Invited paper

Elizabeth Ann Nalley*

Leading by example

https://doi.org/10.1515/pac-2020-0903

Abstract: This article describes the journey of a young girl born to poor cotton farmers in the early 40s who grew up to become a chemist and then became the President of the World's Largest Scientific Society, the American Chemical Society. It describes the obstacles she had to overcome as a woman as she earned a Ph.D. in Chemistry and the successes she celebrated along the way. It also features undergraduate research success stories and how these have contributed to her success. Hopefully it will inspire women to follow her footprints in a journey that reached many corners of the world.

Keywords: Distinguished Women in Chemistry and Chemical Engineering.

How is leadership defined and how do we develop those qualities which make us leaders? I believe that through time, we all develop our own definition of what leadership means. As an educator, I believe we have a responsibility to our students to lead them to become the best professional they can be. It seems there is little doubt that we influence others through our actions, especially when we are in a leadership role. The challenge is that it isn't just great leaders who are leading by example – we all are. As a leader/supervisor/manager, teacher, people are watching us. They are noticing everything we do – whether it is what we would want them to emulate or not. Since people are watching and are being influenced by our behavior, for better or worse, it begs a (very) important question. *"What is the example we want to be setting?"* What "leading by example" should mean is that our actions influence others to behave and respond in ways that we deem valuable and appropriate for our organizational outcomes.

In this article I hope to share with you what I believe to be successful leadership in teaching a STEM discipline and how through my career I have been able to achieve it. My confidence in my ability to lead has come through 50 years of successful teaching of chemistry at the university level, directing more than 200 students in undergraduate research, my 10 years of service as an elected member of the National Board of Directors of the American Chemical Society (three years of which included serving as President-Elect, President and Past President of the Society) and a number of awards. I also served four years as an elected member of the Board of Directors of the American Institute of Chemists and served 21 years as a member of the National Board of Directors of The Honor Society of Phi Kappa Phi (the largest interdisciplinary honor society). Nine years of the service to Phi Kappa Phi included three years as the President-Elect, three years as the President and three years as the Past-President. I have also held numerous leadership positions in American Chemical Society Divisions and Committees both Nationally and locally.

Article note: A special collection of invited papers by recipients of the IUPAC Distinguished Women in Chemistry and Chemical Engineering Awards.

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Here is my list of the leadership qualities that make one a good leader.

(1) Creativity
(2) Vision and purpose
(3) Honesty and integrity
(4) Confidence
(5) Accountability
(6) Humility
(7) Commitment and passion
(8) Ability to inspire others
(9) Empathy
(10) Resilience
(11) Delegation and Empowerment
(12) Ability to communicate

The early years

First of all, I would like to acquaint you with who I am and how I earned a Ph.D. in Chemistry and became a Professor of Chemistry. I was born to parents who were not educated. My father graduated from the eighth grade and my mother attended school up to grade 11. They were farmers and the chance that I would ever grow up and get a Ph.D. in chemistry was probably zero to none. My elementary school education was achieved in a one-room school which housed all eight grades in the same room with only one teacher. I never saw a woman science teacher in my whole 12 years of school from elementary to high school education. In college I never saw a woman professor in chemistry in my undergraduate or graduate programs in spite of the fact that I earned my Ph.D. from a women's university. So I had no women in science as role models and mentors. Fortunately, there are now women at all levels but we still have a long way to go.

I was born in Catron, Missouri near New Madrid, Missouri. New Madrid is located in Southeast Missouri and is located in the part of Missouri known as the New Madrid Fault. The home where I was born was only about a half mile from the Mississippi river. The picture at the right is a picture of me taken on the back porch of the home where I was born on July 8, 1942 (Fig. 1). In those days most babies were born at home. My mother gave birth to five babies all of whom were born at home. The baby in the stroller is me. Note the modern water facilities on the back porch, a pump which was connected to a cistern. I was always amazed at how smart my mother was and even in those days, she added bleach to the water to kill bacteria. The picture here was taken

Fig. 1: Picture of Ann Nalley as a baby on the back porch of the home where she was born. Rescued from this porch from the flood of 1943.

on the back porch of my home when I was nine months old. Shortly after the picture was taken my father rowed in a small row boat in the middle of the night and rescued us from a flood when the Mississippi River flooded. My family spent the next 10 days in a one room school house with 10 other families. When we moved back into the house, my father scooped out the mud which was left behind after the flood waters receded and my mother scrubbed the floor with wood ashes to clean the wooden floors. There were few commercial cleaning supplies at that time. We did not have to worry about carpets then because our floors were covered with linoleum and we simply picked it up and threw it out. My mother had stacked the beds on top of the table but the mattress' were made of chicken feathers and had mildewed. We had to throw them out and we made new ones from corn shucks because it takes a very long time to collect enough feathers to make a feather bed.

The next picture (Fig. 2) is me with my two grandfathers, my father and one of my uncles. The tall man on the left is my grandfather King who was the son of a Cherokee Indian and the other tall man in the overalls is my father. The other man on the right is my grandfather Frazier whose father came to the US from Scotland. We are standing in a cotton field and the tall cotton is the result of the fertile ground left behind after the floods. My father was a farmer and we grew almost every crop you can imagine but since most of the plowing was done with horses until the early fifties, the fields were small. I learned to pick and chop cotton, haul hay and work in the fields at a very early age. The fields were fertile but the floods were discouraging to my parents and when I was three years old, we moved to higher ground to a farm near Dexter, Missouri. I started school there in a one room school house known as the Acorn Ridge school when I was four years old. In those days we already knew about head start. I started to school so my mother would have more time to work in the fields and take care of my younger brother. By the time I was five years old, I had read 27 books. Those were hard times, my father had parachuted out of a plane and broke his leg at the beginning of World War II and had come back home from the war. This had made farming very difficult for him because he had to walk behind a plow. Everything was rationed during the war and we survived only on what we grew in our garden or in the fields including our pigs, cows, and chickens. Those early years enabled me to learn creativity. Because we had no TV and little communication with the outside world, I created my own toys and

Fig. 2: Nalley with her father (middle) and two grandfathers. The tall man is her grandfather King, a Cherokee Indian and her other grandfather Frazier from Scotland.

games. My mother told me that I began to make up stories about life at the age of five years. I also learned about honesty and integrity though great lessons from my parents.

In 1947, my father's brother who lived in Checotah, Oklahoma asked my father to move back to Oklahoma. I think we were having a hard time financially in Missouri but my parents never talked about it. We did not have a car and we drove a wagon to the store to get ice for the ice box and we walked to school, I had an older brother and sister (both of whom were born during the depression). They helped to educate me because they always shared their books with me. We had no electricity or modern conveniences in the homes were we lived until the mid fifties.

When we moved back to Oklahoma, we brought a 160-acre farm and at that time, the bank carried us with no collateral, only my father's word and an agreement that we would make a payment each year at the end of harvest. I was five years old when we moved to Oklahoma but Oklahoma Laws required that I had to be six years old to start school. So I took my first sabbatical at five years old. The one room school (Elm Grove, was located about eight miles from Checotah, Oklahoma) which my older brother and sister attended was 1/2 mile from our home. There was a small store and gas station across the street from the school. The owner's wife had severe crippling arthritis and I took a job as an attendant to the owner's wife. I carried water to her; I read to her and sat with her each day during the school hours. I earned 10 cents per day. However, this was a great experience for me. She taught me to crochet and tat and I soon became an entrepreneur. This picture was taken when I was eight years old. I would crochet doilies and chair covers and I set up a table on the street corner in Checotah and sold my wares. This picture appeared on the front page of the Muskogee Daily Phoenix (Fig. 3). I also raised rabbits and sold them. Those years taught me about vision and purpose.

Now back to my science education and inspiration. As I said earlier I never saw a woman science teacher. My role models came from books and my role model and mentor was Marie Curie, the only woman to win two Nobel prizes, one in chemistry and one in physics. I read her biography at least five or six times when I was going to school in the one room school at Elm Grove, Oklahoma. For three of my first four years there, I was the only student in my class. I had lots of time to read or listen to the older students present their lessons. We learned mostly out of work books. We didn't have television then. We didn't have many stories about women scientists because there weren't many stories to tell about women scientists, because they just did not exist at

Fig. 3: An entrepreneur at age 8 – Ann Nalley started her own business and sold wares on street corner in Checotah, OK.

that time. At the end of my fourth year at Elm Grove, the school was closed and we were transferred to a larger rural school, Victor Public School which located about eight miles from my home and had over 100 students in eight grades. I rode a school bus to school each day and the bus route was more than 30 miles which meant, I spent about 2 h on a bus each day. Life changed drastically for me then and I had to compete with 20 other students in my classes.

As I look back over my life, I believe I began to formulate my philosophy of leadership at a very early age. To me leadership meant performing at my best and setting a high standard for others to follow. I read more books than any one in my school, I had perfect attendance, I won more math contests, I entered personality contests in the 4-H Club and I sewed and entered dress-making contests, and I ran for offices in the 4-H Club and I won. When I finished the first eight grades, I graduated from the eighth grade and then started high school at Checotah High School located in Checotah, Oklahoma in 1956. The school was only eight miles from my home but this meant another 30-mile bus ride both morning and night. As I competed I developed self-confidence and resilience. My years in 4-H Club helped me develop my communication skills and many other skills which I still use today.

As I entered Checotah High School (population of 250 students) I signed a petition with 16 boys requesting that a physics class be offered at the high school. So I was in the first physics class ever taught at my high school. I won award after award in high school. I was very competitive.

They launched Sputnik in 1957, and at that time, I was a high school sophomore. The US said it's time that we get more young people involved in STEM. We're behind, we're losing the technology race, and suddenly the National Science Foundation developed wonderful programs in the US to encourage young women and young men, like myself, to go on in science. I took chemistry when I was a junior because I wanted to take physics my senior year. At the beginning of the chemistry class, my instructor chose two students to study extra hard to complete the course by the Christmas break so that they would be able to compete in the state chemistry contest. My high school chemistry teacher, a man of course was great. I took that test in January and won the state chemistry contest at Southeastern Oklahoma State University. As a result, my high school teacher nominated me for one of the National Science Foundation summer programs in chemical engineering. I was selected to participate in the program and as a result, I spent six weeks at Oklahoma State University in a chemical engineering program (NSF Oklahoma High School Institute), learning about careers in engineering and participating in advanced studies and research. There were six girls and 20 boys in that program. That summer changed my life forever. I came home after the institute with a slide rule with my name engraved on it and a determination to go to college so that I could become a scientist or engineer. The picture in Fig. 4 was featured in my home town newspaper that summer. That summer changed my life because it instilled in me the belief that I could go to college and earn a college degree to become a scientist. We need another Sputnik to encourage our young people to go into science and mathematics so that we will not have a shortage of scientists in the future.

My college education

I began my studies in the fall of 1960 at Connors State Junior College at Warner, Oklahoma. I had scholarships which helped to finance my education. I also worked as a lab assistant for the chemistry instructor. I majored in chemistry and completed an Associate's Degree in Science in two years and transferred to Oklahoma State University (OSU) in the fall if 1962 to begin a degree in Chemical Engineering. I was the only girl in all of my engineering classes at OSU and my classes did not go well. I decided to change my major to become a chemistry teacher and transferred to Northeastern Oklahoma State University where I could complete both education courses and chemistry courses in a year and one half in order to graduate on time.

Fast forward to my career, I completed an undergraduate degree in chemistry and actually taught high school for a year at Muskogee Central High School. This was the school where I did my practice teaching for my education courses. Dr. J. E. Dunn was my mentor during my practice teaching and he was a wonderful mentor and upon completion of my BS Degree the school offered to hire me as a full time teacher. However that was a horrendous year. I taught one section of chemistry, one section of physics, two sections of modern abstract

Fig. 4: In 1950 – National Science Foundation, NSF, was created. In 1957 – Sputnik was launched. NSF created high school academies to attract high school students to select STEM careers. In 1959, Ann Nalley was selected to attend one of the first NSF National High School Institute in Chemical Engineering.

algebra and one section of remedial math. I had never had a course in modern abstract algebra. When I reported for duty at the school, the faculty parking lot was full and I was assigned to the student parking lot. The discipline at the school was very poor and the students continually harassed me. They stole my spark plugs from my car, stole my distributor cap, let the air out of my tires, and filled my gas tank with sand. Discipline in my classes was non-existent. I was driving home from school in April and was about a mile outside the city limits of Muskogee. My car started smoking and I stopped the car, grabbed my books and purse and started running away from the car. When I was less than one hundred feet from the car, it exploded and burned up very quickly. That day I begin to wonder if high school teaching was the correct career for me. My chemistry, physics and modern algebra classes went well but the remedial math class turned out to be the class in which all students who had discipline problems were placed. Near the end of the spring semester a student threw my chair out the fourth floor window (the window of my class) and threatened to throw me out. I went down to the first floor to the Principal's office but he told me discipline was very difficult to enforce. A week later, the Principal had a nervous breakdown and was hospitalized. He never returned to the school that year. So much for discipline at that school.

In the summer following my first year of teaching, I started back to school at Oklahoma State University. I intended to pursue a MS degree in mathematics that summer and return to teach at Muskogee in the fall. Near the end of the summer, I decided to stay on at OSU and continue my graduate education. I applied for a teaching assistantship in mathematics but none were available. I walked across campus to the Chemistry Department to visit with the Department Chairman to enquire about the possibility of pursuing graduate study in chemistry. The Chair, Dr. Otis Dermer, handed me a form which extended an invitation to me to apply for graduate school and a graduate teaching assistantship. I signed the form, called Muskogee High School and

resigned my teaching contract. That fall I entered graduate school at OSU to pursue an advanced degree in chemistry. In my graduate class there were 42 students entering graduate studies in chemistry. Thirty nine of these were men and myself and two other women. I began my graduate courses that fall and selected a research advisor, Dr. Paul Arthur. Dr. Arthur was an analytical professor who specialized in polarography. At the end of my second year, he passed away and left 16 students in his research group with no research advisor. There was only one other analytical chemist in the department and he did not feel comfortable taking on that many graduate students and he did not do research in polarography. Dr. Tom Moore, an inorganic professor discussed a possible research project with me which would use polarography. I choose to study with him and started on a completely new research project.

My career

In spite of this set back, I was able to complete a research project and write a thesis in one year. I was scheduled then to graduate with a Master's Degree in chemistry in August of 1969. In the spring semester of 1969, I begin to search for a position in industry. I sent out 40 letters and resume's and did not receive a single invitation for an interview. The economy was at a low and industry was not hiring anyone. I was in the office of the professor whom I worked with as a teaching assistant. He asked me what I was going to do after I completed my degree and I told him my story of my applications to find a position in industry. He told me I should teach that he had many positive comments about my teaching as a teaching assistant. He said, "as a matter of fact, I am a former President of Cameron University and I think they have positions. The Regents have changed their mission from a two year to a four year college and they are expanding their faculty." He picked up the phone and called the President of Cameron University, Dr. Don Owen. He inquired about a possible teaching position for me in chemistry. Dr. Owen responded positively and transferred me to the Department Chair of the Department of Physical Sciences at Cameron. It turned out to be Dr. Bob Vowell and I had served as his instructor in an organic lab at OSU the previous summer. He told me that he had three openings and would drive up to OSU (168 miles) the next day to interview me. He came for the interview with a contract in hand. I signed the contract without ever seeing the town of Lawton and the Cameron Campus. This was near the end of April and three months before I was scheduled to graduate with a Master's Degree. I reasoned that if I did not like the position I could continue the search next year. I accepted a position as an instructor of chemistry at Cameron University and began my career as a college teacher in August of 1969; I started back to school the following summer to Texas Woman's University (TWU) and earned a Ph.D. in chemistry at TWU in 1975. Another first, I was my research advisor's first Ph.D. Student. He was a great mentor and role model for me.

Through my career, I had many opportunities to be the first: I was the first woman to be promoted to full professor at Cameron, I was the first person to be named as distinguished professor by Phi Kappa Phi at Cameron, I was the first faculty member at Cameron to receive the Student Government outstanding teacher award, I was the first professor at Cameron to be inducted into the Alumni Faculty Hall of Award, I was the first faculty member at Cameron to receive the Distinguished Service Award, and I was the first woman to be honored as the Oklahoma Chemist of the year. As the years passed and I worked harder and harder to earn my firsts, I had an opportunity to be elected as the National President of the Honor Society of Phi Kappa Phi (the largest interdisciplinary Honor Society in the world). I was the third woman in 100 years to serve as the President and I served on their National Board of Directors for 21 years from 1980 to 2001. I was the National President of Phi Kappa Phi during its Centennial and chaired its National Centennial Convention which was held in New Orleans. During those 21 years as a member of their National Board, I spoke at over 100 Universities.

And then opportunities for leadership at the National and International level came my way. In 1997, I was elected to the National Board of Directors of the American Chemical Society, the world's largest scientific society and then in 2000 I was appointed to the Governing Board of Pacifichem, an organization of the chemical societies which border on the Pacific Ocean. The Governing Board consisted of representatives from Japan, Korea, New Zeeland, Australia, Canada, China and the US. I was the first woman to be appointed to Pacifichem and I was told that the ACS was hesitant to appoint me because the Japanese did not like

working with women. I told them I would make the Japanese like me and I think I did because I became the hero of the Japanese women and I regularly go there to speak.

My greatest opportunity for leadership came when I was elected as the President of the American Chemical Society in 2004 (Fig. 5). I was the fifth woman to serve in this position and I soon learned that I was essentially the only woman in the world to lead a chemical society of this magnitude at that time. As I traveled over the world, I became determined to change this situation and I continually challenged my male colleagues to elect women to leadership positions. I traveled to 15 countries and gave more than 25 international presentations including a presentation to Putin's Governing Board in Russia; remarks in Havana Cuba; presentations in London; Seoul, Korea; Taipei, Taiwan; and Budapest, Hungary; Tokyo, Japan; Hiroshima, Japan; Kobe, Japan; Keota, Japan; Singapore; Malta; Frankfurt, Germany; Petra, Jordan; and many others.

During all of this time, I taught at Cameron and my course loads ranged from 9 to 21 h per semester. It was difficult to find time or space to conduct research so my research activities were severely curtailed. Our building was very small until 1997 when we moved into our present facility. Our research lab in the old building was the organic lab and we could only utilize it for research when classes were not in session. In spite of this, I have served as a research mentor for more than 200 undergraduates. Much of my research has been applied research. Early on, I contacted local industries and arranged for my students to do research for the companies. Three important lessons I learned through those internships were: 1) honesty 2) integrity and 3) to be accountable for the work my students and I performed. We were a team and I instilled that in them. I negotiated for the students to be paid or receive scholarships but I never took money for myself. This was formalized when in 1989; I received an Oklahoma Applied Research (OARS) Grant through the Oklahoma Center for the Advancement of Science and Technology (OCAST) to set up an intern program with local industries. This enabled my students to work in industry during the summer as interns and receive monetary compensation or to work at Cameron either in the summer or academic year as interns for local industries. These grants continued for eight years until I was elected to the ACS Board. More than 50 industrial interns benefited from this program through the opportunity to work in industry. I still continue my intern programs today and these have enabled many of my students to be employed as soon as they graduate.

My advice to young faculty who want to have a successful career at an undergraduate institution is to take advantage of every opportunity to enhance your career through professional development. The professional development opportunities which helped me to enhance my career included a summer at Argonne National

Fig. 5: Induction as ACS President 2006, with CU Vice President McArthur, (now President of Cameron University) and Dept. Chair Danny McGuire (one of her former students).

Laboratories studying Nuclear Chemistry, eight summers at the University of Oklahoma Department of Chemistry and Biochemistry conducting research, two summers at the University of Southern Mississippi as a Poly Ed Scholar (a program funded by NSF learning polymer chemistry, three summers at the University of Texas at Dallas conducting research in Laser Photochemistry and 12 courses at the University of Oklahoma Department of Environmental Engineering in Environmental Chemistry and Engineering helping me to enhance my skills in teaching environmental chemistry. I developed the first undergraduate environmental chemistry course at Cameron in 1972. I also attended numerous workshops on instrumentation and computer molecular modeling over the years.

Leadership opportunities

At a small university opportunities for leadership are plentiful. I served on most of the academic committees over the year and served as the Chair of the Cameron Council and the Faculty Council (both were the highest leadership positions available to faculty). I served as chair of seven other committees. I also served as the sponsor to the Chemistry Club beginning in 1971 and helped the students prepare the petition to establish a Student Affiliate Chapter of the ACS. In 1982 the ACS Regional Director traveled to Cameron to install the chapter. The Chemistry Club and the ACS Affiliate Chapter won many awards over the years through my mentorship. The way I lead is to lead by example and I spent many hours over the years with members of the club, building homecoming floats, doing demonstrations and hands on activities for local elementary, middle, and high school students. The clubs won many awards over the years including 18 ACS National Awards. I also served my local section in all capacities and continue to serve as the program chair. My department was always supportive of my activities and through the years, the number of women in the Department grew as was evidenced by 70 % of the graduates were women in some years. I initiated Chem Quest, a program involving hands on activities for sixth grade students in 1981, a career open house for high school students in 1982 and wrote grant proposals to conduct summer science academies for high school and middle school students and wrote grant proposals to fund workshops for K-12 science teachers. These activities continue today and have helped to encourage thousands of students to choose STEM careers.

Over the years I have received many awards for my activities but the two most meaningful highlights of my career which resulted from my activities are: The American Chemical Society named an award after me called the E. Ann Nalley Award for Volunteer Service and in 2010 I was inducted into the Oklahoma Higher Education Hall of Fame (Fig. 6).

Even though I have tried to make changes throughout my life, there continues to be a problem with the employment of women in the field of chemistry. Now is the time to change because the next decade offers great opportunities for us to diversify the academy. There are a lot of faculties in the US that are like me who are nearing retirement age and there are many of the faculty who will be stepping down. This is the time for us to have the programs which afford women the opportunity to move into the work force and to move up to the full professor ranks and increase diversity in our universities. We have to be the leaders to do this. Those of us who've made it through the difficult times have to be the leaders. What is leadership? I love the description given by General Colin Powell, "the art of accomplishing more than science of management says is possible."

The five practices I like of leadership are you model the way, you lead by example. You inspire a shared vision and you challenge the processes. You enable others to act and this is something that many women, don't do nearly well enough. Unfortunately, I've seen this many times where women tend to be jealous of other women instead of helping them, and it's our responsibility as women to not only model the way and challenge the process, but to enable, to be there to help other women and we have to encourage the heart. This is what I try to instill in my students. I call it encouraging the heart or instilling in them self-confidence. This poem on the next page is an example of how I have accomplished this

Fig. 6: Nalley is inducted into the Oklahoma Higher Education Hall of Fame Induction – 2010.

Dr. Nalley,

You gave me encouragement when I was down
And ready to quit.
You kept me smiling in times of my life
When I had nothing to smile about.
You had more faith in me than
I had in myself.
Because of you – not only me,
But also my children are better off.
You touch so many lives in your daily life—
If I touch one person's life as much as you have touched mine,
Then I will know for sure that God has a purpose for me on this Earth.
You will always be my friend, my family, and my mentor.
I hope one day to be as good a scientist as you are.

Love,
Cindy Ignaszewski

Cynthia completed an MS Degree and is now an AP high school chemistry teacher at John T. Hoggard High School in Wilmington, NC.

My philosophy of life

The culture of the workplace changes when women are in power. Women have different leadership qualities including integrity, character, caring about people, knowing that people are the principle asset of any organization. If we can instill the confidence in our young women they will become leaders. I think that women have to be there for other women but men also have to be because it takes a combination of both men and women working together for success.

We're all equal in our uniqueness and because we are unique we tend to see things differently. This includes how we develop solutions to problems. We as teachers have to help our students develop in diverse ways and to help to lead them to find the best way to succeed. My philosophy for life is stated as follows. I will not go where the path may lead, I will go where there is no path, and my path out of that cotton field in Missouri was no path at all because there was not a prayer that I would ever go on and accomplish anything in my life, but I found the way. I will go where there is no path and I will leave a trail for others to follow. That's what I've tried to do with my life and I encourage all other women to do the same.

What does the future hold for women in chemistry? I see women in leadership positions and dominating in the field of chemistry. What about the men? The trend over the years has been that in the US as the number of women goes up, the numbers of men go down. Men are not choosing scientific careers. We need to encourage all talent in the US in order of our country to maintain its position as a world leader. It is the responsibility of all of us to be leaders for both sexes.

One of the most important decisions I made in my life was to marry my husband, Robert Mullican, who supported me in all of my activities. I believe in order for a woman to be successful in life, she must work harder than anyone, work longer hours than anyone, be blessed with good health and choose the right husband.