THE FRONTIERS OF SCIENCE FOUNDATION: TRANSFORMING MATH AND SCIENCE CURRICULA IN OKLAHOMA SECONDARY SCHOOLS, 1957 – 1964

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Title of Study: THE FRONTIERS OF SCIENCE FOUNDATION: TRANSFORMING MATH AND SCIENCE CURRICULA IN OKLAHOMA SECONDARY SCHOOLS, 1957-1964

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Abstract:

One of the most iconic events in curriculum history was the launching of the satellite Sputnik by the Soviet Union in 1957, and the curriculum reform movement that followed in the United States. This study shows how Oklahoma responded to the perception of the failure of the educational system, how leaders in Oklahoma had formed the Frontiers of Science Foundation, and the impact that group had on math and science curriculum in Oklahoma for the seven years following that historic event.

Because this study depended upon the use of historical documents and governmental publications, as well as examining events in two different societies, I used two related methodologies, historical methodology and historical-comparative methodology to show the findings. I also used the Systemic Change Process as my conceptual framework because it called for six elements, all of which fit as a tool to determine if the systemic change had been achieved in curriculum in the seven years studied. At the conclusion of this study, my recommendations for future study and action include studying the relationship between educators and business leaders to see if the process used by the FOSF would work today, and how would social media and the internet impact this process. Based on this study, I believe there is a need for a group like the FOSF today in Oklahoma to advocate for a better math and science curriculum for our students.

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Chapter I: Introduction

"The ascent of the Soviet Sputnik in 1957 inspired an era of school reform in the United States…on an unprecedented scale"
(Dow, 1991, p. 250).

In 1954, the United States of America was involved in a Cold War with the Soviet Union (Hoffman, 2009). The two so-called superpowers of the world following World War II seemed to collide ideologically on every possible issue and seemed intent on advancing their ideas through expansion all over the world (Hoffman, 2009). Issues such as the way Soviet influence started spreading all over the world after World War II and the arms buildup in both countries were examples of the extent to which these two superpowers challenged each other. Americans considered the expansion of Soviet influence in countries in Eastern Europe as attempts to take over the world and believed America should try to "contain" that expansion. Russian citizens viewed these American containment efforts to be interventionist and believed the United States should not meddle in the affairs of other countries. While America had ended World War II with atomic weapons, the Soviets decided to begin testing atomic weapons of their own, which caused the Americans to step up their testing programs and defense buildup (Cold War, 2009).

The people of the United States had endured years of investigation into suspected communist infiltration in all areas of their lives, from Hollywood to the government itself. Beginning in 1947, the House Un-American Activities Committee started holding congressional

hearings to try and ferret out communist sympathizers. Their targets ranged from actors and writers in Hollywood, to college professors and even federal government employees (Cold War, 2009). This ugly episode in American history finally ended in 1954 when Wisconsin Senator Joseph McCarthy, who had taken up the cause of eradicating all communist sympathizers in America in 1950, was censured by the United States Senate, and his open search for communist infiltration into the affairs of the country ended (Thomas, 2012).

The Korean War had just ended in 1953, and the United States had been in a recession since the end of the war (Institute for Economics and Peace, 2011). 1954 also marked the landmark Supreme Court decision *Brown v. Board of Education* declaring that segregation in schools was unconstitutional (Thomas, 2012).

In August of that same year, the United States Congress passed the Atomic Energy Act of 1954, encouraging the peaceful development and use of atomic energy, including domestic production and utilization (Kubiszewski, 2006), indicating that members of Congress were beginning to understand that scientific research was going to play a pivotal role in the economic future of the United States.

This era marked a time in the history of the United States that encompassed political and social upheaval and a changing view of the world, all coming less than ten years after the end of World War II. Americans had witnessed the use of nuclear weapons for destruction during wartime and were now seeing scientists talking about their possible peaceful uses in the future. The times were certainly changing.

The International Geophysical Year

In March 1950, several top scientists proposed to the International Council of Scientific Unions (ICSU), a group of national scientific bodies representing 142 countries whose mission is to strengthen international science for the benefit of society (About us, n.d., para. 1), that an international meeting be held to gather geophysical data from the entire planet, rather than from a single remote area of the world. In 1882-83 and again in 1932-33, International Polar Years had been declared to study geophysical data in arctic areas. While being valuable, they were limited to a small area and the idea of doing a similar undertaking that would look at the whole world was now being recommended. In 1951, the ICSU acted on this recommendation and declared that from July 1, 1957, to December 31, 1958, would be designated as an International Geophysical Year (IGY) to coincide with a time of solar activity predicted in the Earth's atmosphere. Areas of study would include cosmic rays, geomagnetism, meteorology, solar activity and upper atmosphere studies using rocket and satellite vehicles. (National Academy of Sciences, 1956, p. vii-viii). The United States and the Soviet Union were two of the 67 countries that participated in the IGY, and both countries released statements about their plans to participate in the IGY by launching satellites for observation purposes. On July 29, a press release issued by President Eisenhower's Press Secretary James Hagerty announced, "The President has approved plans by this country for going ahead with the launching of small unmanned earth-circling satellites…between July 1957 and December 1958" (Hagerty, 1955, para. 1). On August 2, 1955, just four days after the U.S. announcement, Soviet Physicist Leonid Sedov, during the Sixth Congress of the International Astronautical Federation held in

Copenhagen, told a group of reporters at the Soviet embassy that the Soviet Union would put an artificial satellite into Earth's orbit saying, "The realization of the Soviet project can be expected in the near future" (Schefter, 1999, p. 2).

Thus, began the Space Race between the United States and the Soviet Union, out of a cooperative effort to study the environment of the planet.

Beginning of the Frontiers of Science Foundation

> *"Oklahoma is fortunate in having leaders who see the possibilities ahead in science…Oklahoma with one hand on the plow, looking back to 50 years of agricultural development, now is reaching with the other hand into space, gearing the next 50 years to the scientific and technological world ahead."*
> (United States Senate Memorandum*,* 1955)

With the introduction of the peaceful use of atomic energy through the Atomic Energy Act of 1954, the Oklahoma City Chamber of Commerce, an organization dedicated to supporting the needs of business in Oklahoma City, thought that the development of scientific knowledge through education would be beneficial to Oklahoma City's future, and in 1954 decided to add a committee to its corporate structure which would concentrate on scientific activity (Anderson, 1956). The committee, comprised of "…Educators, businessmen and others who believe that Oklahoma's brightest future lies in the development of a scientific climate…" (Leaders, 1955), immediately began work that same year. Having a thriving petroleum industry and a modernized agriculture industry already, the group set its sights toward advancing the sciences, industry, and education in Oklahoma (The Story of, 1958).

As the committee members began meeting and looking at the issues facing Oklahomans in their pursuit of scientific knowledge, they found there were challenges in the schools that needed to be addressed. Educators from around the state of Oklahoma were concerned with the number of science courses being eliminated in schools, and the school districts around the state were having problems recruiting qualified science and math teachers to come to Oklahoma and teach science and math in the public schools K-12 (Anderson, 1956).

In Oklahoma, there were 493,927 children in K-12 in 1956, compared to 485,168 in 1955, an increase of 8,759 students. In the 1955-56 school year, there were 20,512 teachers in Oklahoma public schools, and 98.4% of all teachers in the state of Oklahoma had a minimum of a bachelor's degree which was an 8% increase from 1951-52. During the 1955-56 year, there were 5,790 teaching certificates issued for K-12 teachers by the State Board of Education, to go along with the 5,270 issued in 1954-55 for a total of just under 11,000 certificates issued during the two-year school years of 1954-56. Of those 10,997 certificates issued from 1954-56, 444 were for science, 23 were for biology, 9 were for chemistry, 393 were for math, and only 7 were for physics. There were three types of teaching certificates given out in 1954-56: Standard, Provisional and Temporary. Standard certificates were good for five years and could be renewed by teaching at least three of the five years during that certificate's life. Provisional certificates were good for three years and were not renewable. Temporary certificates were good only for the academic year in which they were issued (State Board, 1956).

This seemed to fit within a general concern for the number of quality teachers available in the United States at this time. Judy Gelbrich (1999), of the Oregon State University School of

Education, pointed out that after World War II, the US Government's GI Bill program sent over ten million returning veterans off to college. Because this time in history was the beginning of the post-war baby boom, population in secondary schools also began to grow, and the need for teachers increased. In 1941-42, there were a little over 21 million students in public elementary and secondary schools in the United States with over 850,000 classroom teachers. But in response to the increased need for teachers, "teacher certification requirements were lowered and, in some cases, almost eliminated to the point where no professional training was needed to teach" (Gelbrich, 1999, ¶ 1-2).

The lack of teachers was not the only factor influencing the number of science and math classes being dropped around the country and the state of Oklahoma. There were claims from some that our curriculum had grown soft. In 1940, a report called *What High Schools Ought to Teach* the authors maintained that academic subjects were of interest or usage to only a very few school children, and that the schools should be about preparing all students for their role in life, whether professional, clerical or manual (Kliebard, 1995). This tension between scholarship and practicality is still being debated today. Mike Rose (2014) commented that it seemed to him that our schools considered it their goal to achieve certain test scores and achieve high standards of living for their students, while in reality, some parents had other goals in mind for their kids, such as being socially acceptable, ethical, civic-minded and socially competent.

Kliebard (1995) noted that in December 1941, the *Conference on War Problems and Responsibilities of Illinois Schools and Teacher Colleges* was held at the University of Illinois. A large discussion item at the conference was the role schools should play during World War II.

Findings included recommendations that consumer education courses and vocational training should be stepped up and that students should receive first aid training as well as more subjects dealing with nursing. It was even suggested that courses such as physics and math should be redirected towards things like auto mechanics, navigation, gunnery… (pp. 205-206). After this conference and reports from other education organizations, the curriculum across the country started changing to include courses on consumer economics, home management skills, and even wartime needs such as aviation, navigation and the aims of war.

The child-centered theory of education promoted by John Dewey was now being challenged. According to Kliebard (1995), when Dewey opened his Laboratory School in 1896, his idea was that the school should be a place where, "The child lived, participated, and contributed" (p. 54). Dewey felt that the school should be about the child today, not just preparing them for something else in the future. When the Life Adjustment Movement, a distortion of Dewey's theory of progressivism, began taking hold during World War II, critics of this child-centered education felt that since the United States was in a war, it was time to look at the greater need of the majority of students and what the war effort needed, as opposed to the wants and needs of an individual (Kliebard, 1995).

Within the Cold War context, political leaders also discussed the low number of students enrolled in math and science classes in the United States. Porter (1955) found that in 1900, 56% of high school students in the United States took algebra compared to only 24% in 1955, 27% of high school students in the United States took geometry in 1900 compared to only 11% in 1955,

and 19% of high school students in the United States took physics in 1900 before they even had heard of nuclear energy and its derivatives, while only 5% took it in 1955 (Porter, 1955, p. 5).

The national trend of high school students taking fewer math and science courses held true in Oklahoma as well, as highlighted in a speech to a group of business leaders in August 1955. Mr. E. K. Gaylord, Editor of *The Daily Oklahoman*, Oklahoma's largest statewide newspaper, pointed out that out of 650 secondary school districts in Oklahoma, only 125 of them were teaching any kind of science, and only approximately 11% of students in Oklahoma were studying math (Reid, 1955). To the civic leaders who were trying to encourage the development of scientific knowledge in Oklahoma, this seemed problematic.

Later that year, the private Frontiers of Science Foundation was created as an outgrowth of the Oklahoma City Chamber of Commerce. A group of civic leaders, led by E. K. Gaylord, Dean McGee and Stanley Draper, formed the group to improve and expand the teaching of science and mathematics in all of its phases in Oklahoma schools at all levels. Their goals included establishing science and math research programs at Oklahoma's colleges and universities, while simultaneously creating an economic climate that would support recruiting scientifically educated teachers to the state of Oklahoma (Anderson, 1954).

These three civic leaders were prominent and powerful businessmen, with the gravitas and influence to accomplish much. E.K. Gaylord had moved to Oklahoma City in 1902 at the age of 29, when the city itself had only been in existence for 13 years. In 1903, Gaylord invested $5,000 in a small daily newspaper called *The Daily Oklahoman*, and later created the Oklahoma Publishing Company which he eventually expanded into a billion-dollar enterprise (Kline, 2011).

The Daily Oklahoman had, and continues to have, the largest circulation of any newspaper in the state. In 1928 he bought WKY Radio, and then in 1949 he began the broadcast of the state's first television station WKY-TV (Dary, 2003). Stanley Draper came to work at the Oklahoma City Chamber of Commerce in 1919 and began a career with the Chamber that spanned nearly sixty years of helping to develop Oklahoma City into a metropolis. In 1958, Draper was awarded the Exceptional Service Award by the Secretary of the Air Force and was later inducted into the Oklahoma Hall of Fame and the Oklahoma Medical Science Hall of Fame (Smallwood, 1977). Dean A. McGee graduated from the University of Kansas in 1926 and went to work for the Oklahoma-based Phillips Petroleum Company, eventually assigned to work in the Oklahoma City oil field. McGee demonstrated an ability to find oil, by drilling productively, and correctly advised Phillips to expand its operations in that area. McGee was promoted to Chief Geologist for Phillips Petroleum Company. McGee left Phillips Petroleum, joining Robert S. Kerr's Anderson and Kerr Drilling Company in 1937 and was named Vice-President. In 1946, his work had so impressed Kerr that he was named President of the recently renamed Kerr-McGee and Company, and Dean McGee guided the company into the modern era as its Chief Executive Officer (Hedglen, 2009).

These three leaders, one in publishing, one in the petroleum industry, and one devoted to civic support for businesses, joined together to improve Oklahoma science and mathematics education, preceding the current national preoccupation with STEM by more than half a century.

Acknowledging the growing concerns of educators and others about the state of science and math education in Oklahoma schools, The Frontiers of Science Foundation listed three major

objectives, establishment of research programs at Oklahoma colleges and universities that would bring scientists to the state, bring science installations to the state, and most of all to "…improve scientific teaching in Oklahoma's secondary schools, universities and colleges in order to provide better opportunity for our youth and help them meet the national need for more and better trained scientists" (Anderson, 1956, p.8).

In October 1957, in the midst of the Cold War, the Soviet Union successfully launched the communications satellite Sputnik (see Appendix C) into orbit around the earth, triggering fear among the American people that the United States had fallen behind in math and science, and that the Soviet Union had surpassed them in those areas (Thomas, 2012). Leslie W. Ross (1960), a graduate fellow in higher education at the University of Michigan, Ann Arbor noted, "…the Soviet pupil is carried much further in mathematics and science than the American pupil…mathematics includes trigonometry, as well as astronomy. And the study of physics and chemistry begins in the sixth and seventh grades respectively" (p. 543). Regarding American and Soviet secondary education, Dr. Herbert Kliebard (1995), writes, "While American schoolchildren were learning how to get along with their peers or how to bake a cherry pie…Soviet schoolchildren were being steeped in the hard sciences and mathematics needed to win the technological race" (p. 226). The popular *life adjustment* curriculum in U.S. schools was judged to be lacking in this international comparison.

The people of Oklahoma felt those fears, and were further concerned when they saw a story written by Sullivant (1957) in an article in *The Daily Oklahoman* titled "Eisenhower Sees Missile Speedup To Match Soviets" claiming that by the time a Soviet student had graduated

from high school, they would have taken five years of science, four years of physics, four years of chemistry, one year of astronomy, five years of biology and ten years of mathematics through trigonometry.

In response to widespread assumptions that U.S. schools were being surpassed, The Frontiers of Science Foundation decided to begin work addressing the problem of strengthening the science and math curriculum in Oklahoma secondary schools.

Definition of Curriculum

Curriculum has many definitions, as witnessed by the many books and articles written on the subject, by many different authors. In fact, there are over 120 definitions of curriculum that have been published (Portelli,1987). I will set the stage for this project by discussing a few of the definitions that have meaning to me and identify the one that I plan to focus on for this study. In my very first course, Curriculum Issues, of the doctoral program for Curriculum Studies at Oklahoma State University, my professor, Dr. Margaret Scott (personal communication, Jan. 18, 2010) told me that, "…a good working definition for curriculum studies is that it is the study of the things both inside and outside the classroom that contribute to the learning of your field of study", and that definition has remained with me to this very day.

Franklin Bobbitt (1918) believed that curriculum was all about life experiences, and said curriculum as applied to education is, "that series of things which children and youth must do and experience…it is the entire range of experiences, both undirected and directed, concerned in unfolding the abilities of the individual" (p. 42).

Dr. William Pinar (2012) points out that curriculum is "…that complicated conversation between teachers and students over the past and its meaning for the present as well as what both portend for the future…" (p.2).

Perhaps one of the most interesting definitions offered said curriculum is, "the experience which each individual undergoes within a potentially educative environment" (Willis, Schubert, Bullough, Kridel, & Holton, p. 251).

As a political science professor, I particularly appreciate the perspectives of Bobbitt, Pinar and Dewey in my classroom, because I have seen in the field of political science that the best curriculum for my students to really learn about political science has been to combine my personal experiences of a lifetime spent in politics along with the theoretical academic side to give them the most holistic view of not only how politics is supposed to work, but also how it really does work.

I like definitions that are clear, concise and to the point, and I could find no perspective on the definition of curriculum that fits that description or addresses the discussion of curriculum in this study better than that of Dr. Wesley Null (2011) who simply said "curriculum is about what should be taught" (p. 1). Null went on to say that the difference between curriculum and education is that "Curriculum forces us to think about ethics…because curriculum is about…what should be taught" (p. 3). It is important here to understand that curriculum should be put together for classroom use, and then followed through with to make sure the learner gets the full impact of the curriculum. He also pointed out that Joseph Schwab said there were five commonplaces, or things that were commonly accepted by everyone in the field in the

construction of curricula: the teachers – who are the center of curriculum, the learners – who are who teachers teach to, the subject matter – which is what the teachers teach the learners, the context – where and how it is taught, and the curriculum makers – who put it all together (Null, 2011). I feel this is very important to consider as we discuss the curriculum of the 1950's and 1960's.

Another important consideration to discuss as we look at the curriculum of this Cold War era is about the fact that there are several types of curriculum which can also influence what is taught. Null (2011) made the point that it is just as important to understand those types of curriculum as it is to understand curriculum itself. Liberating curriculum liberates the learner's mind and enables them to learn and make critical decisions. The liberating curriculum leads to a liberal education and helps free minds to think. There is also a hidden curriculum, whereby an institution does not specifically say something is policy, or is the culture of the institution, but implies it by its actions. For instance, how they handle and treat students with racial differences or how they treat different students who misbehave may be part of the hidden curriculum. In other words, it may not be written down that they treat African-American students differently than Caucasian students, but if they do, then their actions become an unwritten policy, or part of the school culture. And finally, there is the null curriculum, where the tone is set by what is not said rather than what is. In other words, it is about what is not taught, instead of what is. For instance, if in math and science classes at a school, the instructors pay more attention to the males than to the females, and calls on them more often, that says they think males are more likely to be good at those male subjects than the females (Null, 2011).

For this study, however, I have used the following definition of curriculum, "curriculum can be considered in terms of subject matter (mathematics, science, etc.) or content (the way we organize and assimilate information). We can also talk about subject matter or content in terms of different grade levels" (Ornstein & Hunkins, 2004, p. 11). I believe that this definition is a good fit for the research that I have done because it addresses the concerns individuals and groups seemed to have with American education at the time of Sputnik, such as what courses students were taking and at what grade level were they being introduced to these subjects, compared to the students of similar grade levels in the Soviet Union. Using this definition, this study looked at the particular subject matter of mathematics and science and focused on the high school levels of education in the state of Oklahoma between the years of 1957 and 1964.

Curriculum Before Sputnik

The Common School Movement, which occurred in the nineteenth century in the United States, was an effort to equalize the types of education available to all children regardless of wealth or social status. Those who supported this movement sought to, "increase the general wealth, decrease crime and other social problems, and make all citizens able to participate in a healthy political democracy" (Willis, Shubert, Bullough, Jr., Kridel, & Holton, 1994, p. 39).

In the early years of the twentieth century, the progressive movement, led by John Dewey, was sweeping across the American schools. The idea that the curriculum should be "child-centered" as opposed to being school-centered was picking up momentum. Dewey's strong belief that the school's role was to prepare the child to enter our democracy and be a good citizen, seemed to be an alternative reform to the system at that time (Dewey, 1916).

Around 1918, Bobbitt touted the idea of efficiency in education, claiming that children "should not be taught what they will never use, that was a waste" (Kliebard, 1995, p. 85). Bobbitt believed that education had always before been concerned with teaching facts, but that now it needed to teach from actual experiences people had participated in to gain wisdom (Bobbitt, 1918). He also believed that education should be based on future need, because not everyone needed to learn the same things. For example, Bobbitt believed that boys and girls had different needs, because they would have different roles in society as they grew up, therefore they needed to have different courses that would address their needs. They would have different jobs, play different sports and games and play different roles in their communities, thus taking the same courses in school would be a waste (Kliebard, 1995). Bobbitt (1918) said, "The first necessary thing is for our whole educational profession to acquire a social, rather than a merely academic point of view" (p. 282). It should be noted here that there were also many supporters of the Progressive Education Movement. In fact, in 1919 the Progressive Education Movement Association was formed, and by 1926 the Association membership had grown to over 5,000 (The Progressive Education Association, 1926).

The Life Adjustment Movement of the mid 1940's, was based on an assumption that over half of the students in public schools were not going to go to college and thus did not need courses like algebra and trigonometry. In fact, Klein (2003) noted, "secondary schools were "too devoted to an academic curriculum" (p.5). The Life Adjustment Movement said rather courses to help students live their lives, such as practical math focused on real-life issues like completing tax returns, buying insurance, and creating and following a budget, was more important than the

academic courses. This, in my opinion, contributed to the mathematical deficiencies of students at the time of Sputnik.

In 1942, a group known as the Educational Policies Commission, whose members were appointed by the National Education Association of the United States and the American Association of School Administrators, began developing policies for secondary education in the United States. It was completed and made available for review in January 1944, and its purpose was to best meet the needs of our postwar youth (Educational Policies Commission, 1944). Their report talked about the difficult task of changing from a wartime society to a postwar, peacetime society. Most of the returning soldiers were young, either in their late teens or early twenties, and their education had been interrupted by World War II. Some of those who did not go to war had gone to work for companies or factories that produced wartime products or ammunition, and they too were displaced, so there developed a limited labor market and a flood of workers from the war and wartime civilians looking for jobs. Secondary schools were unprepared for this situation for several reasons, such as the schools had totally dedicated themselves to winning the war, and now found themselves having to figure out how to adapt, and also local funding for the secondary schools was nonexistent, so they were unable to keep up with the new demand of postwar education. But of special note was that maybe the biggest reason the schools were unprepared to handle the postwar blitz was their traditional educational program. The Commission found that they had not made the, "Fundamental changes in the secondary-school curriculum and in the preparation of teachers (p. 6) were necessary for overcoming the postwar educational crisis (Educational Policies Commission, 1944).

The Situation in American and Soviet Schools

The situation in American education in the 1950's was very much on the minds of everyday Americans as well as political leaders as they struggled with the issues of the day. In an article in *The Daily Oklahoman* on Febuary 17, 1955, U.S. Senator Robert S. Kerr from Oklahoma said "more than 50,000 scientists, engineers and technicians are being turned out every year in Russia by the lowest estimate, in contrast to the 20,000 graduated annually by American colleges" (More scientific training urged, Feb. 17, 1955). This idea was furthered in a speech made at the 35th Annual Meeting of the American Petroleum Institute in San Francisco, California by the President of the American Petroleum Institute Frank M. Porter (1955) who asserted:

> In 1954, Russia graduated more than 50,000 engineers; our country only 22,000. …They said the Battle of Waterloo was won on the playing fields of Eton. Let us hope it need never be said that the battle for the Free World was lost in the high schools and colleges of America…that failed to train enough young people to hold our leadership in research, engineering, and scientific discovery. (p. 1)

American Schools

In American schools, enrollment in elementary and secondary schools began increasing in the years following WWII, mostly because of the children of the returning veterans, known as "baby boomers." The decade of the 1950's saw an enrollment increase of 44 percent in public schools in the United States. In Oklahoma, during the 1949-1950 school year, the enrollment in regular public elementary and secondary schools was approximately 441,000. By the 1959-1960

school year, enrollment had jumped to nearly 534,000 or about 21 percent. The length of the school year in the United States had only been about 130 days in the late 19th century and into the early 20th century but increased to about 175 in the 1930's and has changed very little since then (Snyder, 1993). The U.S. school system has basically been a 12-year model, called the 6-3-3 plan, consisting of elementary school (grades 1-6), junior high or middle school (grades 7-9), and high school (grades 10-12). There have been some variations on this plan, with a 5-3-4 plan, elementary school (grades 1-5), junior high or middle school (grades 6-8), and high school (grades 9-12) (The American School System, 2016).

In the curriculum organization of typical American public schools in 1960-1961, in the area of science, it showed that only about 22 percent of students in grades 9-12 were taking general science and biology, 9 percent were taking chemistry, 5 percent were taking physics and less than 1 percent were taking earth science. In the area of math, 29 percent were taking algebra, 17 percent were taking general mathematics, 14 percent were taking geometry and 3 percent were taking trigonometry (Snyder, 1993, p. 50).

"The Nation's educational system must be shifted into a higher gear and provide a college education to every capable high school graduate…today's sagging emphasis on science courses in secondary schools must be shored up" (Haseltine, 1956). By 1960, only about 42 percent of students over the age of 25 had finished the 8th grade, while only 40 percent had completed high school. As for higher education, by 1960 only about 10 percent of white males, 3 percent of black males, 5 percent of white females, and 3 percent of black females were completing 4 years of college in the United States (Snyder, 1993).

Politically, there seemed to be a disconnect between Washington, DC and the states regarding funding education. In 1955, for example, President Eisenhower began working with Congress to change the way the federal government had previously stayed away from educational issues with the states by trying to force them to send money to the states to build more schools. That effort by the President was not acted on by Congress until after the launching of Sputnik, when Congress finally passed the National Defense Education Act of 1958, which provided many federal dollars to education in areas such as the improvement of teaching in math and science (Smith, 2012). In fact, on January 27, 1958, President Eisenhower, after consulting with several of his science advisors, sent Congress, "a special message on education that was ultimately to result in the National Defense Education Act" (Killian, Jr., 1977, p. 193). Eisenhower also got Congress to increase the money for science education and research through the National Science Foundation after consulting with his closest advisor – his brother Milton Eisenhower who was then President of Johns Hopkins University (Killian, Jr., 1977)

Soviet Schools

By the school year of 1955-1956 in the Soviet Union, there were approximately 30,000 students in schools of general education, 2,000 students in schools of middle vocational education, and 1,900 students in schools of higher and professional education (Counts, 1957, p. 309). In 1960, the Soviet education system was composed of three types of educational institutions: four-year, seven-year and ten-year schools. The Soviets knew that this ten-year school plan made education mandatory for Soviet students from age 7 to 17. All students in the Soviet educational system at that time studied the same subjects in every grade as every other

student in their grade. Therefore, wherever one moved within the USSR, a student would have the same curriculum and it would be totally compatible; the Soviets had implemented national curriculum alignment. Curriculum for a Soviet student in 1960 required them to take six class hours per week in math each year – one through ten, two hours per week in Biology beginning in year four, two to four hours of physics each year beginning in year six, two to four hours of chemistry each week beginning in year seven and one hour of astronomy each week in year ten (Ross,1960). The Soviet school year was also quite lengthy in 1960, with the first three years of school children attending 215 days, increasing to 230 days per year in the tenth year. They also had a six-day school week, unlike the U.S. system with its five-day school week. A Soviet student completing the ten-year curriculum would then be able to take the tests for entrance into the university system. In the USSR in 1960, there were 33 universities along with over 700 other higher-educational facilities (Ross, 1960). In contrast, the United States, in 1960, had 2,004 degree-granting postsecondary institutions, of which 1,422 of them were four-year and 582 of them were two-year institutions (Snyder, DeBrey, & Dillow, 2016).

Though it was broadly assumed in the United States that the education system of the Soviet Union was far more rigorous and demanding, Ross (1960) noted:

> The individual counts for nothing in the Soviet Union, except as an instrument which can be molded to aid in the attainment of Communist objectives. Hence, the emphasis in education is not the enrichment of the individual for the individual's sake, but exclusively for the State's sake. This is quite different, of course, from the American concept of general education, which

> is primarily to aid the individual in self-realization and secondarily to help him make a significant contribution to the national economy. (Ross, 1960, p. 550)

Counts (1957) further confirmed Ross's statement of the role of education as it pertains to the youth of the Soviet Union by observing, "In the Soviet Union, everything is viewed from the standpoint of the policies and purposes of the Communist Party. The entire program of the middle school…is shaped by the immediate and long-term interests of the Party" (p. 82).

Personal Connections

I was drawn to this research by several factors, such as the launching of Sputnik by the Soviet Union in 1957, arguably one of the most significant events in the history of curriculum studies (Pinar, Reynolds, Slattery, Taubman, 2000). When it was perceived by the American public that this single act revealed the weakness of American curriculum in science and math compared to that of students in the Soviet Union, there was a symbolic call-to-arms from the President of the United States, and thus began what has been called the greatest education reform movement in American history (Dow, 1991).

As a boy growing up in Oklahoma in the 1950's and 1960's, I personally experienced some of the outcomes of The Frontiers of Science Foundation's work, which further drives my desire to find out what difference, if any, this organization made in Oklahoma. When I enrolled in the sixth grade at Townsend Elementary School in Del City, Oklahoma in 1963, I was part of the first class in our school to take the new School Mathematics Study Group "SMSG" math. The new curriculum was introduced in 1958 to Oklahoma students by the Frontiers of Science Foundation, formed as a response to the launching of Sputnik the previous year and funded by

the National Science Foundation. The group was led by a math professor from Yale University, Edward Begle, who formed teams of mathematicians to write math textbooks for K-12 students to replace the existing textbooks which were written by usually the chair of a school science department. It was noted that most teachers at the time knew so little about mathematics that it was basically not noticed that they were not written by mathematicians (Raimi, 1995).

Another program introduced in Oklahoma by the Frontiers of Science Foundation that I experienced first-hand was the taking of the Iowa Tests of Educational Development. The Frontiers of Science Foundation, along with Science Research Associates of Chicago and the Oklahoma Curriculum Commission, brought the Iowa Tests of Educational Development to Oklahoma in the Spring of 1956 (The Frontiers of Science, 1956). The Iowa Tests were born out of a contest held at an academic meet in the State of Iowa in 1929 for high school students. They were administered by the University of Iowa, and the top 10 students in each subject received medals for their efforts. In 1935, the University of Iowa began the program known as the Iowa Tests of Basic Skills, to be administered to students in grades 6-8. This time they were not used as a contest, but rather as a measuring device for teachers to know what subjects their students needed help in. By 1940, the tests were being administered in states other than Iowa (Bonney, 1981).

Another personal experience I had with the Frontiers of Science Foundation was the competition known as the Sir Alexander Fleming Fellowships. This was a collaboration between the Frontiers of Science Foundation and the Oklahoma Medical Research Foundation which would award a princely for the time $400 stipend and a summer of internship at the laboratories

of the Oklahoma Medical Research Foundation to the winners (The Frontiers of Science Report, 1957). In 1968, at the urging of my math teacher Louis Jones, I entered the "Sir Alexander Fleming" competition, and although I didn't win, I found myself captivated with the study of science and math. This program continues today.

Purpose of Study

This study looked at the role played by the Frontiers of Science Foundation in the curriculum of Oklahoma secondary schools, and even more specifically in the areas of math and science during the seven years following the launching of Sputnik by the Soviet Union in 1957. It is the intent of this study to determine the role played by this organization in the teaching of science and math in Oklahoma's schools, and in the development of programs at Oklahoma's universities to encourage the recruitment and development of science and math teachers for Oklahoma schools. This inquiry has been conducted through archival investigation of the Frontiers of Science Foundation historical records, including both formal archives and informal media artifacts, using document analysis and historical interpretive methods.

I understand that this study is deeply imbedded with curriculum history and may not fit the customary format for most educational works done in the field of curriculum studies. But I believe that curriculum history has an important role in the academic research area of curriculum studies.

Burlbaw (1991) noted, "The field is not without history, but the history is often only briefly known, and often poorly understood when known" (p. 233). He went on to say that with all the educational reforms that seem to continuously emerge, that reformers rarely look back at

what has happened before them in previous reform efforts, but that by "examining an early curriculum reform movement that addressed the same issues may provide guidance for contemporary curriculum and school reformers" (p.233). As Pinar (2012) noted, "In fact, the future will not be found in front of us at all, but in back of us. Reactivating the past reconstructs the present so we can find the future" (p. xv). When I read this quote from Dr. Pinar, it really resonated with me, because it reminded me of something my father told me when I was in high school. My father never finished high school, as he left to go fight in World War II when he was 17. After the war, he did not go back to school, because after witnessing the horrors of war, he was no longer a kid, but was now a man, and he went to work at Tinker Air Force Base thus beginning a thirty-eight-year career in civil service. Despite that lack of formal education, my father was the smartest man I ever knew. He had a way of cutting through all the haze and making everything clear, and that was a special trait in him that I always admired. One day in my sophomore year of high school, I came home from school frustrated about my European History class, because I wanted to learn about things more in my current era, rather than studying things that happened hundreds of years ago. I asked him why we were always looking back, when we should be looking ahead, and I still remember his answer, "Son, if all we did was look in front of us and never behind us we would miss all the knowledge and experience we had getting here. If we can use both our memory and our vision, we will be able to see not only the way things were, but the way they should be. Just remember, you can't know where you are going, until you first know where you have been." That is why this observation by Pinar really makes this comment matter.

Even though curriculum history does not appear to be popular, O.L. Davis, Jr., (1977) pointed out that despite the relatively small number of curriculum historians in recent years, they have begun to gain support and attention. He went on to say, "historical studies of curriculum should help us to understand the antecedents of the present course of study and of our professional field" (p. 159). Some think that curriculum history does not really provide answers to today's problems, Garrett (1994) warned that curriculum history should be broad rather than narrow, and most importantly is not the way to find a cure for the problems of today's curriculum. He made the point that "Curriculum history is one avenue through which understanding not only of the past but also of the present may be gained" (p.4). Those in curriculum studies need to conduct historical research in the field of curriculum to know not only where we have been, but where we need to go.

Bellack (1969) presented a view that seemed to show the very need of this research into the math and science curriculum during the Cold War years following WWII saying that he felt that the formative years of curriculum as a field have been documented, but "Critical studies that trace the development of the curriculum field beyond its formative years are much needed, of special importance would be investigations of the 1940's…and the 1950's" (p.285). This statement sounds as if it were written for this study.

The purpose of this study has been to look at the efforts of the group known as the Frontiers of Science Foundation, see if they accomplished their goals as it is related to curriculum in Oklahoma during the first seven years of its existence, and what the impact of their efforts has been on Oklahoma math and science curriculum.

Problem Statement, Research Question and Limitations

When Sputnik was launched by the Soviet Union in 1957, the citizens of Oklahoma, as well as the rest of the country, asked, "How were the Soviets able to get ahead of us in the fields of science and math to beat us in the Space Race?" While most Americans, and certainly most Oklahomans, thought of themselves as being superior to the Soviets generally, a look at the high school math statistics showed otherwise. Klein (2003) wrote that in the years between 1933 and 1955, the number of American students taking advanced mathematics courses actually declined. In fact, in the 1954-1955 school years, only 25% of American high school students were enrolled in Algebra as compared to 30% in 1933-1934, and in 1954-1955 11% of American high school students were enrolled in geometry as compared to 17% in 1933-1934.

The Frontiers of Science Foundation was formed to encourage more of Oklahoma's secondary school students to study science and mathematics, and to recruit and train more qualified science and math teachers to Oklahoma to teach those subjects to Oklahoma high school students. After the launching of Sputnik by the Soviet Union in 1957, The Frontiers of Science Foundation saw this event as their opportunity to answer the call and immediately began to look at ways they could make a difference in the science and math curriculum in Oklahoma. A further look into the seven-year period immediately following the launching of Sputnik is needed to determine what impact The Frontiers of Science Foundation had on the science and math curriculum of Oklahoma secondary school students. I chose the period of 1957-1964 for several reasons: First, in doing my research into the activities of the Frontiers of Science Foundation, I found a speech made by James Webb, Director of NASA, and former President of the Frontiers

of Science Foundation, in which Mr. Webb reported on the first decade of accomplishments of the FOSF, which was 1954-1964, so that seemed like a good point to use for my time frame. Second, 1964 was such a watershed moment for our country. Three civil rights workers were murdered in Mississippi. The Civil Rights Act of 1964 and the passage of the Twenty Fourth Amendment doing away with the poll tax which had been used to keep African-Americans from voting, marked a time of upheaval in this country. President Johnson began his "War on Poverty". It was also the arrival of the Beatles and the British Invasion, which had such an impact on our society. These seemed like good reasons to use 1964 as the stopping point for my study. The only limitations to this study were linked to the fact that this event happened over sixty years ago, so most of the people who figured prominently in the Frontiers of Science Foundation are either deceased or at such an advanced age that they can no longer recall details from that long ago. That means that I must rely on the historical documents and artifacts for my research instead of interviews and surveys with living individuals.

The research question for the present study is: How did the work of the Frontiers of Science Foundation affect math and science curricula in Oklahoma secondary schools between 1957 and 1964?

Summary

In this opening chapter, I have discussed the beginning of the Frontiers of Science Foundation, as well as the situation that existed in both the American and Soviet schools at the time of the launching of Sputnik. I have given the definition of curriculum as I have used it in

this research, my personal connections to the research, the purpose of the study, problem statement and research question, as well as the limitations of the study. It was of special note that the research found from the late 1940's and early 1950's showing a teacher shortage and concomitant reduction of teacher certification requirements, remains an issue today in Oklahoma, which I will discuss in my recommendations for future action in chapter 5.

In chapter two I have reviewed the existing literature exploring several recurring themes that help define the study. In chapter three I have described the research methodology I have used as well as the conceptual framework used to determine if the Frontiers of Science Foundation achieved systemic change in the math and science curriculum in Oklahoma from 1957-1964. In chapter four I have presented my findings, and in chapter five I discussed the overall conclusions of my work and what implications I think it has on further research.

Chapter II: Setting the Context

At the time of the launching of Sputnik in 1957, the world was in a very fragile state. The two major political powers of the world, the United States and the Soviet Union, were embroiled in a Cold War in which each was trying to outdo the other and gain the upper hand in all areas so to achieve world dominance (Hoffman, 2009).

This chapter addresses the context of the times related to four pertinent issues: 1) How did the Soviets having a superior math and science curriculum to that of the United States contribute to their launching the first satellite into space? 2) How did the United States government get involved in the curriculum battle between the Soviet Union and the United States? 3) What was happening regarding math and science curriculum in Oklahoma preceding the launching of Sputnik? (4) What was happening in curriculum in other states and other countries?

Soviet vs. US Math & Science Curriculum

The launch of Sputnik brought immediate close examination and critique of schools in the United States. Dow (1991) claimed that after the United States was beaten to space by the Soviets, many critics were quick to place blame on the inferior schooling of the American system, and he particularly noted that the scientific and technological prowess of the Soviets was the product of a better educational system, particularly in the fields of science and math (p.250).

Kliebard (1986) pointed out that when comparing the American life adjustment education, popular at the time, to the Soviet system, the American system looked soft while the Soviet system looked rigorous. Continuing this theme, Marshall, Sears, and Schubert (2009) claimed that the reason the Soviets beat the United States in the Space Race, was a consequence of a failing education system (p.74), and further wrote that if one looked at and contrasted American education to Soviet education, one would see that America needed to borrow from their curriculum and the United States could make better scientists (p. 41). Keeping with this theme, Steeves, Bernhardt, Burns and Lombard (2009) went as far as to say that when compared to the Soviet education system, the American system was a failure and needed a pretty complete overhaul. Killian (1977) took it a step further claiming that some Americans even took the line of thinking that since Soviet engineers and scientists had beaten American engineers and scientists in the race to space, they must have had a better education.

One view of the educational decline in American schools perceived by the American people was that the schools were not doing a good enough job of teaching subjects such as reading and that they also were not counseling students well enough in the need to study math and science. A Gallup Poll taken in 1957 showed seventy percent of Americans thought American students were not working as hard as Soviet students. It was simplistically assumed that Americans had lost confidence in the American education system because the education systems of the two powers had trained the scientists of the two countries, and since the Soviets had beaten the Americans to space, then the American education system was at fault. There was the feeling by some that the United States had gotten into this position because the American

schools had done such a poor job of preparing American children to be leaders in the world (Dickson, 2001; Flynn, 1995; Hiatt, 1986; and Killian, 1977). Whether it was the perception of the problem being the schools or the reality that it was the schools' fault didn't seem to matter, the public seemed convinced that it was education's fault.

In my view, just because the public perceives something to be a certain way, doesn't mean that it is that way; in fact, I feel it is safe to say that public perception does not necessarily reflect accuracy. Public perception can be heavily influenced by the media, and while the American media was reporting all the failures of the space program during this time, it was later revealed that the Soviet media was not so forthcoming, and that in fact, they had as many failures, if not more, than the United States (Schefter, 2010). Additionally, from 1957 through 1966, the only year the Soviet Union had more successful space launches in attaining earth orbit or beyond was 1957, when the Soviets had two successful launches to zero for the United States. For the next nine years the United States had 343 successful launches compared to 128 for the Soviet Union (National Aeronautics and Space Administration, 2014, p. 147). And although the media did not try to quell the public alarm at the Soviet launching of a satellite before the United States in 1957, within the White House it was well known that President Eisenhower had tried to reassure everyone that his scientific experts saw no ICBM gap or even parity in missile-know-how between the United States and the Soviet Union. Had the White House pushed a program similar to that which produced Sputnik, they advised, a U.S. satellite could already have been aloft. (Dick, 2008, p. 160)

To further show the incorrect public perception of the United States being behind the Soviet Union in relation to the reality of where they really were, in a memorandum of a conference with President Dwight D. Eisenhower held on October 8, 1957, four days after the Soviet launch of Sputnik, Assistant Secretary of Defense Donald A. Quarles tells the President that "there was no doubt that a Redstone (rocket), had it been used, could have orbited a satellite a year or more ago…that it was better to have the earth satellite proceed separately from military development" (Executive Office of the President, 1957).

According to Dr. William Barry, NASA Chief Historian (personal communication October 12, 2017), both the CIA and the Air Force had been working on so-called spy-satellites well before the Soviets launched Sputnik and could have launched one in 1956. But President Eisenhower just did not want the first U.S. satellite launched to be sitting on a military missile, so he opted for the first satellite to be Vanguard which was a scientific program carried out by the U.S. in its participation in the International Geophysical Year which would be a peaceful scientific satellite, not an aggressive action.

I found it intriguing that there were some conflicting statements made in the press about the United States Government's response to Sputnik. One report claimed that "Sputnik…caused members of the Eisenhower administration and the military-industrial complex to panic "(Flynn, 1995, p. 53), while another report claimed "not everyone in the United States was surprised (by Sputnik's ascent). U.S. intelligence, the military and the administration of President Dwight D. Eisenhower…were fully informed of the Soviets planning to launch…no later than the end of

1957" (Ryan & Keeley, 2017). This suggested that the government knew about Sputnik and was working on other things.

I had a professor in undergraduate and graduate school by the name of Henry Bellmon, former United States Senator and Governor of Oklahoma, and he once told me that there were two roads in life that ran parallel to each other: one was perception and one was reality, and at some point, they became one road because if someone perceives it to be that way, then to them, that is their reality. I believe that is what happened in 1957: the perception was that American education was inferior to Soviet education, and that was why the Soviets beat us to space with Sputnik. So even though it was only a perception, not based on factual data but rather on reporting by the media, that became the reality to most Americans, something that resonates with what is going on in America in 2018.

In another look at the situation as it related to education at the time of Sputnik, some blamed the schools for not requiring more students to take additional math and science, claiming that only about one-third of all American high school students were taking chemistry and only about one-fourth were taking physics (Mieczkowski, 2013). Others noted the shortage of qualified math and science teachers in American schools (Wissehr, Concannon, & Barrow, 2011). Whether it was because of lack of students enrolling or lack of teachers teaching the classes, a lack of students taking the math and science classes was a major problem.

Many scientists from the President's Advisory Committee, originally formed by President Truman and continued by President Eisenhower to act as advisors to the President on matters of space and defense, felt that there was not enough emphasis being put on the

importance of taking math and science in the high school curriculum of the day, noting the relatively low number of students studying algebra and physics (Divine, 1993). By having a low number of qualified teachers and a low number of students taking the subjects of math and science, the problem was being magnified.

Johanningmeier (2010) suggested that after Sputnik, scholars had to be brought in to revise, review, and reform curriculum because the public perceived that to be the problem (p. 351). Donahue (1993) observed that the curriculum in American high schools was no match for the superior curriculum of the Soviet Union and was in fact flabby in comparison to the Soviet's math and science curriculum (p. 321). Looking backward from the 21st Century, curriculum historians surmised still that, "In particular, poor science curriculum and teaching were targeted as the root of the problem" (Zandstra & Null, 2011, p. 322). These three findings seemed to all address the idea that the curriculum in American schools needed to be reviewed, and reformed.

Pepperdine University professor Diana Buell Hiatt (1986), in an address to the California Educational Research Association, told that group of the pressure to make changes in curriculum in American schools after Sputnik was intense. One group of authors was very specific in identifying change in science curriculum saying that "Sputnik served as a catalyst for several innovations and reforms for science education in the United States" (Wissehr, Concannon, & Barrow 2011, p. 371). It was even said by some that American schools were not emphasizing science in their high school curriculum and that led to two weaknesses, basic research and education. Without support for science and math education in the classrooms and money for basic research in math and science, it seemed that America was more interested in having the

best sports teams in the world instead of having the best scientists and scholars in the world (Divine, 1993). It seemed quite clear that the American public had lost faith in the American education system and blamed it for allowing the Soviet Union to have the ability to launch a satellite before the United States.

United States Government Involvement in Curriculum

Until the launching of Sputnik, the federal government had not been heavily involved as it related to education in this country, leaving that to the states and local entities. The government's support of education took a step towards more involvement with the creation of the National Science Foundation from the National Science Foundation Act of 1950, through which it directed the foundation "to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences" (Wilson, 1983, p. 2). This response from the American government through the programs and workings of the National Science Foundation "supported the creation and revision of curricula in biology, chemistry, physics and math" (Cavanagh, 2007, p. 13).

Another important step in the involvement of the American government into the educational system took place in 1957, when the Subcommittee on Education was created within the U.S. House of Representatives' Education and Labor Committee. This was a certain sign that education would become part of the Congress's policy network (Wilson, 1983). With the Cold War and the launching of Sputnik by the Soviet Union the U.S. government got involved in school curriculum and the training of teachers (Cavanaugh, 2007, p. 13).

On September 2, 1958, President Dwight D. Eisenhower signed into law the National Defense Education Act (NDEA), signaling once again that the federal government wanted to show its support for strengthening education at all levels in the United States. This piece of legislation was key to helping put in motion federal involvement in education in a way not seen before (Killian, 1977). Some of the highlights of the NDEA included authorizing appropriations to institutions of higher education to make funds available for low-interest loans to students, in the amount of $47.5 million in 1959, $75 million in 1960, $82.5 million in 1961, $90 million in 1962, and whatever would be necessary for the following four fiscal years to keep students able to complete their education (National Defense Education Act, 1958, public law 85-864, p. 1583). This legislation was especially impactful considering that in 1955, "one-third of all high school students qualified for college had failed to continue their education because of lack of funds" (Travaglini, 1975, p. 27). It seemed that the federal government had indeed decided to get involved in public education with its financial investment. Other areas of NDEA included providing financial assistance to the states' educational agencies for the purpose of strengthening science and math instruction, and the funding of one thousand fellowships for graduate students in 1959, with one thousand five hundred more in each of the three following years (National Defense Education Act, public law 85-864,1958).

Thus, the NDEA made a huge investment to the infrastructure of college campuses around the United States, and in fact, "After 1958, 25 percent of construction costs on American campuses was financed by federal funds, and by 1960, the federal budget provided 20 percent of university operating expenses…and also paid for 70 percent of university research" (Walker,

1993, p. 117). This was especially important to helping the colleges and universities improve the capital projects on their campuses during the financial crisis they all faced after World War II.

According to Title I, section 102 of the National Defense Education Act (NDEA), the federal government, while showing its total support for pushing science and math education was careful to make the point that it was not telling local schools what to do. In spite of a tremendous increase in federal spending on specific educational endeavors, policy makers recognized the need to maintain the sense of local control of schools. The law said:

> Nothing contained in this Act shall be construed to authorize any department, agency, officer, or employee of the United States to exercise any direction, supervision, or control over the curriculum, program of instruction, administration or personnel of any educational institution or school system. (National Defense Education Act, 1958, public law 85-864, p. 1582)

The irony of this piece of legislation was that before 1958, education had generally been deemed a local matter, and the federal government should stay out of the states' business. Yet due to the public outcry of education being the cause of the United States falling behind the Soviet Union in putting a satellite into orbit first, the federal government felt the need to step in and show its support for public education by making a law that required their presence and intervention.

Many Americans felt that the Soviets beating the Americans to Space was directly related to the weak educational system in the United States, and this widely-shown sentiment contributed to the passage of the National Defense Education Act of 1958 (Rudolph, 2012, p. 3).

Even though most Americans had previously opposed the idea of federal involvement in schools, claiming it as a state and local issue, the launching of Sputnik brought about a large public demand for federal involvement, leading quickly to the passage of the National Defense Education Act (Bybee, 1997, para. 2). By passing the National Defense Education Act, the support of the U.S. Government for education was confirmed, and higher education specifically benefited from its passage (Wilson, 1983). This action by the federal government was unprecedented.

Among the provisions of the National Defense Education Act (NDEA) were funding increases and widespread school reform (Steeves, et al, 2009, p. 73). Even though the government's involvement in education was clearly born out of the reaction to Sputnik and the thought of trailing the Soviets in space exploration, the NDEA made a difference in research because of the support it gave to university students through graduate training stipends, renovating and improving university facilities, sponsoring conferences and even supporting financially many research projects around the country (Appley, 1984, p. 1050).

However, some felt that a lack of involvement by the United States government in helping insure that America produced the necessary number of scientists and engineers to compete with the Soviets would impact the balance of power throughout the world. Thus, the world community should be supportive of the US government's involvement in making America's school systems strong (Krige, 2000). Many Americans were concerned that with the Soviet Union beating America to space with Sputnik, the U.S. had suddenly lost its standing as the leader of both political and technological arenas and that our educational system with its

inability to keep up with the Soviets, would then indicate a weakness in national security (Steeves, et al, 2009).

By the mid-1950's, it seemed that most Oklahomans, as well as most Americans, had begun recognizing the need to strengthen the math and science curriculum in the schools. But it wasn't until the launching of Sputnik that there was wide spread support to involve the federal government by increasing spending and bringing about its concomitant control which changed the role of the federal government in education.

A Gallup poll conducted in 1958 asked principals of over 1,100 high schools in the United States about what they were doing differently since the launching of Sputnik. Of those polled, 23% said they had made changes in their requirements or their curriculum already and 29% said they are planning to make changes to their requirements or curriculum, so 52% or over half of the schools contacted have made changes to their curriculum or they plan to work on curriculum changes or their educational requirements since Sputnik. Interestingly enough, the majority of those schools contacted said they plan on making improvements in the areas of math and science (Gallup, G. (1958).

Oklahoma Math and Science Curriculum Before the Launch of Sputnik

In the spring of 1952, the Oklahoma Secondary-School Principals Association set up the Oklahoma Secondary-School Curriculum Improvement Commission, which operated under the umbrella of the Oklahoma State Department of Education, with a goal of doing curriculum studies in Oklahoma secondary schools. The group published a report called "Guide for the Improvement of the Curriculum in Oklahoma Secondary Schools." In 1955, the group's name

was changed to the Oklahoma Curriculum Improvement Commission to reflect the group's efforts to go beyond secondary schools to include college as well. This newly-named group was sponsored by the Oklahoma Secondary-School Principals Association, the Oklahoma Elementary-School Administrators Association, the Oklahoma Association of School Administrators and the Oklahoma Department of Classroom Teachers (Daniel, 1959).

When the Oklahoma Curriculum Improvement Commission was formed, the Oklahoma State Department of Education gave the group eight points of purpose for its existence:

1. Serve as the directing and coordinating committee for Oklahoma curriculum studies.
2. Promote curriculum improvements in the schools.
3. Enlist and encourage all Oklahoma schools to participate in a total State program of curriculum improvement.
4. Enlist the support and participation of all agencies interested in Curriculum improvement.
5. Promote meetings, conferences, workshops, etc., designed to bring about curriculum improvement in Oklahoma schools.
6. Serve as a clearinghouse for materials and resources for curriculum Improvement.
7. Inform schools which are not participants about what is being done currently in curriculum improvement.

8. Make certain that there is a clear understanding about attempts or efforts being made toward curriculum improvement. (Daniel, 1959, pp. 113-114)

The Oklahoma Curriculum Improvement Commission was made up of 35 members from all around the state of Oklahoma, and had at least 16 committees, in areas such as math and science, doing the work. And even though the Oklahoma Curriculum Improvement Commission was technically a private, independent group, they worked with the approval of the Oklahoma State Department of Education, and all secondary school teachers and administrators were encouraged to work with this Commission to better their curriculum (State Board of Education, 1964).

As discussed earlier, The Frontiers of Science Foundation had begun working on the problem of math and science curriculum in secondary schools before Sputnik caused the national furor it did with its launch in 1957. In the first annual report given by the Frontiers of Science Foundation covering its first year in operation, the group reported that it had gotten more than 60,000 students from high schools around the state of Oklahoma to take the Iowa Tests of Educational Development, and be part of, "the first testing program of its kind in the United States" (The Frontiers of Science, 1956, p. 13), which helped to evaluate impact on student learning of the high school curricula around the state of Oklahoma (The Frontiers of Science, 1956). In the same document, the group reported that they had hosted the 1956 National Science Fair in Oklahoma City which became the largest and most successful science fair to date, funded a project which televised for the first time in the United States on a state-wide basis math and physics courses to students within 90 miles of Oklahoma City, allowing those in small schools

the opportunity to take these classes, provided scholarships for students to attend the 1956 High School Summer Science Institute held at Oklahoma A&M, and were able to help secure a grant for Oklahoma A&M College from the National Science Foundation to train high school math and science teachers in a year-long pilot program (The Frontiers of Science, 1956).

In the Second Annual Report of the Frontiers of Science Foundation's progress during the year of 1957, the group reported that they had sent three mailings to approximately 1200 science teachers and administrators in Oklahoma containing packets of materials such as reports from the Atomic Energy Commission, scientific groups' reports on science teaching problems and folders to help guide and counsel possible future scientists from the schools around Oklahoma. The group also printed 12,000 copies of a guidance folder to be used in the schools to help encourage students to look for careers in the fields of science and technology. In October 1957, the group sponsored a conference at Oklahoma A&M College, now Oklahoma State University, to help make community science fairs be the way young people around the state learn about science, and over 170 administrators, teachers and professors from 81 secondary schools and 16 Oklahoma colleges and universities attended (The Frontiers of Science, 1957).

In June of 1957, the Frontiers of Science Foundation, along with the National Science Foundation and the American Institute of Physics sponsored a symposium held in Oklahoma City called The International Symposium on Science, Industry and Education. Dr. Mervin Kelly, President of Bell Telephone Laboratories headed up the event which included presentations by Dr. Lee DuBridge, President of the California Institute of Technology, Dr. Haakan Sterky, Director of Swedish Telecommunications, Dr. W.O. Baker, Vice-President in charge of

Research, Bell Telephone Laboratories, Sir Henry Thomas Tizard, former President of Magdalen College, Oxford University, Dr. Guy Suits, Vice-President and Director of Research, General Electric Company, Dr. H.B.G. Casimir, Director, Laboratory of Physics, The Netherlands, Dr. Augustus Kinzel, Vice-President in charge of Research, Union Carbide Corporation, and Dr. Vannevar Bush, Chairman, MIT Corporation. The first session of this prestigious event was presided over by Dr. Alan Waterman, Director of the National Science Foundation, while the second session was presided over by Dr. Frederick Seitz, Chairman, American Institute of Physics. The moderator for the closing banquet was Dr. Laurence Snyder, President, American Association for the Advancement of Science. This august group presented ideas and hopefully solutions to help Oklahoma conquer the new frontier ahead of it in the areas of science and technology (Oklahoma's new frontiers, 1957).

Two other events occurred in 1957 that merit special note: in February, the group sponsored a conference on math education at the University of Oklahoma. Speakers including the Director of Education for the American Association for the Advancement of Science, a professor from the Iowa State Teachers College and the Vice-President of Oklahoma A&M College helped make this conference significant in working on improving math and science curriculum in the schools of Oklahoma (The Frontiers of Science, 1957). Then in the summer of 1957, the Frontiers of Science Foundation, along with Oklahoma A&M College and the Oklahoma Curriculum Improvement Commission held a month-long workshop in math education on the Stillwater campus. Out of this workshop came a publication which was a new curriculum outline for math curriculum in Oklahoma schools. The report was called

"Improvement of the Teaching of Mathematics" and it laid out a math program for elementary and secondary schools. It also had sections suggesting ways to better teach math and help students understand modern math (Oklahoma State Department, 1957). The report was distributed to high school math teachers and administrators around the state of Oklahoma (The Frontiers, 1957).

What were the other states and countries doing about curriculum in response to Sputnik?

In searching extensively for what states were doing about reforming math and science curriculum, I really could not find other states forming groups to deal with it within their state, but rather group efforts that were largely backed by either the federal government or educators themselves, again, not dealing with a state department of education, but rather as a group of content experts within the field of math or science. Oklahoma seemed to be the only state with a privately formed and backed group of individuals working to change the math and science curriculum in their own state.

Principals in many states were working on curriculum changes of their own to answer the call after the Launch of Sputnik. Schools in Pennsylvania, Georgia, Ohio, California, Massachusetts and Texas all have either enriched their math and science curriculum or worked to identify students who seemed to excel in those two areas. As an example, in Pennsylvania, the principal of a high school with approximately one thousand students stated, "We have enriched the curriculum in math and science, and we have established a group of fast learners in each grade level" (Gallup, 1958, p. 13).

After Sputnik, it became apparent to many educators that the mathematics courses and instruction in America's schools needed to be improved. Ball State Teachers College in Indiana began experimenting with new curriculum in a tenth-grade geometry course as well as an experimental ninth-grade algebra course. The University of Chicago mathematics department was developing a new mathematics for general education curriculum to try and modernize what students were learning. The Mathematical Association of America assembled a committee to design new courses in the areas of physical science and engineering for college sophomores. The National Council of Teachers of Mathematics set up the Secondary School Curriculum Committee to look at the mathematics curriculum for students grade seven through twelve. In 1958, the Social Science Research Council set up a committee called the Social Science Research Council Committee on Mathematics in Social Science Research to look at policies relating to the mathematical training of social scientists (Mayor & Brown, 1959).

As pointed out in the previous section, after Sputnik, the federal government became more involved in local education, and after the National Defense Education Act was passed by Congress in 1958, money began flowing into science education. As a result, the National Science Foundation began funding state-of-the-art science textbooks. Two other important curriculum studies were also begun in 1958, The Biological Sciences Curriculum Study (BSCS) and The Physical Science Study Committee PSSC). Then in 1959 and 1960, two projects in the field of chemistry were started: The Chemical Bond Approach Project and the Chemical Education Materials Study (Engleman, 2001).

The Biological Sciences Curriculum Study group was working out of the University of Colorado, and their founders included professors from Columbia University, Johns Hopkins University, University of Florida, University of Chicago and the president of the National Association of Biology Teachers. The group came up with a matrix used to design biology curricula, naming nine biological themes, and developed three different versions of new high school biology courses which focused on learning concepts instead of facts (Engleman, 2001).

The Physical Science Study Committee was formed in 1956 at the Massachusetts Institute of Technology (MIT) by physics professor Jerrold Zacharias, and included members from Cornell, Harvard and the President of MIT (Rudolph, 2006). Their focus was to work on curricula for a better introductory physics course, and they were very successful. In a 1957 summer work session at MIT the committee worked on a new textbook, films, tests, and other classroom materials, and they were able to produce a new textbook that was used the 1957-58 school year in several schools. After three years of experimenting with the new course and its materials, their use was open for use by any school that wanted to do so in the fall of 1960 (Finlay, 1960).

In 1958, a three-year study called "The University of Maryland Mathematics Project" funded by the Carnegie Corporation of New York began, with more than twenty junior high school math teachers meeting weekly to work on their own use of teaching and learning more about the new math and new theories of learning. The group also worked to, "assist with preparation and revision of teaching materials, conduct interviews with children, and teach newly-prepared materials in their own classes" (Keedy, 1959, p. 59). The group came up with an

experimental seventh grade course, which in 1958-59 school year was used in about 25 schools in the Washington, DC area. The emphasis of this experimental course was to focus on mathematical understanding, where students could "Reason both inductively and deductively" (Keedy, 1959, p. 59).

The reform movement in mathematics in the 1950's and 1960's was not just limited to the United States, as many countries around the world found themselves in the same situation. In August 1958, the International Congress of Mathematicians was conducted in Edinburgh, Scotland, and several American professors from places such as Princeton, Yale and Virginia gave presentations showing the current reform movements going on in the United States. After that meeting concluded, the Organization for European Economic Cooperation decided to call a meeting to look at the mathematics program in France. It is interesting here to note that much as the formation of a committee to look at math and science curriculum in Oklahoma in the mid 1950's (the Frontiers of Science Foundation from the Oklahoma City Chamber of Commerce), the Europeans formed a group out of an economic group in 1958 to look at their math curriculum. To me, this shows the connection between education and success in life. There were similarities in their findings as well, such as a shortage of filling technical positions such as engineers and physicists. The findings of the conference after doing a two-week study of the issues told the story that the French secondary school system was not doing a good job of preparing its students for science and math positions.

In 1960, two conferences were held looking specifically at geometry curriculum, one in Denmark and one in Italy. In 1961, a conference was held in Bogota, Columbia which was the

first of its kind, called the Inter-American Conference on Mathematical Education. All the countries in the western hemisphere except Cuba, sent at least one great mathematician, including four very prominent speakers from Europe. Out of this historic meeting, a committee was appointed to act on a permanent basis, and they had a meeting in 1963 to start a package of mathematics reform.

An International Congress of Mathematics met in Stockholm, Sweden in 1962, to hear presentations from three different countries on studies conducted looking at studies they had conducted since the 1958 meeting. A professor from Dartmouth gave a presentation from the United States, a professor from the University of Oslo gave a report from Norway and a professor from Warsaw gave his findings on the study of algebra in Poland. In 1962, UNESCO, the United Nations Educational, Scientific and Cultural Organization, sponsored a conference in Budapest, Hungary where seventeen countries, including the United States and the Soviet Union, sent representatives.

There were also more than conferences occurring, as many countries began the work to reform their curriculum. In July 1960, representatives from Norway, Sweden, Denmark and Finland were appointed to a committee called The Scandinavian Committee for Modernizing School Mathematics. They produced thirteen books which were used in each of their countries schools from 1961-1963. In November 1961, the Minister of Education in Greece formed a committee to review and reform mathematics instruction. The committee decided to change the Greek curriculum, and in 1962 had produced an experimental textbook for use in their schools, along with intensive training of the teachers. In 1962, Italy joined the reform movement

appointing a committee to reform curriculum in their schools, as well as England and Belgium (Fehr's work as cited in Aichele & Reys, 1971). This is by no means the complete list of international curriculum reform conferences and efforts during this time period but shows that it was not just a Soviet/United States issue.

Summary

In Chapter II, I have discussed the differences between the Soviet secondary school math and science curriculum and the United States secondary school math and science curriculum. I have also shown how the United States Government got involved in the secondary schools' curriculum after the launch of Sputnik, as well as how the State of Oklahoma and other states in the United States, as well as other countries dealt with math and science curriculum preceding and following the launch of Sputnik. In Chapter III, I discussed the research methodology and the conceptual framework for the study. In Chapter IV I discussed my findings and implications, and in Chapter V I discussed the recommendations for future study and use.

Chapter III: Research Methodology

I believe that this topic was best suited for qualitative methods because it depended on two related methodologies, historical methodology and historical-comparative methodology. Historical methodology is the process by which historians gather evidence and formulate ideas about the past and the framework through which an account of the past is constructed. I have used historical documents, both primary sources and secondary sources, and historical interpretation to tell the story of the Frontiers of Science Foundation. This type of study comes from extant documents, such as correspondence and reports that are located in collections or archives, due to the date of this group's existence, thereby making the use of historical documents and historical interpretation a good fit. Government publications and notices were also used, as well as congressional testimony and other documents from congressional collections.

Historical-comparative methodology is "qualitative research in which one examines data on events and conditions in the historical past and/or in different societies" (Neuman, 2011, p. 52). Researchers should use this methodology when they want to explore why a particular social outcome occurred, when they want to compare outcomes across different societies and if they want to determine whether an old explanation of a social phenomenon is still valid, given what has happened historically since the explanation was developed (Historical-Comparative

Methodologies, n.d.). Types of data sources used in this methodology include research data collected by other social scientists, any records created at particular moments in time for reasons other than research that shed light on the topic, such as newspaper articles, letters, minutes of an organization's meetings, and any historical explanations written about the topic, usually by historians. It must be noted in this methodology, direct collection of data on the topic being studied is often impossible because the issue occurred in the past or the people involved are no longer living (Historical-Comparative Methodologies, n.d.).

Some of the data sources I have collected include annual reports of the Frontiers of Science Foundation (FOSF) which reflect highlights of the accomplishments each year, the archives of the group which have been donated to the Oklahoma Historical Society, and also pictures and stories from the archives of the *Daily Oklahoman* and the Carl Albert Congressional Studies Center at the University of Oklahoma, because all of these sources provide me with important records of the activities of the Frontiers Of Science Foundation. As Patton points out, "Historical information can shed important light on the social environment. The history of a program, community, or organization is an important part of the context for research" (Patton, 2002, p. 284). In order for us to know where we are going, we must first know where we have been. It is important for us to know what was happening in the 1950's in the area of curriculum reform, to know what we need to do to today. According to Dr. William F. Pinar (personal communication, March 9, 2012), studying Oklahoma's response to the Sputnik event would be important research for the field, and it would be important for Oklahoma.

The only way we can know what the schools were doing in the area of curriculum back then is to research and study what they were doing, what their curriculum was at the time, and then see what we need to do today.

Another reason this study of the Frontiers of Science Foundation called for an historical approach is that a big part of the story of this phenomenon is contextual, including the political and social climate was like when the group was formed and, in the time following the launch of Sputnik. Exploring the ideas and beliefs of the time depended on historical documents and data, along with popular press items that may give insight into the ideas and beliefs of the times.

It must be noted here, that since I used data and sources that are largely public information and government documents, I continued to strive to ensure that the data I used was accurate, and I also respected the differences in cultural issues as I compared two countries, the United States and the Soviet Union. As I have compared the two countries and cultures, I strove to remain true to my data and sources, and not getting lost in issues of power and privilege (Neuman, 2011).

Conceptual Framework for the Study: Systemic Change Process

I chose to use the Systemic Change Process theory for my conceptual framework for this study. This was proposed by Dr. Roberto Joseph of Hofstra University and Dr. Charles M. Reigeluth of Indiana University, providing a conceptual framework with six major aspects or elements to determine if the systemic change process has succeeded. I felt that this fit well with this research into whether the Frontiers of Science Foundation succeeded in making any difference in the curriculum in Oklahoma math and science from 1957-1964. The six elements

of the framework are: broad stakeholder ownership, a learning organization, understanding the systemic change process, evolving mindsets about education, develop a systems view and finally systems design (Joseph & Reigeluth, 2010).

First, the *broad stakeholder ownership* aspect fit because just as the authors listed in their article describing the need for all members of a community to buy into the public education system, so was there a need for the people of Oklahoma to buy into the need to improve the math and science curriculum in the K-12 schools and universities across the state. The authors made a strong point in their article that really parallels the situation following the launch of Sputnik in 1957, saying:

> The welfare of every stakeholder in a democracy depends to some extent on the welfare of all other members of that community, and therefore, they should be interested in ensuring that every child be provided with the best educational opportunities in order to continue the improvement of their community. (Joseph & Reigeluth, 2010, p. 100)

The fact that the people of not only Oklahoma but of the entire United States would have to buy into this change of math and science curriculum to strengthen America's position in the world was vital to its success.

Second, a *learning organization*, as defined by the authors, was "what an organization strives to become (product); it is an ideal vision of an organization" (Joseph & Reigeluth, 2010, p. 102). I again feel that this mirrors what the Frontiers of Science Foundation was attempting to do after the launch of Sputnik: create a vision of what they wanted the K-12 schools of

Oklahoma and the universities to look like according to a shared vision, complete with strategies to achieve that goal or vision.

Third, *understanding the systemic change process* as explained by the authors had two very significant factors that aligned it with my study of this group. In order to accomplish systemic change, it is necessary for the stakeholders to have a "deep understanding of the systemic change process…communication and dialogue are important parts of the systemic change process" (Joseph & Reigeluth, 2010, p. 105). They also said that, "it is important to understand that to invent a fundamentally different educational system will require helping people to evolve their mindsets about education" (Joseph & Reigeluth, 2010, p. 106). This research will identify the efforts made by the Frontiers of Science Foundation in those areas.

Fourth, *evolving mindsets* is about looking at the view the stakeholders have of education and the authors say that until their minds about what schools are supposed to be, we cannot achieve real change in our schools (Joseph & Reigeluth, 2010, p. 107). The research will show that the Frontiers of Science Foundation was trying to change people's minds about what our Math and Science programs would like in Oklahoma and show them what it could be.

Fifth, *developing a systems view*, as related by the authors, consists of several ideas, including observing and studying various systems looking for common goals, and then looking at ourselves and internalizing them and apply them to a real-life situation we can identify with (Joseph & Reigeluth, 2010, p. 109). This study showed how Oklahoma business and education leaders looked at the Soviet system of education, then tried to learn from it and adapt it to our needs and uses.

Finally, the sixth aspect was a *systems design*, meaning the stakeholders take the current obsolete system, talk with the goal of arriving at concensus about their ideal system and then go about planning the design (Joseph & Reigeluth, 2010, p. 112). Again, the current study shows how the Frontiers of Science Foundation looked at what the current math and science curriculum was in Oklahoma, had groups meet to determine and design the ideal curriculum, and then implemented curriculum change accordingly.

This conceptual framework provides a vehicle to look at the seven-year span after the launch of Sputnik and describe ways in which the Frontiers of Science Foundation achieved systemic change in Oklahoma math and science curriculum.

Summary

In this chapter I have discussed the use of historical methodology and historical-comparative methodology in this review, as well as the types of data sources I will use to accomplish the study. I then discussed the use of Systemic Change Process theory as the conceptual framework for this study and described the six elements used in this framework to determine if the study is successful, and how well it fits into my research. Chapter IV will show my findings from the work of the Frontiers of Science Foundation in Oklahoma from 1957 to 1964, while Chapter V will show my conclusions, implications and recommendations for future study and use.

Chapter IV

Findings

Introduction

The purpose of this study was to determine how the work of the Frontiers of Science Foundation affected math and science curricula in Oklahoma secondary schools between 1957 and 1964. During the research into this effort, I discovered that curriculum development for teacher training was also a vital part of their mission. The Foundation conducted training sessions for teachers as well as students, and that is reflected in the findings in Chapter IV. Because the period of study was over fifty years ago, I had to rely on historical and archival documents. I went to the Oklahoma Department of Libraries and researched in their archives, as well as the Oklahoma History Center, where I was able to access the files of the Frontiers of Science Foundation that were donated to them by the Greater Oklahoma City Chamber of Commerce. I spent considerable time in the libraries of Oklahoma State University and the University of Oklahoma, as well as the Carl Albert Center of Congressional Studies on the campus of the University of Oklahoma. I visited the Harry S. Truman Library in Independence, Missouri and the library of NASA in Washington, DC. I assembled the activities of the Foundation, and put them in chronological order for Chapter IV, and gathered details for setting the context in Chapter II.

In chapter III the Systemic Change Process theory was named as the conceptual framework for this study, and the findings shown here will illustrate why that framework was used.

The six elements of the framework are: broad stakeholder ownership, a learning organization, understanding the systemic change process, evolving mindsets about education, developing a systems view and systems design (Joseph & Reigeluth, 2010). While researching the work of the Frontiers of Science Foundation, I discovered that a yearbook was printed at the end of each of the calendar years during the existence of the group, and in those archives I found statements which showed these six elements in the work of the organization under study.

Related to element one, broad stakeholder ownership, the following statement was key: "This foundation is unique in that it was created and supported by a large number of the industrial, business and professional leaders of the state" (The Frontiers of Science Foundation of Oklahoma, 1956, p. 1). The work of the Frontiers of Science Foundation of Oklahoma was not conducted in a vacuum, but rather in collaboration with people from all over the state of Oklahoma who all had a stake in this effort.

Directly related to element two, a learning organization, Foundation literature included the following statement, "Distinguished scientists are now working with us within a framework which enables us to benefit from their great knowledge, experience and wisdom in planning the activities of the Foundation" (The Frontiers of Science Foundation of Oklahoma, 1956, p.4). The Foundation leaders understood that they needed to reach beyond the boundaries of the state

to find the most learned minds in the country to be available to make this effort successful, and they brought in some of the most gifted scientists in the world to be a part of this team.

Illustrating element three, understanding the systemic change process, was the following statement: "A major function of the Foundation will be the mobilization of science and the scientific method to assist in the solution of Oklahoma's problems and to promote Oklahoma's maximum growth and development" (The Frontiers of Science Foundation of Oklahoma, 1956, p. 3). The Foundation understood the need to make changes in the current educational process in order to make the gains that were needed to position Oklahoma as a leader in the areas of science and math, and this statement of their objectives showed that the group recognized the need for shared resolve to make that change.

For element four, evolving mindsets about education, the Foundation claimed, "Directed primarily at creating understanding and interest in science and technology among Oklahoma citizens, its leaders, and particularly its youth, the program has already attained wide recognition as one of the most promising ways of building support" (The Frontiers of Science Foundation of Oklahoma, 1956, p. 7). The Foundation knew that to change the way the kids of Oklahoma had been learning math and science, it would require them to change the minds of Oklahomans about that outdated method and understand the need to make significant changes in order to vault Oklahoma graduates to new heights in the area of math and science.

Related to element five, developing a systems view, the following statement was made, "In late September, the Foundation sponsored its Tenth Investigatory Tour...to become acquainted with the remarkable developments in Palo Alto, California…around the Stanford

Research Institute…which provide excellent prototypes for similar activities in Oklahoma" (The Frontiers of Science Foundation of Oklahoma, 1957, pp. 11-12). It was clear by their tours of other locations that the Foundation was intent on studying successful systems that could be utilized in Oklahoma and try to apply them to achieve common results.

And finally, in element six, systems design, the following statement was made: "The Foundation supported a special conference on mathematics education in Oklahoma…the conference laid the groundwork for educational work and improvement of the curriculum in mathematics in Oklahoma schools" (The Frontiers of Science Foundation of Oklahoma, 1957, p. 13). The Foundation was pressing forward to change the math and science curriculum in Oklahoma, and sponsored conferences such as this one to improve and bring up to date the mathematics curriculum in Oklahoma.

In comparing the United States and the Soviet Union and their school systems, one must remember that the objectives of the two countries were very different in the Cold War Era. In the Soviet Union, the focus was on the needs of the Soviet Union, not the individual. The State basically told the individuals what curricula they would study, and what they needed them to be career wise. While in the United States, the focus was on the individual and all curricula was shaped around the individual's needs and wants, and the individual decided what career they wanted to pursue (Ross, 1960).

There have been several mentions in this study of the "new math" of which I wish to give a brief explanation of what that entails. There was a feeling by some mathematicians that before 1958, most math books were written by the head of the school science department rather than a

mathematician and taught by teachers who were schooled in education schools and were not trained in math. When the School Mathematics Study Group was formed in 1958, headed by Yale math professor Edward Begle, they put together a writing committee of mathematicians who wrote new textbooks for math students grades 1-12. They also organized teaching institutes to help teachers understand and better teach the subject. (Whatever Happened to the New Math, n.d.) Before the SMSG writing committee began working on this new math, the traditional way to teach math was by memorizing facts and repeating them until the student learned the facts. Now they will learn and study the properties and principles of math, not memorize them. (Aichele & Reys, 1971)

Findings

In searching the many historical files and documents related to the Frontiers of Science Foundation, it became apparent that because of the sheer volume of their work, I could not list every single activity this group participated in for this study. After reviewing the conceptual framework used and thinking of the scope and unique impact this group provided, I decided to focus on their efforts related to curricula and training of teachers, and list those findings.

In early documents of the Frontiers of Science Foundation, the board of directors made it clear that one of the problems they wanted to solve was related to the math and science curriculum in the secondary schools of Oklahoma (The Frontiers of Science, 1956). My research into the work of this foundation through analyzing historical documents revealed the efforts made to reform the math and science curriculum of Oklahoma secondary schools between the years of 1957 and 1964.

Before the launch of Sputnik: Assessing the situation

In 1956, the Frontiers of Science Foundation in conjunction with the Oklahoma Curriculum Improvement Commission and the Science Research Associates of Chicago, brought the Iowa Tests of Educational Development to over 62,000 Oklahoma students from over 360 high schools (Memorandum on Frontiers of Science, 1956). The importance of bringing these tests to Oklahoma was to systematically show which areas of the secondary schools' curriculum in the areas of math and science is doing well and which areas need improvement through quantifiable, standardized measures of student achievement. Test results also predicted the students' ability to succeed in the fields of science and math (The Frontiers of Science Foundation, 1956). Lyle Spencer, President of Science Research Associates said "Oklahoma is the first state to have had the vision and the courage to objectively measure the curriculum of its high schools (The Frontiers of Science Foundation, 1956, p. 13). This statement, made by a nationally recognized leader in the field of science research, illustrated the significant efforts being made by the Frontiers of Science Foundation in Oklahoma to make a difference in science and math curriculum.

Broad look at Math Education

In February 1957, the Frontiers of Science Foundation, along with the Oklahoma Curriculum Improvement Commission and the Oklahoma State Department of Education, hosted a workshop on the University of Oklahoma campus in Norman to look at the state of mathematics education in Oklahoma. This meeting helped provide important information that led to the improvement of mathematics curriculum in Oklahoma secondary schools with over

seventy secondary school and college mathematics educators participating in the conference (The Frontiers of Science Foundation, 1957). Two very important observations were made by the State Board of Education about this workshop,

"One of the important recommendations of the conference was that a workshop on the improvement of the teaching of mathematics for Grades K-12 be held during the summer of 1957" (State Department of Education, 1964, preface) and "One of the principal outcomes was the development of the bulletin, Improvement of the teaching of mathematics, with which educators interested in mathematics are familiar" (State Department of Education, 1964, preface).

In summer 1957, the Frontiers of Science Foundation, along with the Oklahoma Curriculum Improvement Commission and the Oklahoma State Department of Education and Oklahoma State University, sponsored a workshop for teachers that lasted four weeks, looking closely at mathematics education in the secondary schools of Oklahoma. Unlike the previous workshop held in February, a document was produced out of this workshop, which contained a new mathematics curriculum outline to be used in the Oklahoma secondary schools. The title of the document was "Improvement of the Teaching of Mathematics," prepared by the workshop committee, and it was sent out to the school districts around the state of Oklahoma (The Frontiers of Science Foundation, 1957). Dr. Robert MacVicar, Vice-President for Academic Affairs and Dean of the Graduate College at Oklahoma State University and former chief executive officer of the Frontiers of Science Foundation, announced:

The introduction of new mathematical concepts into the curriculum

> of the elementary and secondary schools has lagged far behind the introduction of newer concepts in other areas…Curriculum reorganization, particularly when this involves the introduction of new and unfamiliar concepts, is a job which must be done on a very broad base if results are to be achieved with any degree of rapidity. (The Frontiers of Science Foundation, 1957, p. iv)

Participants in the workshop included educators from around the state, the University of Oklahoma, Oklahoma State University, and some mathematics specialists from Teachers College at Columbia University, Northwestern University, University of Illinois, and Iowa State Teachers College. The recommendation made by the workshop committee was that in order to improve the teaching of mathematics in elementary schools in Oklahoma, teachers needed to raise the level of understanding of the structure of the number system, advising, "The concepts of the number system contribute to understandings in all mathematics as well as to other areas of the curriculum, and that this developmental approach to the number system should be basic to other curriculum studies" (Oklahoma State Department of Education, 1957, p. 5). The committee recommended what concepts and topics needed to be taught at what grade level, in order for the students to fully comprehend them and be able to use them to understand mathematics more fully. The committee's published document included the curriculum to be taught and suggestions for teaching it (Oklahoma State Department of Education, 1957). The recommendations that came out of this workshop for curriculum were to provide new ways for the students in the elementary math program to be able to understand our whole number system, to better

understand the decimal system, to better understand the ideas of ratio and comparison, to better understand the concepts of geometry and to better understand formulas as they relate to the idea of the variable. The committee from the workshop recommended a sequential list of concepts that students would need to learn and understand in grades 1-8. It included concepts such as counting to 100 by ones in grade one to counting by 5's to 100 in grade two, the concept of understanding three-place numbers in grade 3 and understanding four-place numbers in grade 4, and introducing positive and negative numbers in grade 7, and identifying prime numbers in grade 8 (Oklahoma State Department of Education, 1957, pp. 3-7).

Broad look at Science Education

On June 17, 1957, The Frontiers of Science Foundation, along with the National Science Foundation and the American Institute of Physics, sponsored a symposium called "Oklahoma's New Frontiers: Science, industry and Education" held at the Municipal Auditorium in Oklahoma City. The meeting welcomed nearly 5,000 people (Patrick, 1957) to hear seven of the world's best scientists, who were invited to present their papers, led by Dr. Mervin J. Kelly, president of the Bell Telephone Laboratories. Dr. Lee DuBridge, President of the California Institute of Technology, was the first speaker, and he presented a paper and the keynote address dealing with the importance of the study of science (The Frontiers of Science Foundation Symposium, 1957). Referring to Oklahoma's Frontiers of Science Foundation, Dr. DuBridge commented:

> This Foundation is one of the most imaginatively conceived, most devotedly operated and potentially one of the most important organizations in this country…here in Oklahoma…a group of farsighted

people have become really convinced of where the new frontiers lie, and have decided to do something about it. (The Frontiers of Science Foundation Symposium, 1957, p. 11)

Sir Henry Thomas Tizard, former President of Magdalen College, Oxford University, told the attendees of his experiences in England as it related to science, education and industry. He commented that fifty years before this symposium, when he was finishing his degree at Oxford, he began talking to his tutor and asked where the best place would be to now go and do some graduate work in chemistry. He asked his tutor about going to study in the United States, but was told, "There was no school of chemistry in the United States good enough for me" (The Frontiers of Science Foundation Symposium, 1957, p. 43). He ended up studying in Germany and got his M.A. at Berlin University. Tizard went on to tell the gathering that after World War II, knowing England recognized the need to reform their educational system. He said their traditional education was liberal arts and did not focus on science enough, and that while that was sufficient in the nineteenth century, it now needed updating. Tizard said that since they had changed their focus to allow science to be a bigger part of students' educations, the number of students majoring in science had grown to be as big as non-science humanities majors, and the number of engineers and scientists in the colleges and universities in England had more than doubled (The Frontiers of Science Foundation Symposium, 1957).

In 1957, the Frontiers of Science Foundation gave over $20,000 in grants to school districts within a 90-mile radius of Oklahoma City to help them pay for televised instruction of mathematics and physics courses, which the Foundation had helped get started in 1956. They

used Educational Station KETA-TV, and the courses taught were physics, algebra and trigonometry. During the year of 1957, there were 200 students from 30 high schools taking those courses on television (The Frontiers of Science Foundation, 1957). The salient positive aspect of this program was that it allowed students in some of the smaller schools to be able to take some math and science courses that their own school couldn't offer due to lack of a qualified teacher and/or small student numbers. According to the Frontiers of Science Foundation, this program is the first of its kind to be used on a statewide basis in the United States (The Frontiers of Science Foundation, 1956, p. 14).

In October 1957, the Frontiers of Science Foundation, along with the University of Oklahoma and Oklahoma State University, sponsored a groundbreaking conference called "The Conference on Science Fairs" in Stillwater on the Oklahoma State University campus. The conference focus was improvement of science education through science fairs in the communities around the state of Oklahoma. There were over one hundred seventy educators in attendance, including teachers, professors, and administrators from over eighty Oklahoma secondary schools and from sixteen Oklahoma colleges and universities. There were also some powerful participants from outside the state of Oklahoma, including the Chairman of the President's Committee on Scientists and Engineers, the State Director for Science Fairs in Louisiana, and representatives from the U.S. Office of Education in Washington, DC, the University of Kansas, University of Texas and Oregon State University. Response to the conference was overwhelmingly positive, and the Foundation expected to see an increase in community participation in local science fairs throughout Oklahoma (The Frontiers of Science Foundation, 1957). In fact, two teachers from

Ardmore said that science fairs make a difference and that "enrollment in physics jumped from sixteen to forty after Ardmore's first community science fair" (Teachers Boost Science Fairs, 1957, p. 7). Dr. Howard Bevis, President Emeritus of The Ohio State University, told the gathering how important science fairs were to getting students involved in science. He said that communities and local areas can build around science fairs and that will mean that "better science programs can form" (U.S. Training Lags, 1957, p. 17).

Post-Sputnik: Taking action

1958: Beginning wide-spread professional development.

In March 1958, The Frontiers of Science Foundation, in conjunction with the Oklahoma Curriculum Improvement Commission and the Oklahoma Department of Education, sponsored a conference entitled "Conference on the Improvement of Mathematics Teaching" in Oklahoma City dedicated to improving mathematics teaching in secondary schools around the State of Oklahoma (Zant, 1959). The Frontiers of Science Foundation provided a consultant from Columbia University, who advocated using intensive summer workshops for teachers to help improve the teaching of mathematics. Thirty-five people worked collaboratively to make an improvement in the mathematics curriculum used in the high schools around Oklahoma, led by Dr. Howard Fehr of Columbia University. They spent four days working on ways to improve the mathematics curriculum in secondary schools in Oklahoma, and the results of their efforts to come up with new ideas for activities to help make the mathematics curriculum in Oklahoma high schools better were published and distributed to secondary schools and colleges and universities

around the state of Oklahoma (The Frontiers of Science Foundation, 1958). A summary of the accomplishments of the conference reported:

> Areas which often came under discussion…were the concepts of modern mathematics applicable to the school curriculum and to the training of teachers, the sort of revised or reorganized program needed for mathematics teaching, methods of…how this material could be presented in the schools, the production of the actual teaching material, the training of teachers in mathematics. (State Department of Education, 1958, p. 13)

The conference made a list of specific recommendations on how to develop a program that would help to improve the teaching of mathematics in Oklahoma. Included in the list were recommendations to establish a position called a State Supervisor for Mathematics Education to work under the Oklahoma Curriculum Improvement Commission, and the Commission's appointment of a twenty-person board of university mathematicians and secondary school mathematics teachers called the State Committee for the Improvement of Mathematics Instruction with the State Supervisor for Mathematics Education to act as Chairman. The conference added that this group should be supported by an adequate budget and their role should be to write teaching materials and improve mathematics teaching in Oklahoma (State Department of Education, 1958).

On May 1, 1958, The Frontiers of Science Foundation, in conjunction with the Oklahoma Department of Education, the Oklahoma City Public Schools, and the Oklahoma City Chamber of Commerce, sponsored a conference in Oklahoma City called "Space Age Conference." It was

an all-day conference aimed at students in secondary schools in Oklahoma, and the event attracted more than 7,000 students from 234 schools throughout the state of Oklahoma. The conference was also broadcast by KETA-TV, the state's Public Broadcasting affiliate, to over 250,000 other students in their classrooms. The goal of the conference was to help interpret the new technology and ideas of the Space Age for students in secondary schools (The Frontiers of Science Foundation, 1958). There was a very special presentation made by Dorothy Simon, technical assistant to the president of AVCO Manufacturing Corporation on problems with fuels and metals. As the chair of the conference proclaimed to the students in attendance, "I don't think there's a young lady in here who now doubts that there is a future for her in science" (Space Generation, 1958, p. 2). This showed that the Frontiers of Science Foundation was light years ahead of the STEM programs efforts of today to attract women into the fields of science and math. However, there were no indications as to whether or not this extended beyond the Frontiers of Science Foundation or if it was merely espoused values of the group itself.

Rounding out the year of 1958, on May 2-3, 1958, The Frontiers of Science Foundation and the Oklahoma Curriculum Improvement Commission sponsored a two-day conference for science educators on the campus of the University of Oklahoma in Norman. Two hundred people attended the conference and their focus was to develop new approaches to teach science in Oklahoma. Consultants from Columbia University and Michigan State University were brought in by the Frontiers of Science Foundation to lead the discussions, and the results and recommendations of the conference were copied and distributed by the Oklahoma Curriculum Improvement Commission (The Frontiers of Science Foundation, 1958).

1959-1961: Impacting classrooms

Other activities by the Frontiers of Science Foundation continued in the 1958-59 school year, as the Foundation, through a grant, helped fund a weekly one-hour program on the Oklahoma Educational Television Authority (OETA) aimed at helping secondary school mathematics teachers in modern math (The Frontiers of Science Foundation, 1958). The efforts continued into the next year, as on April 2, 1960, the Frontiers of Science Foundation, along with the State Mathematics Committee sponsored A Symposium on the Impact of Modern Developments in Mathematics on Oklahoma Schools, which was attended by 125 mathematics teachers and school administrators who were admonished to go back to their schools and adjust their curriculum to the new modern math (The Improvement of Mathematics, 1960).

By the time 1960 had arrived, the work of the Foundation had grown far beyond the central Oklahoma area. There were now two regional chapters of the Frontiers of Science Foundation located in southeastern Oklahoma and in southwestern Oklahoma. These two chapters served a total of thirty of southern Oklahoma's counties, and had their own officers and board of directors (The Frontiers of Science, 1960).

Later that year in December 1960, a publication was released by the Oklahoma State Department of Education and the Oklahoma Curriculum Improvement Commission, called *The improvement of mathematics instruction in Oklahoma grades K-12*. This publication gave the tentative recommendations of the State Mathematics Committee and was inspired by the mathematics workshop at Oklahoma State University in 1957 sponsored by the Frontiers of Science Foundation. The State Mathematics Committee discussed four groups that had been

working on revising the secondary school curriculum in mathematics around the country. First, they discussed The University of Illinois Committee on School Mathematics which had started in 1952 and which since 1956 had been supported by grants from the Carnegie Corporation. They had only printed books for 9th and 10th grades thus far. Next, the report discussed The Ball State Experimental Program in Geometry and Algebra, which was in its 5th year, and had produced algebra and geometry textbooks using modern math concepts. They then discussed the work of The Commission on Mathematics of the College Entrance Examination Board, which had gotten started in 1955 and which had issued a report on a Program for College Preparatory Mathematics in 1959. They had suggested a complete high school mathematics program for grades 8-12 and had even recommended how to help prepare the teachers to use this new curriculum in the classroom. The final group they discussed in their recommendations was The School Mathematics Study Group which had started in 1958. Because this group had been funded by the National Science Foundation, they had been able to accomplish much work, and had written a complete set of modern math textbooks which were used in an experimental pilot-program format in about 300 schools during the 1959-60 school year. The Commission was especially impressed by the work of this group, whom they considered to be highly qualified. A group of 20 worked on this curriculum for 4th – 6th grades during the summer of 1960 and implemented it in pilot schools in Oklahoma during the 1960-61 school year. (The Improvement of Mathematics Instruction, 1960).

In January 1961, a symposium named "Tomorrow's Teaching" was held in Oklahoma City, Oklahoma sponsored by the Frontiers of Science Foundation. Over one thousand educators

from eighty-five cities and ten states attended the conference, which had as its focus discussion about the newest development in the teaching field – programmed learning. Programmed learning was based on a theory that students learned best by moving at their own pace, taking small steps and being given immediate reinforcement as they grasped a concept (Encyclopedia Britannica, n.d.). Papers were also presented on the subject by such academics as the Dean of the Graduate School at the University of Chicago, the Director of the Center for Programmed Instruction at The Collegiate School, New York City, the Dean of the College of Education at the University of Oklahoma, and professors from the University of Pennsylvania, Michigan State University, University of Southern California, University of Pennsylvania, University of Illinois, and the University of California at Los Angeles. (The Frontiers of Science Foundation, 1961).

In April 1961, seven thousand Oklahoma high school students attended a symposium called "Stars and Galaxies" sponsored by the Frontiers of Science Foundation. The focus of this meeting was research in today's astronomy, and nine of America's leading astronomers led the meetings. Presenters included astronomers from the Radio Astronomy Institute, United States Naval Observatories, the National Radio Astronomy Observatory, UCLA, the University of Chicago, Harvard University, and Indiana University (The Frontiers of Science Foundation, 1961).

Looking back, 1954-1961: Improving coursework

By the end of the 1960-1961 school year, major changes in Oklahoma secondary schools were taking place. To help put things in perspective, in 1954-55 there were 175,774 students in grades 7-12 in Oklahoma, (State Department of Education 1956), and by the 1960-61 school

year, enrollment for grades 7-12 in Oklahoma had climbed to 235,886 (State Department of Education, 1962). There were 1,802 school districts in Oklahoma in the 1954-55 school year, compared to 1,274 school districts in Oklahoma in 1960-61 (State Department of Education, 1962). During the 1954-55 school year, there were 20, 512 teachers in Oklahoma (State Department of Education, 1956), compared to 22,466 teachers in 1960-61 (State Department of Education, 1962).

By the end of the 1960-61 school year, major changes were also occurring in the areas of secondary schools' math and science classes. During that 1954-55 school year, 6,874 students or 3.9% of the total secondary student enrollment were taking algebra II in Oklahoma. In the 1960-61 school year, 14,109 students or 5.98% of the total secondary school enrollment were enrolled in algebra II, more than doubling the number of students and almost doubling the percentage of students taking algebra II in just five years. Some even bigger increases were shown in the more specialized math classes, with 1954-55 showing only 1,498 students, or less than 1% of the total secondary school population enrolled in solid geometry, while by the end of the 1960-61 school year 4,250 Oklahoma secondary school students, or 1.8% of total secondary school population were enrolled in solid geometry, nearly tripling the number enrolled, and doubling the percentage in just five years. Two areas showed a remarkable increase in enrollment during this time: in 1954-55, there were no students enrolled in advanced mathematics, but in 1960-61, there were 373 students enrolled in advanced mathematics. In 1954-55, there were no students enrolled in statistical analysis, but in 1960-61 there were 291 students enrolled in that course. The overall enrollment in math classes of all kinds was 10,175 in the 1954-55 school year, or

5.8% of the secondary school population, compared to 24,157 in the 1960-61 school year, or 10.2% of the secondary school population. That is an amazing increase of 13,982 students, almost two and a half times the number, and almost double the percentage of students in just five years (The Frontiers of Science Foundation, 1961).

In science, similar results were seen. During the 1954-55 school year, 5,370 students, or 3.1% of the secondary school population were taking chemistry in Oklahoma high schools. By the 1960-61 school year, 10,965 students, or 4.65% of the total secondary school population were enrolled in chemistry classes in Oklahoma, more than doubling the enrollment figures, and having more than 1.5% increase in total student enrollment in chemistry in just five years. But it was in some of the more specialized areas of science that even more striking change was seen. In 1954-55, only 9 students were enrolled in geology classes in Oklahoma. But in 1960-61 there were 407 students enrolled in geology. There were zero students enrolled in earth science in 1954-55, compared to 186 in 1960-61. There were zero students taking physical science in 1954-55, compared to 1,843 in 1960-61. The overall enrollment in all science classes in Oklahoma high schools in 1954-55 was 8,011, or 4.6% of the total secondary school population. The overall enrollment in all science classes in Oklahoma high schools in 1960-61 was 20,720, or 8.8% of the total secondary school population, more than a two and a half times increase in numbers, and almost doubling the percentage of students enrolled in just five years (The Frontiers of Science Foundation, 1961).

1962-1964: Incorporating more stakeholders

In December 1961, six hundred people from fifty Oklahoma communities attended a symposium called "Science and Mathematics: Countdown for Elementary Education: Phase Two." The focus of this conference was to further help improve the teaching of math and science in Oklahoma's elementary schools. Guest speakers included the Director of the School Mathematics Study Group at Yale University, and professors from the University of Florida and the University of Tennessee (The Frontiers of Science Foundation, 1961).

In April 1962, five thousand secondary school students from around the state of Oklahoma attended a symposium sponsored by the Frontiers of Science Foundation called "Molecular Architecture." The Chemical Education Division of the American Chemical Society helped plan the symposium, and the list of speakers included representatives from the American Chemical Society, Vice-President for Research, Union Carbide Corporation in New York City, and several universities including the University of Minnesota, Northwestern University, University of California, Berkeley, and the University of Iowa (The Frontiers of Science Foundation, 1962).

In May 1962, the Frontiers of Science Foundation along with Oklahoma State University sponsored the first ever conference for the group known as JETS. JETS is a national organization, which stands for Junior Engineering Technical Society, and it had been growing in Oklahoma. Many high schools around the state had formed JETS clubs to encourage the desire to pursue a career in engineering, and 75 high school students representing 15 JETS clubs in Oklahoma attended the May symposium (The Frontiers of Science Foundation, 1962).

As noted earlier, every year since 1958 the Frontiers of Science Foundation had sponsored the development of curriculum support material for high school math and science teachers to help them in their classrooms. In 1962, the Frontiers of Science continued that valuable program and mailed out over 15,000 pieces of information to high school math and science teachers around the state of Oklahoma. These mailings included items such as notices of outstanding television programs about science for both the teachers and the students to watch, materials to help counsel outstanding and prospective scientists, reprints of major speeches and addresses made by respected individuals in the fields of science, math and government and reports from professional science and math societies and associations dealing with issues in math and science (The Frontiers of Science Foundation, 1962).

With the continued work of the Frontiers of Science Foundation came continued growth, and by 1962 the list of regional chapters had risen to 5, the Eastern Oklahoma Chapter in Wilburton, the Northern Oklahoma Chapter in Tonkawa, the South Central Chapter in Lawton, the Southeastern Oklahoma Chapter in Durant and the Southwestern Oklahoma Chapter in Hobart. Each of these chapters had its own officers, and their activities included "science fairs, addresses by outstanding scientists of the region, in-service training for teachers, programs for gifted youth and symposia on science-based activities of special importance to the region" (The Frontiers of Science Foundation, 1962, p. 5).

On April 5, 1963, the Frontiers of Science Foundation sponsored a symposium called "Engineering 1970: Building our Nation's Future" which attracted several thousand secondary school students from around the state. The focus of the symposium was to make sure the students

understood the opportunities that exist for them in engineering. Attendees heard from several nationally well-known engineers, including several women, among them Maryly Park, Rocketdyne Division, North American Aviation and Dr. Beatrice Hicks, President of Newark Controls Company. It was noteworthy that these women, serving as living examples, made a big point of letting the females in attendance know of the opportunities that exist particularly for young women in the field of engineering (The Frontiers of Science Foundation 1963).

Another impressive way in which the Frontiers of Science has impacted the curricula and teaching of math and science in Oklahoma is evident in the fact that by 1964, nearly twice as many teachers from Oklahoma were taking part in institutes sponsored by the National Science Foundation than the national average among all states, thus changing the way teachers applied the math and science they were teaching to their students in Oklahoma (Webb, 1964).

One of the concerns of the members of the Frontiers of Science Foundation when the group formed was the development of more math and science teachers in Oklahoma, and ways to help them in their classrooms. In 1956, the Foundation played the key role in securing a grant for more than a quarter of a million dollars from the National Science Foundation to what was then Oklahoma A&M College for a year-long program aimed at training high school teachers. They also distributed printed science material to help teachers in their classes (The Frontiers of Science, 1956). As mentioned earlier, the Foundation conducted 2 workshops on mathematics in 1957 to help teachers with new curriculum and teaching methods, as well as a conference looking at the use of science fairs in which over 170 teachers from around the state participated (The Frontiers of Science, 1957). In 1958, the Foundation co-sponsored a conference for

improving the teaching of mathematics and again, as had become an annual occurrence, mailed curriculum to teachers around the state to help them in the classroom (The Frontiers of Science, 1958). This coincided with an upward trend in the upgrading of teacher standards in Oklahoma. In 1956, there were 20,200 teachers in Oklahoma holding a degree, by 1964 that number had jumped to 23,537 or 99.67% of all teachers in Oklahoma (State Board, 1964).

By 1964, the impact of the work done by the Frontiers of Science Foundation was truly being felt in secondary schools throughout the State of Oklahoma. In what was a yearly staple of the Foundation, mailings were done to thousands of math and science teachers around the state with packages of material to supplement their curricula and to support their teaching. By 1964 over 80,000 packages had been mailed out by the Frontiers of Science Foundation (Webb, 1964).

Each year the Frontiers of Science Foundation sponsored symposia and programs with leading scientists and engineers from around the world, and since its inception had enabled over 40,000 high school students from all over the state of Oklahoma to not only hear these experts, but also see them and in many cases, talk to them and experience something first hand that most never dreamed of doing (Webb, 1964).

Summary

In chapter four, I have shown the results of my research into what were the ways the Frontiers of Science Foundation impacted math and science curriculum in Oklahoma from 1957 – 1964. By researching the records of the Frontiers of Science Foundation, which were donated to the Oklahoma History Center by the Greater Oklahoma City Chamber of Commerce, records of Sen. Robert S. Kerr, which were donated to the Carl Albert Center for Congressional Studies

housed at the University of Oklahoma, and many other historical documents located in the libraries of the University of Oklahoma, and Oklahoma State University, and the Truman Library, as well as the archives of the Daily Oklahoman newspaper, I was able to piece together a chronological list of what the Foundation did in those years to address the problems faced by Oklahoma secondary schools from 1957-1964 related to math and science curriculum and teaching. In chapter five, I will tell my conclusions, implications and recommendations for the future based on these studies.

Chapter V

Conclusions, Implications and Recommendations

Introduction

The research question for this study was: How did the work of the Frontiers of Science Foundation affect math and science curricula in Oklahoma secondary schools between 1957 and 1964? The purpose of this study was to look at the efforts of the group known as the Frontiers of Science Foundation and see if they accomplished their goals as related to curriculum in Oklahoma during the seven years after the launch of Sputnik, with the limitations of how long ago the events studied occurred. Most of the activities of the Frontiers of Science Foundation that is being researched here occurred in the 1950's and 1960's, before digital recording was common place. Most of the people involved with the Frontiers of Science Foundation during the period this research documents, are either no longer living or are of such an advanced age that they cannot remember things that happened fifty to sixty years ago, making interviews not a possibility. I will start by drawing conclusions, stating their implications, and finally making recommendations for future study and action.

Conclusions

Teacher shortages in Oklahoma existed in the 1950's and they are once again a problem in 2018. After World War II and into the 1950's, there was a severe teacher shortage which

between 1954 and 1956 reached record levels (State Board, 1956), prompting many to be concerned with the quality of teaching available (Gelbrich,1999). Looking at this issue in Oklahoma today, it was noted that "In the last three years, Oklahoma has approved more than 2,600 emergency teaching certificates, leaving tens of thousands of Oklahoma students with underprepared, underqualified teachers" (Oklahoma State School Boards Association, n.d.) As Bestor (1953/2016) pointed out, the citizens along with the educators should push for strong and certain minimum standards in teacher certification and training, to make sure that our teachers are well-prepared to teach their subjects and to be qualified to pass on their subject to the students. This reflects the view that everyone should be concerned with the quality of the teachers in the classrooms because they are the ones preparing the leaders of tomorrow to take their places in leading Oklahoma and the United States into the future. Sir Ken Robinson (2013) drove this point home by saying, "You cannot improve education if you do not pick great people to teach, and if you do not keep giving them constant support and professional development. Investing in professional development is not a cost, it is an investment" (12:30 mark). If efforts to prepare the teachers for their work are not being done, everyone suffers, whether in 1955 or 2018.

There may have been different reasons for that teacher shortage in the 1950's, but the problem is the same. After World War II, there was a shortage of teachers to handle the Baby Boomer generation, generally regarded as those people born from 1946-1964 (Pew Research Center, 2016). In 2017, Oklahoma had the lowest average teacher salaries in our seven-state region at $45,276 compared to the regional average of $48,190. With that low salary teachers

have been leaving the state of Oklahoma in large numbers, creating huge teacher shortages (Oklahoma State School Boards Association, n.d.). Considering the problem of low teacher pay in Oklahoma brings to mind what Berliner and Biddle (1995) wrote, "If we pay teachers substandard wages and treat them like recalcitrant incompetents, won't they eventually come to think of themselves in this light?" (p. 349). If Oklahoma chooses not to pay its teachers a salary that is comparable to salaries in other states, not only will they suffer financially, but the teachers of Oklahoma will feel like they are inferior and not appreciated in Oklahoma and will look elsewhere to find a place where they are not only well paid but appreciated.

The concern of not training and educating enough science and math graduates in this country was a major concern at the time of the launch of Sputnik. In the statewide newspaper the *Daily Oklahoman*, in a story about the United States needing to train more scientists and engineers, United States Senator Robert S. Kerr (1955) said "more than 50,000 scientists and engineers are being turned out every year in Russia…in contrast to the 20,000 graduated annually by American colleges" (More Scientific Training Urged, p. 2). Fast forward to today, and we find the same concern being voiced again. Lt. General Lee K. Levy II, commander of Tinker Air Force Base Sustainment Center in Oklahoma City, told the Oklahoma State Regents for Higher Education, "We are being eclipsed by the Russians and the Chinese…The U.S. needs more people educated in science, technology engineering and mathematics (STEM)…The inability of the state of Oklahoma to produce enough STEM graduates causes me great concern" (McNutt, p. 3a). This shows the same concern that was expressed during the 1950's that we are not turning out enough graduates in the fields of engineering and science.

During the 1950's and 1960's, it was a private group, not a public entity, that made a difference and made things happen. Every annual report of the Frontiers of Science Foundation since its inception listed its leadership, its board of directors and its foundation members, all of which were largely made up of private sector individuals. There were certainly government officials from every level involved in the organization, but it was privately funded, and therefore free of government-related limitations. A financial report was included in each issue, with reported receipts and disbursements, clearly showing exclusively private funding through membership dues, events, dinners and grants.

The members of the Foundation were powerful people, with a combination of political strength, civic strength, and economic strength. The officers of the foundation were always prominent and powerful civic leaders such as E.K.Gaylord, President of the Oklahoma Publishing Company, Stanley Draper, Managing Director of the Oklahoma City Chamber of Commerce and Dean A. McGee, President of Kerr McGee Oil Industries, or powerful political figures like U.S. Senator Robert S. Kerr and James Webb, former Undersecretary of State of the United States who went on to become the director of NASA (Webb, 1964). The list of board members and general members of the foundation read like a who's who of Oklahoma City, and included lawyers, doctors, academics, corporate CEO's, political leaders both past and present, with hundreds of names listed. These members were able to enact curriculum change quickly, because of their standing in the community and state. They had the money or the ability to raise the money they needed to do the things they saw as necessary to carry out the Foundation's work. They also had the ability and connections necessary to attract national and international

leaders from the fields of science, math, academia and engineering to come to Oklahoma and speak to our students. The members of the Frontiers of Science Foundation were also able to sponsor travel for students and teachers to other states to observe successful ventures identified by the Foundation, further helping set the stage for advancement of math and science in the secondary schools in Oklahoma.

The work of the Frontiers of Science Foundation in the areas of working with the teachers to improve teaching methods and curricula was a big contributor to the staggering statistics of change in just the eight years noted in this study, but the historical record shows that the work in state universities by the Frontiers of Science Foundation also contributed to the success achieved in Oklahoma's secondary schools. Since 1958, the Foundation had given research grants to the colleges and universities in Oklahoma to both encourage research in the areas of science and math, and to provide opportunities for undergraduate and graduate students to work in these research areas, thus encouraging the teaching of subjects in math and science.

The Frontiers of Science Foundation saw the problem facing Oklahoma, identified it, and took a rapid, multi-pronged approach to address it: they increased the offerings of math and science to Oklahoma students, they worked to recruit quality, well-trained teachers for those math and science classes, they worked to provide professional development to enhance pedagogy, sponsored practical research and the sharing of ideas to strengthen content offerings, and they got the students engaged with math and science by exposing them to both nationally- and internationally-renowned experts in conference settings. They were also somewhat ahead of

the times, by bringing attention to recruiting females to the fields of math and science, both as students and teachers.

The Frontiers of Science Foundation brought both national and international attention of both political and educational leaders regarding the advancements made by Oklahoma in math and science curriculum. As one article in the *Fort Worth Star Telegram* reported upon learning of President Dwight D. Eisenhower traveling to Oklahoma City to make an address to the nation in 1957, "By seeing and seizing opportunity, Oklahoma has fallen into step with the march of science. The President scarcely could have chosen a more appropriate setting for a speech dealing with national security and its dependence upon advances in scientific knowledge" (Appropriate Setting, 1957). The speed of this curricula change fostered by the Frontiers of Science Foundation was largely due to timing. The Frontiers of Science Foundation had already been formed before the launch of Sputnik, and because they were a private entity and made up of business, political and civic leaders rather than governmental or university bureaucrats, they were better able to act swiftly and decisively.

Implications

When the Frontiers of Science Foundation was formed, there was a shortage of qualified teachers teaching math and science in Oklahoma secondary schools, very few students taking math and science courses in Oklahoma secondary schools, and the widely-held perception, whether valid or not, that the secondary school math and science curriculum in Oklahoma secondary schools was "soft" not preparing Oklahoma's youth for a future that was unquestionably trending towards scientific endeavors.

An examination of the differences in Oklahoma from 1954 to 1964 shows a difference in all those categories. As shown, the percentage of teachers in Oklahoma holding university degrees went up from 96.3% in 1954 to 99.7% in 1964. In fact, Senator Robert S. Kerr reported in May 1961 that according to the National Science Foundation, the number of Oklahoma teachers participating in the training programs sponsored by the National Science Foundation was 88% above the national average.

In the 1954-55 school year, only 511 schools in Oklahoma offered math courses, and only 313 offered science courses. By the 1960-61 school year, 1,034 schools in Oklahoma offered math courses and 781 schools were offering science classes. In the 1954-55 school year, there were 10,175 students enrolled in math classes in Oklahoma schools, and 8,011 students were enrolled in science classes. By the 1960-61 school year, there were 24,157 students taking math classes in Oklahoma and 18,020 students enrolled in science classes in Oklahoma (The Frontiers of Science, 1961).

In May 1960, Dr. Robert Wiesner, Executive Secretary of the Committee on the Undergraduate Program in Mathematics of the Mathematical Association of America, said that Oklahoma was "leading the nation in its adoption of the newly revised curriculum in secondary school mathematics" (The Frontiers of Science, 1961, p. 8). Remarkably, this nationally-renowned mathematician averred that Oklahoma was looked upon as the leader in reforming mathematics curriculum in the United States.

The National Aeronautics and Space Administration (NASA) was born on October 1, 1958 and has been involved in highly technical and scientific ventures dealing in space travel,

robotics, aeronautics and space science (NASA History Overview, n.d.). Twenty-two graduates from Southwestern Oklahoma State University in Weatherford, Oklahoma have gone to work at NASA and five graduates have gone to work for NASA contractors. All graduated from the Physics Department at SOSU from 1961-1967 (Hill, 2013). Between 1961 and 1966, nine graduates of Central State College, now the University of Central Oklahoma, went to work at NASA, while seven more later graduates also went to work for either NASA or one of its contractors (Moore, 2011).

All these individuals were students in Oklahoma secondary schools or colleges during the time of the active work of the Frontiers of Science Foundation, and all would have benefited from the work of the Foundation in the areas of math and science.

Recommendations

Future study

Because the Frontiers of Science Foundation was formed over sixty years ago and is no longer in existence, several questions still need to be answered. Would the strategies used by the Foundation in the 1950's and 1960's be effective today? In today's era of educators being wary of business leaders trying to control education, would the Frontiers of Science approach with its members being those business and civic leaders that many do not trust, be effective? How would the internet and social media impact efforts such as these? And what about the long-term impact of the changes implemented by private groups like this? These questions should be looked at in the future and studied for practicality.

Future action

The Oklahoma Legislature has cut funding to K-12 education funding per student, with inflation adjusted, by more than 28% from FY 2008 through FY2017, by far, the greatest such cuts of any state in the country. Because of the dire financial situation that exists in Oklahoma education due to this steep decrease in state funding, Oklahoma K-12 schools employ 4,900 fewer people in 2017 than they did in 2009, which means there is once again a shortage of qualified teachers leading to more underqualified teachers receiving teaching certificates. Only about 3.6% of the K-12 schools' budget goes toward funding for curriculum development and staff training. Because of the severe financial crisis, about 20% of school districts in Oklahoma only have classes four days a week (Perry, 2017). The idea of four-day school weeks saving money would come from savings on transportation of students, utilities and lunches. This model of education in Oklahoma cannot sustain itself. And according to the Governor's Office, the projection for FY 2018 appropriations is 12.2% less than in 2017 (Office of the Governor, 2017), so the state funding picture for the near future does not look promising.

Based on the findings from this study along with the dismal financial picture for education in the State of Oklahoma, a private sector group that resembles the Frontiers of Science Foundation should be formed today to advocate for secondary schools in Oklahoma the way they did when they began in 1955. The Frontiers of Science Foundation was born out of the Greater Oklahoma City Chamber of Commerce, a private sector business group in Oklahoma City. The leaders of the organization were all civic and professional leaders who agreed they had to act to make a difference. They knew that it would take money to make things happen, and

they were willing to give of their own money and go out and raise money to make a difference. For example, from October 1, 1960, to September 30, 1961, the Frontiers of Science Foundation raised $78,758.58 from membership dues to be a part of the Foundation. Through symposiums, lectures, luncheons and grants, another $17,259.99 was raised for a total revenue for the year of $96,018.57 to the Foundation. That huge amount of money for the time was then spent on science symposiums, teacher mailings, 7th grade testing programs, teacher tours, Sir Alexander Fleming Scholarships, research grants to five Oklahoma colleges and much more (The Frontiers of Science, 1961, p. 11).

America seems to react to threat, such as the national sense of alarm exhibited after the launch of Sputnik. The numbers of students in Oklahoma attracted to math and science after Sputnik and the work of the Frontiers of Science Foundation were impressive, but we have seen those numbers dwindle since the Foundation dissolved in 2005. The enthusiasm was like the interest that the space program brought to the students of America. For example, during the years of the manned space program, the number of graduates in the various STEM subjects in every level, from high school grads to Ph. D., more than doubled [see Appendix B]. The space program clearly inspired students, but when NASA ended the Apollo program, the number of STEM graduates declined (Dove-Jay, 2014). America needs inspiration again.

An encouraging bit of news is now coming out of Oklahoma City. In February 2018, a group known as the Oklahoma Center for the Advancement of Science and Technology (OCAST), with a grant from General Electric, sponsored the 2018 Oklahoma Engineering Foundation Engineering Fair, held at the Science Museum Oklahoma in Oklahoma City.

Approximately 300 middle school and high school students from around the state of Oklahoma attended, with the aim of the fair to "promote interest in STEM-science, technology, engineering and math to its participants." (Stafford, 2018, p. 4C) It is encouraging to see the idea of science fairs being used once again to stimulate interest in math and science after its successful run during the years of the Frontiers of Science Foundation. This is a group doing what is an example of what is needed today to once again, stimulate math and science interest in Oklahoma's schools. OCAST is a state agency, that was created in 1987 to help Oklahoma through technology-based businesses to diversify the economy and expand the business climate in the state (Oklahoma Center for the Advancement, n.d.). It is encouraging that much like the Oklahoma City Chamber of Commerce, through a newly-formed committed the FOSF, was looking for ways to diversify and expand the economy of Oklahoma in 1955 by working with the schools on science and math, the State of Oklahoma, through an agency (OCAST), is looking for ways to diversify and expand the business climate in Oklahoma by working with the school students in Oklahoma in 2018. Economic development seems to use education as a tool to help create a positive business climate, as both groups suggest.

My recommendation would be to approach chambers of commerce and other civic organizations around the state and show them about the Frontiers of Science, how they started and the impact that they had. If you visit with chambers of commerce today, one thing that they all seem to share is a stated concern for public education, and it is usually on their legislative agenda to take or support related action. The Greater Oklahoma City Chamber of Commerce says that education is a top priority and they specifically address 4 issues in their 2018 agenda:

fundamental education reform, support for early childhood and pre-K, increased curriculum standards and graduation requirements, and development of charter schools (Greater Oklahoma City Chamber, n.d.). The Norman, Oklahoma Chamber of Commerce has a program called Partners in Education, through which they encourage businesses and groups in Norman to interact with and get involved with the schools to "provide programs, materials and personnel that add to the school curriculum and enhance student learning" (Norman Chamber, n.d.). The Stillwater, Oklahoma Chamber of Commerce lists education as one of its top priorities, and specifically mentions "Support[ing] a restructuring of the salary schedule to incentivize Oklahoma's teachers to remain in the profession…and fill high-need areas like STEM teaching positions" (Stillwater Chamber, n.d.).

These examples show that a common thread among business groups in the state of Oklahoma to support improvement of education, to raise teachers' salaries, to reform curriculum, and to help recruit and keep specialized teachers in areas like STEM. This shared stance is reminiscent of the beginnings of the Frontiers of Science Foundation, and there seems to be an interest in forming private-sector groups to deal with issues of importance to education.

Regardless of who makes up the groups looking at supporting this effort, classroom teachers should play a key role in the work of the groups. The teachers are on the front lines, and their voice needs to be heard. They could act as the facilitators of collaboration between the business, civic and educational interests. Teachers are vital to the effort.

One group that resembles the Frontiers of Science in many ways has formed to support Higher Education in Oklahoma called "Oklahoma Tomorrow". Talking with their CEO, Devery

Youngblood (personal communication, January 30, 2018), I found that the group formed in 2016 in response to the massive cuts to higher education of 16%, while all the other areas of state funding received just a 10% cut. The group was started by four prominent businessmen from around the state of Oklahoma, and its officers and board of directors are highly connected civic and business leaders who pay an upfront amount of cash to join and then make yearly contributions to the group. There is diversity in the composition of the board, with there being bankers and CEO's from both large companies and utilities around the state of Oklahoma, making its composition similar to the makeup of the Frontiers of Science Foundation. Youngblood sees the "supply side: of higher education as well-represented by educators themselves but sees no one fighting for the "demand side" of higher education. His organization seeks to remedy this gap. The supply side that needed to be represented was made up of the employers around the state, such as Tinker Air Force Base and its many contractors who need, according to Youngblood, over 18,000 positions in engineering but can't find enough engineer-trained college graduates to fill those jobs. So, Oklahoma Tomorrow promotes STEM education in Oklahoma colleges and universities, as well as informs the public of this need. This newly-formed group is much like the beginnings of the Frontiers of Science Foundation, and if there could be a group put together like this for secondary education in Oklahoma, I believe it would help turn this struggling system around.

Recently, another new group called Step Up Oklahoma formed, made up of business and civic leaders on a deliberately nonpartisan basis to propose a funding plan to give Oklahoma teachers a pay raise and to move the gridlock at the legislature in getting a budget passed. Again,

the group resembles the Frontiers of Science Foundation, in that they are made up of powerful political and business leaders who have the political power as well as the financial backing to effect change (Ellis, 2018).

Now is the time to do something about the crisis in education being experienced in Oklahoma. It seems clear that the legislature and the executive branch of the government find themselves unable or unwilling to fix things in a positive way, so it must fall to the private sector, to the business and civic leaders of Oklahoma, to stand up and be counted as supporters of education. Leadership is about power and how to use it, and we need leaders to stand up and use their power to make a difference and change the trajectory of the K-12 education system in Oklahoma. In his presidential nomination acceptance speech on July 15, 1960, John F. Kennedy said this about leadership: "For courage – not complacency – is our need today. Leadership – not salesmanship. And the only valid test of leadership is the ability to lead, and lead vigorously" (Kennedy, J.F. 1960).

Now is the time for a leader or leaders to rise and lead a group forward to save the pre K-12 educational system in Oklahoma.

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Appendix A

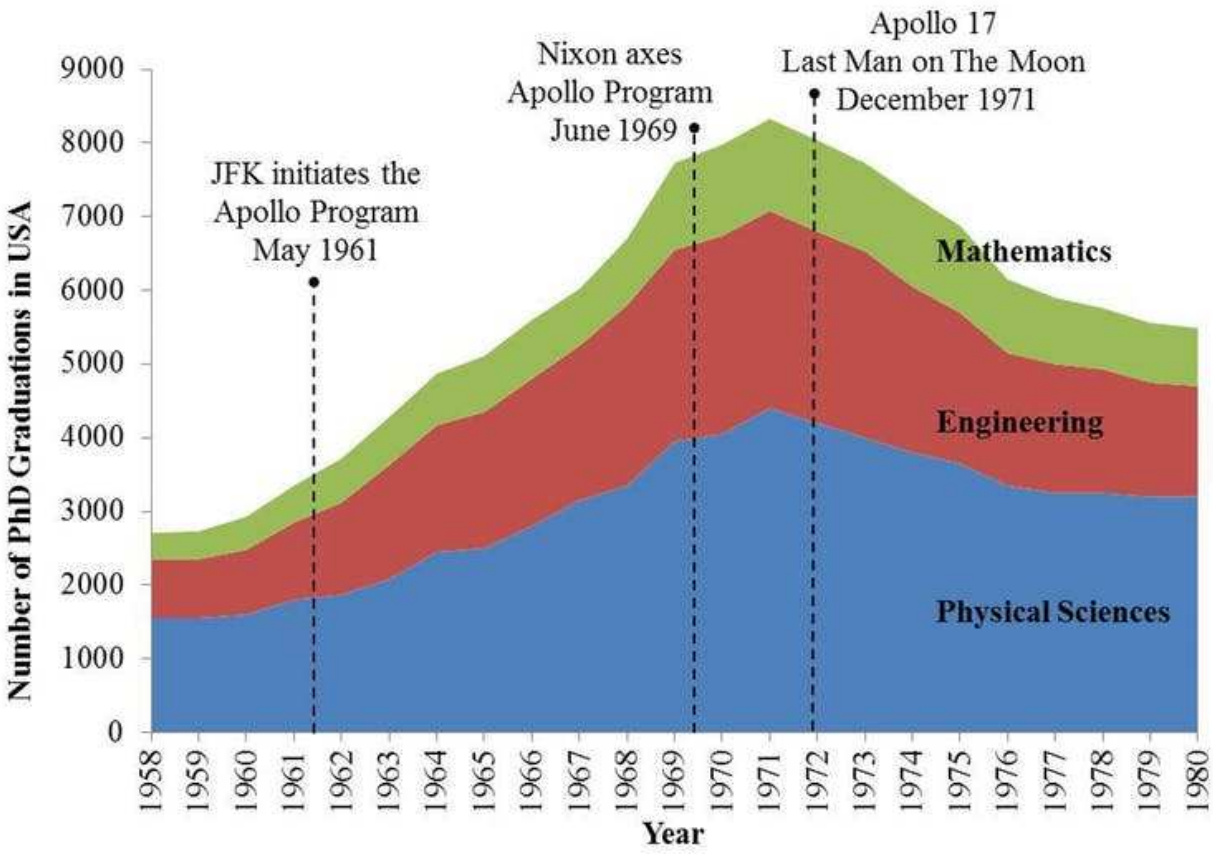
Activities of the Frontiers of Science Foundation 1957-1963

Year	Month	Location	Name of Conference	Summary
1957	February	University of Oklahoma	Mathematics Workshop	Improvement of the curriculum in mathematics in Oklahoma schools
	June	Oklahoma State University	Mathematics Workshop	Produced publication called "Improvement of the Teaching of Mathematics"
	October	Oklahoma State University	Conference on Science Fairs	Improve science education through use of community science fair
1958	March	Oklahoma City	Conference on the Improvement of Mathematics Teaching	Improve mathematics curriculum and teaching methods
	May	Oklahoma City	Space Age Conference	Interpret the new ideas and technology of the Space Age
	May	Oklahoma City	Science Education for the Space Age	Formulation of principles to develop new approaches for science education in Oklahoma
1959	December	Oklahoma City	Science & Mathematics: Countdown for Elementary Education	Improve elementary school science and math
1960	April	Oklahoma City	Impact of Modern Developments in Mathematics in Oklahoma Schools	Help teachers adjust their curriculum to the new modern math
	December	Oklahoma City	Science & Mathematics: Countdown for Elementary Education -- Phase 2	Improve elementary school science and math
1961	**January**	**Oklahoma**	**Tomorrow's**	**Discuss newest developments in**

		City	Teaching	the teaching field
	April	Oklahoma City	Stars and Galaxies	Research and cultivate interest in astronomy
1962	January	Oklahoma City	Investing in People	Discussed the economic impacts of expenditures for science education
	April	Oklahoma City	Molecular Architecture	Discuss molecular research
	March	Oklahoma City	Space Science & Engineering Seminar	Reported scientific applications of space efforts
1963	January	Oklahoma City	Space Address	Explained the reasons for landing man on the moon
	April	Oklahoma City	Engineering 1970: Building Our Nation's Future	Informing students of engineering opportunities in the future
	October	Oklahoma City	Space Technology and You	Discuss the technology associated with the space program
	November	Oklahoma City	The Machinery of the Brain	How to think

Note. Adapted from *The Frontiers of Science Foundation Annual Reports 1957- 1963.*

Appendix B



Note: Taken from (Dove-Jay, 2014)

Appendix C

Sputnik
22.5 inch ball of polished aluminum
weighing 184 pounds
(Schefter, 2000, p. 473)

Appendix D

ITIERS OF SCIENCE FOUNDATION OF OKLAHOMA, INC.
Suite 700 Republic Building OKLAHOMA CITY, OKLAHOMA
Telephone FOrest 5-4583

OFFICERS
DEAN A. McGEE
Chairman of the Board
E. K. GAYLORD
Vice-Chairman of the Board
JAMES E. WEBB
President
ROBERT MacVICAR
Executive Director

MEMORANDUM

: Robert MacVicar February 16, 1956

James E. Webb Mr. D. A. McGee for info.

CT: Progress of Testing Program

I know you will be pleased as I have been, to learn that the testing project of the Foundation is succeeding in a most amazing fashion. As of this date 364 high schools with over 62,000 pupils are participating in the program. I regard this as nothing short of phenomenal since it accounts for nearly half of all the high schools in Oklahoma and over 2/3 of the pupils in grades 10-11-12, the principal grades being tested.

This program is already stirring the imagination of the teachers. It should also engender an enthusiastic response from the public. Favorable national publicity should be coming from it.

Robert MacVicar

RMcV:ds

From James E. Webb Papers, 1928-1980, Harry S. Truman Library, Independence, MO

Appendix E

7th F.S

Memorandum of Understanding

A major problem in the development of the latent talent of the youth of Oklahoma in the areas of science and mathematics is the fact that the organization of the schools of the state prevents the offering of adequate programs of instruction in many of the schools of the state. Nearly half of the secondary school pupils attend schools offering an inadequate curricula for the optimum training of prospective scientists, engineers and members of the other science-related professions.

The media of television, itself the product of science and technology, offers a means of reaching many of these youth during the period until an adequate reorganization of the school system can be effected.

Such a program will require in its initial stages support from other than public funds to demonstrate its usefulness and effectiveness. In the belief that Oklahoma needs to pioneer in the use of this new media, the following understanding is effected:

The Board of Education of the Oklahoma City Public School District agrees through its facilities and personnel to mount a program of instruction in high school mathematics and science during the 1956-57 school year. The exact nature and scope of the program will depend upon the needs and desires of the participating schools. The facilities for television broadcasting and supporting services will be made available for a period of not more than two hours per day, five days per week, for the two school terms, October 1956 through May, 1957.

The Frontiers of Science Foundation of Oklahoma, Inc., agrees to support the above program by payment of the direct instructional costs of the program as related to the Oklahoma City Public Schools, including the salaries of teachers and a coordinator, teaching materials consumed in the instruction, secretarial and technical assistance and travel costs.

The Oklahoma Educational Television Authority agrees to provide transmitting facilities and to transmit for KETA-TV in Oklahoma City the above programs for a maximum of two hours per day five days per week from October 1956 through May 1957.

For the Foundation	For the Board of Education	For the Oklahoma Educational Television Authority
J. E. Webb, President	, Pres.	Chrm.

From James E. Webb Papers, 1928-1980, Harry S. Truman Library, Independence, MO

Appendix F

FRONTIERS OF SCIENCE FOUNDATION
OF OKLAHOMA, INC.
Suite 700 Republic Building OKLAHOMA CITY, OKLAHOMA

OFFICERS
DEAN A. McGEE
Chairman of the Board
E. K. GAYLORD
Vice-Chairman of the Board
JAMES E. WEBB
President
VIRGIL BROWNE
Treasurer
S. D. ELLISON
Secretary
ROBERT MacVICAR
Executive Director

October 15, 1956

To BOARD OF DIRECTORS, TRUSTEES,
and MEMBERS of FRONTIERS OF SCIENCE FOUNDATION

Please accept this as a formal call for the Foundation's first annual joint meeting of the Board, Trustees and membership, to be held in the Continental Room of the Skirvin Hotel, Friday, November 16, at 12:15 noon. This will be an important and interesting meeting. Please make note of this on your calendar.

Achievements of the Foundation's first year of operation are beyond what was originally conceived as being possible, as will be reflected in the report of the officers to our membership. Among other activities, the President will report on. . .

the original Geneva Atoms for Peace show, brought to Oklahoma by the Foundation, the only public showing of this particular show which has been held or will be held, attended here by more than 400,000... conducting many conferences in the State, attended by nationally-recognized scientists, on subjects keyed to development of resources of Oklahoma... financing research studies looking toward acquiring industrial installations for Oklahoma... sponsoring National Science Fair with more than 500 participants from 100 cities of America... placing unique "Questar" telescopes in State's public schools... securing National Science Foundation $255,000 grant to improve science teaching in public schools... conducting water resources study conference attended by leading engineers and scientists, with follow-up program underway ...activating Curriculum Committee of public school system of State and providing a grant to upgrade State public school curriculum... underwriting teaching of algebra, trigonometry, solid geometry and physics by television, being first state in Nation to do so... conducting statewide testing program of 60,000 high school students through Oklahoma Curriculum Improvement Commission and Science Research Associates, "Oklahoma being the first state to have had the vision and courage to objectively measure the curriculum of its high schools". . .

These are only a few of the items that will be covered in an attractively-prepared Annual Report that will be submitted to you at the Annual Meeting, and which will include, also, a detailed, CPA-audited financial report of the Foundation. You are privileged to bring interested friends to this meeting.

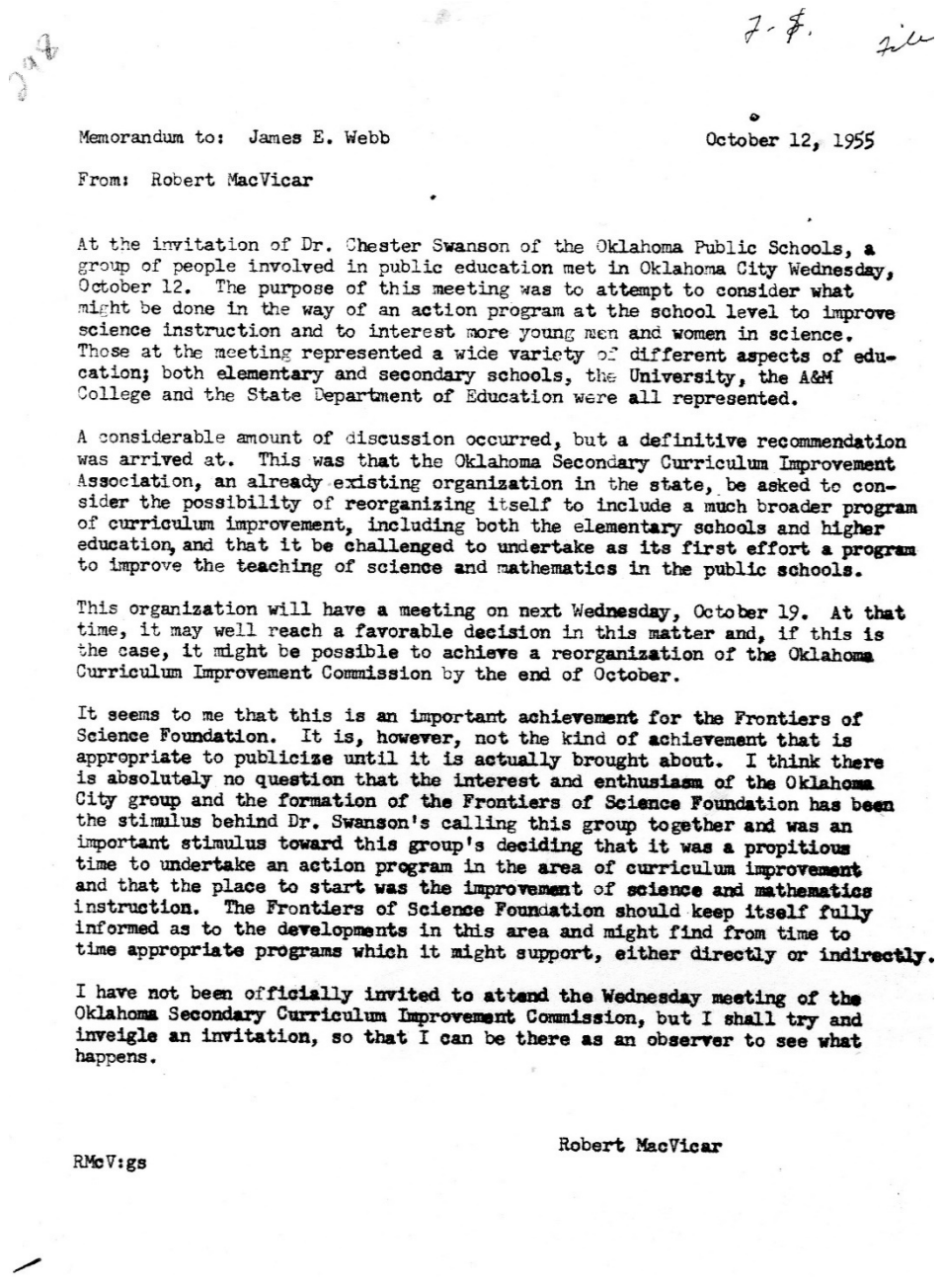
Sincerely,

D. A. McGee
Chairman of the Board

Mr. James E. Webb
Republic Supply Co.

From James E. Webb Papers, 1928-1980, Harry S. Truman Library, Independence, MO

Appendix G



Memorandum to: James E. Webb October 12, 1955

From: Robert MacVicar

At the invitation of Dr. Chester Swanson of the Oklahoma Public Schools, a group of people involved in public education met in Oklahoma City Wednesday, October 12. The purpose of this meeting was to attempt to consider what might be done in the way of an action program at the school level to improve science instruction and to interest more young men and women in science. Those at the meeting represented a wide variety of different aspects of education; both elementary and secondary schools, the University, the A&M College and the State Department of Education were all represented.

A considerable amount of discussion occurred, but a definitive recommendation was arrived at. This was that the Oklahoma Secondary Curriculum Improvement Association, an already existing organization in the state, be asked to consider the possibility of reorganizing itself to include a much broader program of curriculum improvement, including both the elementary schools and higher education, and that it be challenged to undertake as its first effort a program to improve the teaching of science and mathematics in the public schools.

This organization will have a meeting on next Wednesday, October 19. At that time, it may well reach a favorable decision in this matter and, if this is the case, it might be possible to achieve a reorganization of the Oklahoma Curriculum Improvement Commission by the end of October.

It seems to me that this is an important achievement for the Frontiers of Science Foundation. It is, however, not the kind of achievement that is appropriate to publicize until it is actually brought about. I think there is absolutely no question that the interest and enthusiasm of the Oklahoma City group and the formation of the Frontiers of Science Foundation has been the stimulus behind Dr. Swanson's calling this group together and was an important stimulus toward this group's deciding that it was a propitious time to undertake an action program in the area of curriculum improvement and that the place to start was the improvement of science and mathematics instruction. The Frontiers of Science Foundation should keep itself fully informed as to the developments in this area and might find from time to time appropriate programs which it might support, either directly or indirectly.

I have not been officially invited to attend the Wednesday meeting of the Oklahoma Secondary Curriculum Improvement Commission, but I shall try and inveigle an invitation, so that I can be there as an observer to see what happens.

Robert MacVicar

RMcV:gs

From James E. Webb Papers, 1928-1980, Harry S. Truman Library, Independence, MO

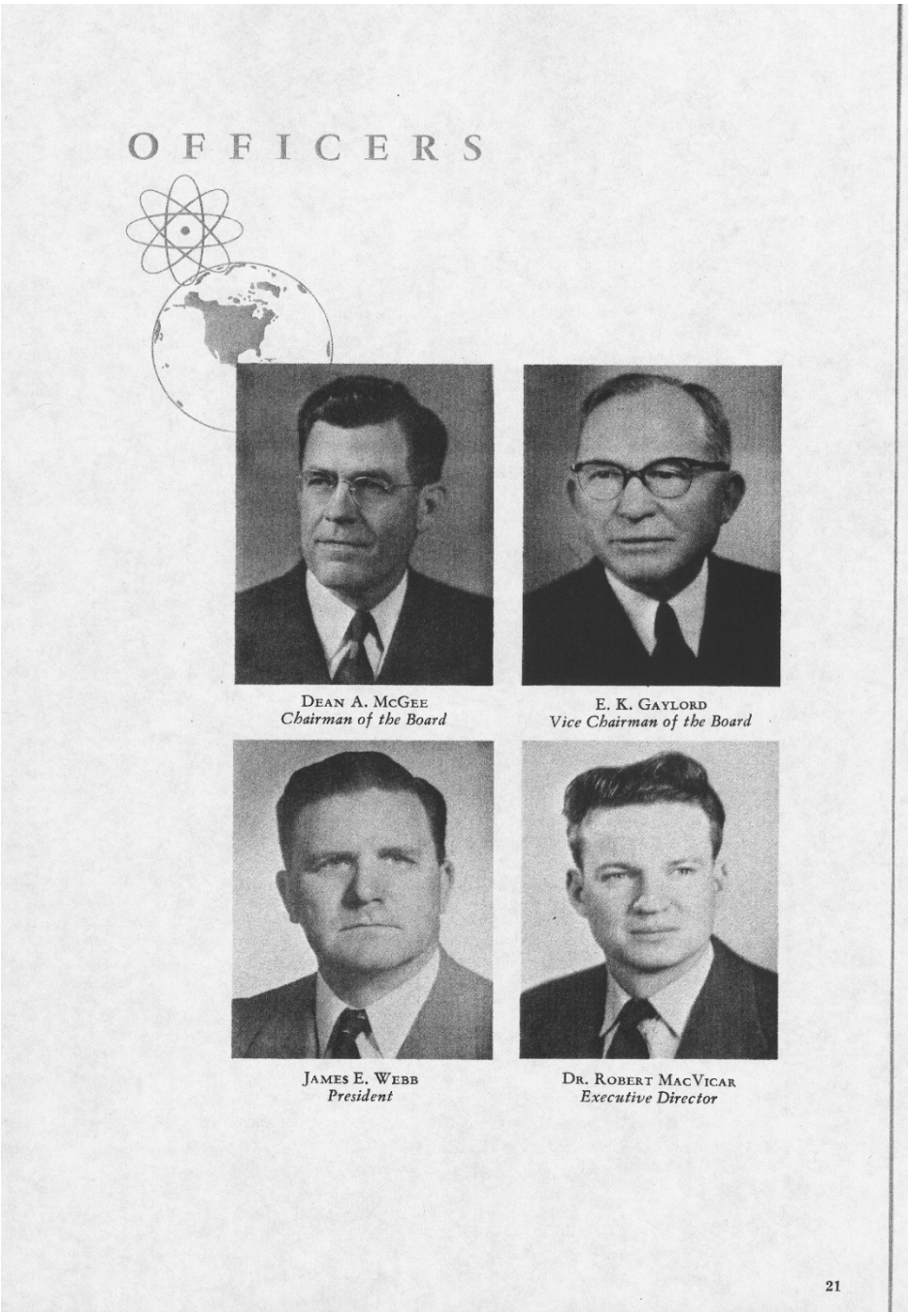
Appendix H

Frontiers of Science Foundation Meeting

(l-r) Senator Robert S. Kerr, James Webb

From James E. Webb Papers, 1928-1980, Harry S. Truman Library, Independence, MO

Appendix I



OFFICERS

DEAN A. McGEE
Chairman of the Board

E. K. GAYLORD
Vice Chairman of the Board

JAMES E. WEBB
President

DR. ROBERT MacVICAR
Executive Director

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From The Frontiers of Science Annual Report 1956, p. 21

VITA

Ricki John Moore

Candidate for the Degree of

Doctor of Philosophy

Dissertation: THE FRONTIERS OF SCIENCE FOUNDATION: TRANSFORMING MATH AND SCIENCE CURRICULA IN OKLAHOMA SECONDARY SCHOOLS, 1957-1964

Major Field: Curriculum Studies

Biographical:

Education:

Completed requirements for the Doctor of Philosophy in Curriculum Studies at Oklahoma State University, Stillwater, Oklahoma in May/2018.

National Endowment for the Humanities Workshop "Landmarks of American History and Culture: From Freedom Summer to the Memphis Sanitation Workers' Strike", at Jackson State University in Jackson, Mississippi, summer 2008.

Completed the requirements for the Master of Arts in Political Science, with a specialty in Urban Affairs at the University of Central Oklahoma, Edmond, Oklahoma in July, 1993.

Completed the requirements for the Bachelor of Arts in Political Science, with a specialty in Public Service at the University of Central Oklahoma, Edmond, Oklahoma in May, 1989.

Experience:

Member, Board of Regents, Oklahoma City Community College, 2012-present.
Chair, Board of Regents, Oklahoma City Community College, 2016-present.
Adjunct Professor, Oklahoma City Community College and Rose State College, 1993-2009.