM classes in both high school and my undergraduate educations, I noticed that as a woman, I was always a minority. After I had applied to be a SOCHE intern and Dr. Lanzerotti contacted me about the project, I knew that this was going to be not only a project I was passionate about, but also a project that was important for encouraging women to enter and stay in STEM fields. Therefore, I decided to accept her offer to work on the project.”

**How did I select my interviewees?**

“To identify key female leaders in their desired career fields, I searched through the National Academy of Engineering (NAE) website, National Academy of Sciences (NAS) website, the Harvard Business School faculty website, a STEMconnector publication provided by the STEMconnector, the one stop shop for STEM information, and the Girls in Information and Communication Technology (ICT) Portal. Through these searches as well as references from STEM researchers at the DOD government institution, I obtained contact information and send invitations to potential interviewees.”

**RQ#1 “What are the key factors that led to the success of the distinguished leaders?”**

“To answer this question, I drew upon the wisdom of the distinguished leaders in STEM fields from their oral history interviews. The renowned women that participated in this project often noted the importance of taking opportunities as they come to you, and never being discouraged by others who may not believe in you. Because these are several of the most common answers that were given by the interviewees, I conclude that overall, such factors led to the success of these leaders.”

“So one thing that a lot of [interviewees] have said, which I guess isn’t completely unexpected but has been really consistent, is that a lot of [interviewees], when I ask, “How do you balance professional and family life?” or “How do you manage to get through all of these things?” or “How do you overcome these obstacles?” whether that be related to the gender questions or just to getting through graduate school or something like that, a lot of [them] have said, “Just keep going.” There’s no magic formula to doing it. You just have to be interested. You just have to want it enough. It’s not necessarily about being intelligent, while that is important, but having the determination and the interest to get through it, and about having the support system to get through it. So, I guess that is not necessarily a very surprising thing to hear, but it has been a very consistent thing.”
RQ#2 “What are the crucial skills that enabled their success?”

“The distinguished leaders in STEM fields that participated in this oral history project emphasized the key skills of hard work, interpersonal skills, focus, leadership, confidence, drive, time efficiency, and prioritization. These leaders also noted the importance of balancing family and professional lives. These were the most emphasized skills by the interviewees, and were also the most repeated overall in all of the collected interviews combined. Therefore, I conclude that the above skills were critical to the success of these distinguished women in STEM fields.”

RQ#3 “What is the impact on my career path?”

“The oral history interviews have impacted my outlook as I pursue a doctorate degree in a STEM field and hope to have a career in academia. After reading all of the collected interviews and conducting many of them, I have been fascinated by several central responses. Most notably, I have learned the challenges of being a woman in a STEM field, but also have learned the importance of addressing discrimination. I have also learned that some of the key skills which are important in a STEM field, such as confidence, focus, and interpersonal skills, and continuously attempts to improve these skills in myself for her present and future career. I have learned these things through the responses provided by the distinguished women in STEM fields in their oral history interviews.”

How I am Benefiting from this Project

“When beginning the Oral History Project during the summer of 2013, my five questions for the interviewees were the following: (1) How did you first get into your profession? (2) What were the key decisions or paths you took that affected your career? (3) Was there any additional pressure to balance your professional and personal/family life? If so, how did you handle it? (4) What do you feel were the most vital skills in your field? (5) How has your field changed since you entered it?”

“From the answers provided by the interviewees of the Oral History Project, I’ve learned that skills important for success in a STEM field include dedication and prioritization, and that it is important to seize opportunities when they arise. As I begin my doctorate program in Clinical Psychology, my research focus is on the neural correlates of emotion dysregulation and reward processing as it is associated with mood disorders in children. This research is done using an ERPs (Event-Related
Potentials. I am also completing coursework in research methods, statistics, psychopathology. I hope to gain a better knowledge base of my research interests, and develop skills in analytical writing and neural imaging.”

Kelsey Irvin’s Evaluation of Her Career Flowchart (Figure 1)

“Following my graduation, I began to attend graduate school in a research-focused Clinical Psychology Ph.D. program at University of Missouri, Columbia. After completing my Ph.D. in Clinical Psychology, I hope to attain an academic position at a strong research institution and pursue research in developmental psychopathology while teaching and practicing clinical psychology.”

“Learning about the importance of certain skill identified by interviewees may drive decisions of what classes to take in the future. Additionally, the knowledge of what it means to be a woman in a STEM field, and the challenges that go along with it, will be present in the continuation of education and the pursuit of a career. The interviewees have shown us that once you start in one career path you do not necessarily have to finish in that same career path. Each individual has a personal route. They have provided inspiration that you can follow your own personal wishes in terms of education and career route.”
Figure 1. Career Flowchart of Ms. Kelsey Irvin.
Liz Hiteshue’s Evaluation of Her Personal Narrative

What led me to STEM as an undergraduate student

“Like many engineering college students, I was always interested in math and science in high school. I found chemistry especially interesting, so I enrolled in Penn’s chemical engineering program initially, hoping to focus on food science. Throughout my first year at Penn, I realized I was more interested in the math portion of the program, but wanted to stick with an engineering field given the problem solving focus of an engineering degree. Hence, I switched to systems engineering, combining both math and the larger scale problem solving applications.”

How and why did I initially want to participate in this project?

“With family living in the Dayton, Ohio area, I was originally motivated to apply for the Southwestern Ohio Council of Higher Education (SOCHE) intern program. After then learning about the opportunity to work with Dr. Lanzerotti at the Air Force Institute of Technology (AFIT), I accepted the position.”

“My reasons for accepting were twofold. First, the position gave me the opportunity to conduct both technical research on integrated circuits as well as participate in the Oral History Project. Secondly, I felt the Oral History Project would have impressive and practical outcomes for myself and other females in STEM, especially given there was little prior work on the topic.”

How did I select my interviewees?

“Similar to Kelsey’s response, I leveraged the National Academy of Engineering (NAE) website, the National Academy of Sciences (NAS) website, the Harvard Business School faculty website, a STEMconnector publication and the Girls in Information and Communication Technology (ICT) Portal. I focused on selecting women who not only had success in STEM fields but also had experience in business, aligning with my interests in combining technology and business.”

RQ#1 “What are the key factors that led to the success of the distinguished leaders?”

“The main factor that was mentioned consistently by these female leaders was the focus on finding what makes an individual happy – either something specific, such as a niche industry, or a broader topic. One an individual has found this, the focus
should then shift to balancing career aspirations that the person is passionate about with personal life aspirations.”

RQ#2 “What are the crucial skills that enabled their success?”

“A crucial skill that enabled their success was the ability to overcome adversity. One leader shared how she’s portrayed as always having been successful, but her experiences actually show how she’s failed. The connection – which is not always obvious to a bystander – is how she pushed through the challenges and changed her environment to one where she could better thrive.”

RQ#3 “What is the impact on my career path?”

“The oral history interviews have impacted my outlook as I recently began my professional career as a management consultant and hope to eventually combine technology and business later in my career. I have learned that there is a balance women must find when juggling both a professional career and being a mother. Additionally, I learned the importance of women professionals finding a specialty, or niche, where they can make a passionate impact and having enough self-confidence along the way that they will be able to make that impact.”

How I am Benefiting from this Project

“I have learned from these interviewees that the most crucial skill in STEM fields is understanding that a female’s professional career and family life are two separate but related challenges. Each female – and her family – must figure out their own way of managing the demands of being a professional and a mother. To do this successfully, a great amount of hard work and diligence is necessary.”

Liz Hiteshue’s Evaluation of Her Career Flowchart (Figure 2)

“At the core of my flow chart is an undergraduate engineering education from the University of Pennsylvania. The interspersed light pink boxes show three unique summer experiences. One of those experiences – oral history and integrated circuits research conducted at AFIT – resulted in certain personal motivations. Arrows indicating influence point from the outputs of that research to current and future career aspirations.”
“My career pathway after undergraduate education is first starting at Bain & Company, a company where I have been learning business skills through work experience that I wasn’t formally taught in my undergraduate engineering education. With all the great resources Bain has to offer for their employees, I plan to continue broadening my knowledge of business and learning how to apply this knowledge to a wide range of industries and capabilities.”

“My long-term goal is to effectively combine technical and business knowledge in an industry that I feel passionately about, such as food production or food services. Along the way, I will need to expand my knowledge and skills through formal and informal training, whether that be from working with clients or attending business school.”
How Other Students Can Benefit from this Work

Other students are encouraged to contact the authors for more information. They can benefit from this work by reading the oral histories posted at ethw.org with direct links at the project website: http://maryvonnlanzerotti.wordpress.com.

“Because all the oral history interview transcripts are available online, other students have access to all the information and advice provided by the successful women in STEM fields. Other students can learn from the stories of these distinguished women, and implement their strategies and advice into their own lives and careers. Students who are interested in pursuing a career in a STEM field might read these transcripts and learn that they are not alone as a woman in their field, and recognize the importance of standing up for oneself, taking opportunities as they come, and developing the critical skills identified by the interviewees. [My] contact information [is] as follows: Kelsey Irvin kelsey.irvin@wustl.edu.”

“A key benefit I took away from this work – and I fully believe other students can as well – is understanding that women can follow their unique and individual passions within STEM. The transcripts show that there is not one path for success, so it is up to each woman to define what that success looks like.” Liz Hiteshue

Common Threads and General Trends of This Work

“There are several themes that have emerged from the oral histories of the distinguished women in STEM fields that participated in this project. Several interviewees emphasized the importance of self-confidence and pursuit of opportunities as they arise. Overall, these interviewees identified some of the most integral skills that led to their success: hard work, interpersonal skills, focus, time efficiency, leadership, confidence, drive, and prioritization.” Kelsey Irvin

“All the interviewed women said that they had felt additional pressure to balance family and professional life, and agreed that while more women are present in STEM fields than previously, the overwhelming majority of professionals in STEM fields are male, and that fact is not changing quickly. One interviewee noted the importance of addressing discrimination, and several stressed the importance of standing up for oneself in a majority-male field.” Kelsey Irvin

“This project comes at a time when women in STEM has been steadily improving, but still has some way to go. A few interesting statistics30:
- While women receive over half of bachelor’s degrees awarded in the biological sciences, they receive far fewer in the computer sciences (17.9%), engineering (19.3%), physical sciences (39%) and mathematics (43.1%).
- Women make up half of the total U.S. college-educated workforce, but only 29% of the science and engineering workforce.

There is still a gap to close for women in STEM, and this project seeks to do that by motivating young women to pursue and continue STEM degrees and professions. Additionally, the project addresses some of the difficulties that women face when pursuing STEM degrees and professions, which aren’t commonly discussed in such an open and detailed forum.” Liz Hiteshue

“This project is always great to come and look back at. These women are outstanding role models, and knowing that they didn’t always have a plan is comforting. They inspire me to keep working toward my goals as a woman in physics, and motivate me to apply my experience in STEM to all aspects of my life. This project continues to push me and remind me that the gift of education is the best gift I can give myself, and has opened my eyes to the amazing opportunities STEM offers.” Caroline Wochnick

“The oral history project gave me the opportunity to hear firsthand perspectives from powerful, impactful women who have been trailblazers in STEM fields. This project has motivated me to continue in academia with the goal of performing medical sociology research related to health inequities, and I am currently preparing to take the GRE and apply to graduate school in this area. My experience with the oral history project has contributed to my confidence in my ability to succeed in traditionally male-dominated fields.” Hannah Bech

Additional trends in the oral histories have been previously published with the students at the IEEE Integrated STEM Education Conference (2015, 2016) and American Society for Engineering Education Annual Meeting (2014, 2016).

Conclusion
This paper offers our first chronicles of the oral histories of living female leaders in science, technology, and mathematics in the early part of the 21st century and impact that these stories are having toward inspiring female students at the very early stages of their careers. Our students prepared career flowcharts and identified these leaders as role models in the students’ intended careers. The students receive previously unprecedented mentorship and perspectives into the life stories of women leaders in science.
At the same time the project supports IEEE’s interests in recognizing women's outstanding achievements in IEEE fields and in facilitating the development of programs and activities that promote the entry into and retention of women in engineering programs. The IEEE History Center, the IEEE organization that curates the Oral History Collection supports these activities by preserving, researching and promoting the historical role of women in engineering. The Oral History Collection is an important component of this activity, and the Center intends to continue to cooperate in efforts such as the one presented here.

Acknowledgements

The authors thank Dr. Heidi Ries for feedback on the article. Dr. Charles Cerny, Technical Advisor, RF Systems Branch, Air Force Research Laboratory Sensors Directorate, for discussions. The authors also thank Mr. Brad Paul, Chief of Integrated Circuits and Microsystems, Sensors Directorate, Air Force Research Laboratory, for discussions. The authors thank the National Science Foundation NSF ADVANCE under Award #0810989, Air Force Research Laboratory Sensors Directorate, IEEE Foundation, and American Institute of Physics for research support. This work was partly supported by a grant-in-aid from the Friends of the Center for History of Physics, American Institute of Physics. Any opinions, findings, conclusions, and recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation or the Center for the History of Physics at the American Institute of Physics.

Appendix: Personal Narratives of the Participating Students

Samantha Swanson

What led me to STEM as an undergraduate student

“I have been interested in STEM as a possible career path since early middle school. I attended a girls camp at University of Wisconsin-Stout called STEPS which focused on introducing young girls to the STEM field and encouraging them to pursue STEM in high school, college, and beyond. After attending this camp I pursued STEM much more seriously than I had in the past. I took advanced math classes, enrolled in all the science classes I could and eventually found my calling in physics and engineering. I decided to follow my love of physics into my undergraduate degree at Augsburg College. I found that I thoroughly enjoyed my studies for the first two years of my course work, but after that point found myself feeling disconnected and
disenchanted with the physics degree. After much self-reflection I came to understand that physics may not be my calling and decided to transfer to Minnesota State University Mankato to continue my studies as a Mechanical Engineering Undergraduate. I came to this decision based on my long-time enjoyment of all things engineering and my success in the first two years of my studies.”

How and why did I initially want to participate in this project?

“I initially wanted to participate in this project as an opportunity to work alongside a successful woman in the STEM fields and learn from Dr. Lanzerotti as a personal mentor and advisor. She introduced me to this project and I was excited to join the project to learn more about and find guidance from other successful STEM women. I was hopeful to use their advice to find success myself and positively contribute to the field.”

How did I select my interviewees?

“I began my search for potential interviewees by looking at the faculty lists at University of Wisconsin-Madison, University of Minnesota-Twin Cities, and other surrounding universities in the MidWest for women as full or assistant professors. I looked for women who had ties to the Midwest and ties to the field of physics. As both were very important to me. This search lead me to Dr. Susan Coppersmith from UW Madison and under the suggestion of Dr. Mary Lanzerotti, Heidi Ries from Wright Patterson Air Force Base in Ohio.”

RQ#1 “What are the key factors that led to the success of the distinguished leaders?”

“One big thing that I believe lead to the success of these distinguished leaders was a lot of tenacity and grit. They believed in themselves and found other people that also believed in them and used them as a support system. These women are smart, hardworking, and strong individuals. They were willing to take chances and follow their dreams and goals.”

RQ#2 “What are the crucial skills that enabled their success?”

“The crucial skills include the fact that they are good at as well as understand their chosen STEM field and the supporting fields of study. They both had at least general goals and were self-motivated to complete their tasks. After reading their interviews I
feel that these women who pursued careers in STEM fields had to be brave, tenacious, and goal oriented.”

RQ#3 “What is the impact on my career path?”

“There are several specific lines from the interviews that really resonated with me personally. These include:”

“Having a specific plan was not such a big deal, you could just study things you like and if it doesn’t work out something else will come along,” Dr. Susan Coppersmith

“A secret of life is to be able to be in a situation with good things and bad things, and to be able to arrange your life to take advantage of the good things and minimize the bad things,” Dr. Susan Coppersmith

“Being able to look back and see how I helped create positive change in the organization I was in is success,” Dr. Heidi Ries

“In the last year, I made a very big decision about my own personal career path when I transferred to Minnesota State University Mankato. This decision was impacted by all three of these quotes. I was having some major health issues, which resulted in me taking most of a semester off. It was a very hard decision to make but looking back and see the positive things I did and brought to Augsburg made me feel much better about leaving it. I personally always have a plan and I really struggle when things don’t go according to plan. However, when I read what Dr. Coppersmith said about not needing a specific plan and understanding that more opportunities will come along is extremely comforting. I also had to rearrange my life and my goals to take into account the health issues I was facing and try to use the results in the best way possible to further my own career goals.”

How I am Benefiting from this Project

“I have and still am benefiting from this project as I am able to look back and read through these interviews and seek out advice and mentorship from these women. I am able to read their interviews and understand what worked well for these women and what maybe didn’t work so well for them and then apply that information to my own life and my own goals.”

My Career Flowchart (Figure 3)

“Below is my career flow chart. It is broken into five main sections each defined by a different color. The blue blocks represent the three years that I spent at Augsburg
College studying for a Bachelor of Science degree in Physics. The three yellow blocks to the left of the blue blocks represent the three research projects I worked on at Augsburg during the school year and during the summers. Above the blue blocks the three orange blocks represent my three years that will be spent at Minnesota State University Mankato pursing a degree in Mechanical Engineering. To the left of those blocks are the three green blocks. These signify my one completed internship as well as my goal to hold two more before graduation. At the very top of the chart a fourth green block can be seen which represents my goal to work in industry as a mechanical engineer after graduation. On the right-hand side of the chart the gray blocks represent my work on the Oral History Project in 2015 and the quotes that most resonated with me and my experiences from Dr. Coppersmith and Dr. Ries. The final part of note with my career flow chart is that the black arrows represent completed events, while the blue arrows represents future events.”
Figure 3. Career Flowchart of Ms. Samantha Swanson
Caroline Wochnick

What led me to STEM as an undergraduate student

“My love for the STEM field came to me when I was very young. I remember when I was in kindergarten, we did the classic “Sink or Float” science experiment where students are told to guess whether or not an object will sink or float in water, test it, and write down our observations. Although it was a very simple experiment, my five-year-old self was beaming because I liked it so much. When I got home, I couldn’t wait to tell my father how much fun I had and how much I liked science. When I told him, he said something to the order of, “You like science? That’s great! You should stick with it.” From then on I was always interested in science. I particularly liked physics and chemistry throughout my years through middle school and high school. When I was accepted into Augsburg I had a really hard time choosing between the two. I eventually landed in physics, and I have enjoyed every minute of it.

How and why did I initially want to participate in this project?

“My initial interest in this project came from how unique it was. As a first year student, I was looking for guidance and this project was going to supply that for me. I liked the way that Dr. Lanzerotti was pairing natural science with social science, and it felt like a good opportunity to broaden my horizons.

How did I select my interviewees?

“To select my interviewees I started by looking up large universities in the Midwest. From there, I focused on women in STEM, and looked at the different fields they worked in. Eventually, Dr. Lanzerotti, Sam Swanson and I came to agree on Dr. Susan Coppersmith and Heidi Reis.

RQ#1 “What are the key factors that led to the success of the distinguished leaders?”

“I think the most important thing that led these women to success was their determination. They were determined to succeed, even when they took chances that left them uncertain of the future. Support systems are also important. Both of them mentioned other how much other people pushed them and made them strive to be better. They also mentioned that these were the same people that were cheering them on.”
RQ#2 **“What are the crucial skills that enabled their success?”**

“These women were determined. That is the most important skill they could bring to the table. The idea that “you can do anything you set your mind to” becomes more realistic the harder you’re willing to work at it. Another skill they learned along the way was people skills. Throughout their journeys they learned that relationships are important, and that having connections with people can be a real advantage throughout your career.”

RQ#3 **“What is the impact on my career path?”**

“The impact of these women on my career path has been minor, but important. Both women never gave up, but also never strived to do the impossible. They taught me that I don’t always have to have a plan, and that I shouldn’t limit myself to only one option. When opportunities arise, I shouldn’t write them off because they aren’t part of “the plan,” I should seriously consider them and weigh my options. Also, when things don’t go according to plan I need to look for other doors and ways to achieve my goals. This idea has led me to believe I should consider other job opportunities outside of physics after I graduate.”

**How I am Benefiting from this Project**

“Interviewing successful women has given me a good picture of what it means to be successful, and how the path to success is different for everyone. I can use the path of these women, and other successful women around me to find what success means to me. I can use their paths as inspiration and as a source of comfort when I feel that I don’t know what should come next.”

**My Career Flowchart (Figure 4)**

“My flowchart is divided up by colors. Anything in blue is from the past, or has already happened. The green box is where I am now, and the purple is where I want to be in the future. The quotes in yellow are quotes from this project that have helped me make decisions. The quote that I have conveniently placed in the future also helped me decided my major, and I feel it will be useful in the future when I am making that major career decision. The quote from Dr. Coppersmith helped me have the courage to take a year and explore what I wanted my major to be, and where I wanted to focus my studies.”
Figure 4. Career Flowchart of Ms. Caroline Wochnick
Amanda Kapetanakis

What led me to STEM as an undergraduate student

“Before I attended Augsburg College as an undergraduate student, I knew I wanted to pursue a career in the STEM field. My interest in science and math started early on in my life. In grade school, I was one of four students who were placed in an excelled math group. I would study math topics that were a grade level above of where I was in school. I continued to excel in math throughout all of my schooling. My interest in science started in grade school as well. I was fascinated by space and the ocean, and would watch documentaries on both. I quickly learned how important an ecosystem was, and grew very concerned about the oceans ecosystem as I watched documentaries about it. I wrote a letter to the governor of Florida and California, begging them for tighter regulation on fishing industries so we could save all the creatures that die each year from being trapped in nets. For this reason, I had considered the field of Biology as a marine biologist, but then changed my mind later on in grade school to the field of dentistry. I was born with bad teeth, and had a hard time pronouncing words clearly because of it. In late grade school, I got braces. I loved going to the orthodontist. All the dental work I had done changed my life. From that point on, I knew I was going to pursue a career as a dentist. I wanted to make that same difference in someone else’s life, so I knew a STEM field was for me.”

How and why did I initially want to participate in this project?

“After taking a semester of physics with Dr. Lanzerotti, I developed an interest in physics that I never knew I had. I learned that physics is truly everywhere. For this reason, I asked Dr. Lanzerotti if I could do research with her. I initially started working on a project that was detecting weak radio frequencies, and then got asked, later in the summer, by Dr. Lanzerotti to participate in the Oral History Project. I was very interested in the project because as an undergraduate in a STEM major, I could meet women who were once where I am now, and learn how and why they got where they are today. For this reason, I decided to participate in the Oral History Project.

How did I select my interviewees?

“Because I started working on the Oral History Project later in the year, the interviewees had already been selected. Though the interviewee’s had been selected, a site I used to find additional potential interviewees for the 2017 year was the
Through looking back at previously interviewed distinguished leaders and the first interview I recently carried out, I was able to see a pattern of key factors that led to their success. The key factor in a lot of them was a good support system. They had families, churches, mentors, friends, or someone in their life that helped back them through whatever they tried to accomplish. By having this, they were able to use their own unique skills to lead them down different paths and help them to become successful, distinguished leaders.

**RQ#2 “What are the crucial skills that enabled their success?”**

“The distinguished leaders had skills that were crucial to their success. The main one throughout all of the distinguished leaders was determination. When the going got tough, they stuck with it. When it seemed impossible, they worked that much harder. All of these leaders were determined to be as successful as they could be. Another skill that seemed to be prominent throughout all of them was hard work. They were all hard workers. They worked to find opportunities and excelled in everything they did through hard work. An important skill that the interviewee I recently interviewed developed along the way was public speaking. Public speaking helped her to effectively communicate the information she needed to be successful.”

**RQ#3 “What is the impact on my career path?”**

“The oral history project will affect my career path in many ways. Every distinguished leader I interview will have a different story and path they took. By seeing what worked best for each distinguished leader, I will be able to take that and apply it to my path. After interviewing all of the distinguished leaders, I may see paths and opportunities I never knew existed. By taking every interviewee’s advice and guidance, I will be able to shape my career path so it will best fit me and help make me as successful as the distinguished leaders I interview.”

**How I am Benefiting from this Project**

“By interviewing successful women in STEM fields, I’m learning about the skills it takes to be successful in a STEM field. As my first interviewee showed me, it’s very important to seize opportunities as they arise. Some of her greatest successes came from opportunities she took a chance on. As I’m getting ready to apply for grad
school, it will be important to listen to the advice of each interviewee to help make the best decisions about opportunities that come up in my life. Along the road to success comes important decisions, so I hope to listen to these interviewees that were once in my shoes, and take their advice to heart as I continue on my journey to becoming a dentist."

My Career Flowchart (Figure 5)

“Currently, I’m a junior at Augsburg College. As senior year approaches, I’ll be applying to Dental school. This is an important time, as many important decisions will be made that will affect my life forever. After dental school, I hope to open my own dental practice. By participating in the Oral History Project, I will be able to apply the advice given by the interviewees, who were once in my shoes, to the important future decisions I’m about to make. Each interviewee will start and end up in different places so it will be interesting to hear each and every one of their paths. So far, I have been shown by my first interviewee that anything is possible. If I can dream it, I can do it. I just have to want it bad enough to give it everything. Successful woman in these STEM fields will help show me a path to follow my dreams.”
Figure 5. Career Flowchart of Ms. Amanda Kapetanakis
References

1. IEEE. Online: www.ieee.org.


