SHIFTING FOCUS TO TRAIN THE FUTURE: SHOULD ARMY JUNIOR RESERVE OFFICER CORPS PROGRAMS' PURPOSE BE MODIFIED TO INCREASE STUDENTS' PROFICIENCY IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS?

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

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General Studies

by

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14. ABSTRACT

The Army Junior Reserve Candidate Training Corps (AJROTC) is a DoD federally funded program that prepares high school students to contribute to society following high school. In an era where Science, Technology, Engineering, and Mathematics (STEM) career fields are outpacing qualified applicants, the DoD and the federal government wholly recognizes the importance of recruiting and retaining talented STEM professionals. This thesis investigates the current state of AJROTC programs and addresses whether transitioning to a STEM-based curriculum would fulfill federal STEM initiatives.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

SHIFTING FOCUS TO TRAIN THE FUTURE: SHOULD ARMY JUNIOR RESERVE OFFICER CORPS PROGRAMS' PURPOSE BE MODIFIED TO INCREASE STUDENTS' PROFICIENCY IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS?, by Major Leslie E. Akins, 133 pages.

The Army Junior Reserve Candidate Training Corps (AJROTC) is a DoD federally funded program that prepares high school students to contribute to society following high school. In an era where Science, Technology, Engineering, and Mathematics (STEM) career fields are outpacing qualified applicants, the DoD and the federal government wholly recognizes the importance of recruiting and retaining talented STEM professionals. This thesis investigates the current state of AJROTC programs and addresses whether transitioning to a STEM-based curriculum would fulfill federal STEM initiatives.

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ACRONYMS

AJROTC	Army Junior Reserve Officer Training Candidate Program
AFJROTC	Air Force JROTC
ACLU	America's Civil Liberty Union
CTE	Career Technical Education
DoD	Department of Defense
GPA	Grade Point Average
HRC	Human Resources Command
ISTEM	Inclusive STEM Schools
IQ	Intellectual Quotient
JROTC	Junior Reserve Officer Training Candidate Program
JROTCCA	JROTC Career Academies
LET	Leadership, Education, and Training Modules
NASA	National Aeronautical Space Association
NCLB	No Child Left Behind
NDAA	National Defense Authorization Act
NSF	National Science Foundation
NJROTC	Navy JROTC
OPAC	Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict
POI	Program of Instruction
STEM	Science, Technology, Engineering, Mathematics

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CHAPTER 1

INTRODUCTION

> If you want something new, you have to stop doing something old.
>
> —Peter F. Drucker, Quotable Quotes

> As the foundation of America's robust technology industry, computer science drives advancements in health care, aerospace, financial services, national defense, retail and so many other industries both at home and abroad. Young people should be exposed to computer science in our schools so they have the opportunity to learn, innovate, and develop new advancements to promote the future of technology.
>
> —Cathy McMorris Rodgers, quoted in Code, "Leaders and Trend-Setters All Agree on One Thing"

Overview

The purpose of this study is to consider whether Army Junior Reserve Officer's Training Corps (AJOROTC) programs should be modified to focus on science, technology, engineering, and mathematics (STEM) education. In 1916 the first high school AJROTC educational programs were established to train and prepare future soldiers for military service.[1] Over time, AJROTC programs have evolved from recruitment centric programs to citizenship—based programs, designed to prepare students to graduate from high school and positively contribute to society.[2] By comparing

[1] Arthur T. Coumbes, Lee S. Harford, and Paul N. Kotakis, *U.S. Army Cadet Command-The 10 Year History* (Fort Monroe, VA: U.S. Army Cadet Command, 1996), 257.

[2] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History*, 257; U.S. Army JROTC, "An Overview of JROTC," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_Overview.html.

AJROTC programs to STEM education programs, this research will explore whether STEM educational programs should form the basis for the AJROTC curriculum.

In the United States, high school STEM initiatives[3] have garnered support from local, state, and federal governments, because of the United States' projected inability to compete with other nations in the area of STEM career fields in the future.[4] Today, high school STEM initiatives, funded by the federal government concentrate on curriculum and programs, designed to strengthen high school student's proficiency and desires to work in a STEM career fields following high school.[5]

As AJROTC's program curriculums evolve, and the global need for trained STEM professionals increases—this research considers whether a pivot in the AJROTC

[3] STEM federal initiatives are further defined in chapter 2 of this thesis. They include: emphasis on providing quality STEM education to minorities, women, and students residing in rural communities (underrepresented populations) and the emphasis on computer technology literacy for all students.

[4] Ryan Noonan, *STEM Jobs: 2017 Update* (Washington, DC: Department of Commerce, 2017), 3, accessed May 1, 2018, http://www.esa.gov/reports/stem-jobs-2017-update.

[5] Noonan, *STEM Jobs: 2017 Update*, 1-3; Library of Congress, Congressional Research Service, *Selected STEM Education Legislative Activity in the 112th Congress* (Washington, DC: Congressional Research Service, October 2011), 1-8.

curriculum to a STEM-based curriculum will better serve federal initiatives[6] (both STEM and AJROTC) and more effectively fulfill the mission objectives related to AJROTC.[7]

Master of Military Art and Science Outline

Chapter 1, the introduction, provides a basic overview of the research. Chapter 1 includes: an abbreviated overview of the research (the literature review provides an in-depth background of both STEM and AJROTC programs), the aims of the study, the problem statement, research questions, assumptions, definitions relevant to the research, and limitations and the scope of the research.

Chapter 2, the literature review, provides a qualitative comprehensive review of prior research collected in categories relevant to both STEM education programs and AJROTC programs. The research collected includes: research papers, thesis, published books, memorandums, articles, information collected from web sites, and interviews. The relevant categories of STEM education programs and AJROTC programs researched include: the history, current operations, program's effectiveness, and critiques of the programs. The review of literature forms the basis for the comparison research provided in chapter 3 of this thesis.

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[6] Federal Initiatives are further defined as historical AJROTC social initiatives implemented to establish AJROTC programs in underserved communities established during President George H. W. Bush's administration. It also refers to current AJROTC strategic social initiatives designed to facilitate community outreach and STEM education into JROTC programs as discussed in chapter 2 of this thesis (AJROTC strategic initiatives). This definition also refers to current STEM education federal initiatives including recruitment of minorities, women, and recruitment of those from rural communities into STEM careers, as discussed in chapter 2 of this thesis (STEM education strategic initiatives).

[7] U.S. Army JROTC, "An Overview of JROTC."

Chapter 3, the research methodology, further describes the comparison categories used to analyze the qualitative research. This chapter identifies the sources used in this research and defines the categories used to compare the STEM education programs and AJROTC programs to each other.

Chapter 4 provides facts about both programs, specifically related to the categories researched in chapter 2. An analysis of the facts is provided with recommendations related to the research questions sought to be addressed.

Chapter 5 provides the recommendations and the conclusion of the research.

Definitions

At Risk Population: "Describes students or groups of students who are considered to have a higher probability of failing academically or dropping out of school."[8]

Career Technical Education (CTE): Prepare students for a career in STEM following high school or for entry into college—mainly "technologically proficient workers".[9]

Economically Disadvantaged Students: "Students who are eligible for the National School Lunch Program."[10]

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[8] The Glossary of Education Reform, "At Risk," August 29, 2013, accessed May 1, 2018, https://www.edglossary.org/at-risk/.

[9] National Research Council, *Successful STEM Education: A Workshop Summary* (Washington, DC: The National Academies Press, 2011), 14, accessed May 1, 2018, https://doi.org/10.17226/13230.

[10] Jon P. Bridges, "Preparing Historically Underserved Students for STEM Careers: The Role of an Inquiry-based High School Science Sequence Beginning with Physics" (Ph.D. diss., Portland State University, Portland, OR, 2017), 11.

Emotional Intelligence: The ability to exhibit "self-control, zeal, persistence, and motivation," especially under pressure.[11]

Intellectual Quotient: measure of a person's intellect.[12]

Inclusive STEM Schools (I-STEM): Specialize in at least one discipline and normally not require students to be accepted through a screening process based on academic achievement prior to enrollment.[13]

Intangible Results: Results that are not tangible or clear to the mind.[14]

Standardized Test: "Test that (1) requires all test takers to answer the same questions, or a selection of questions from common bank of questions, in the same way, and that (2) is scored in a "standard" or consistent manner, which makes it possible to compare the relative performance of individual students or groups of students."[15]

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[11] Daniel Goleman, *Emotional Intelligence: Why It Can Matter More Than IQ* (New York: Bantam Books, 1995), xii.

[12] Dictionary.com, "Intelligence Quotient," accessed May 1, 2018, http://www.dictionary.com/browse/intelligence quotient.

[13] Niyazi Erdogan and Carol L. Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," *International Journal of Education in Mathematics Science and Technology* 80-84, no. 1 (January 2015): 81-84.

[14] Dictionary.com, "Intangible," accessed May 1, 2018, http://www.dictionary.com/browse/intangible.

[15] The Glossary of Education Reform, "Standardized Test," November 12, 2015, accessed May 1, 2018, https://www.edglossary.org/at-risk/.

Selective STEM Schools: Specialize in at least one discipline and normally require students to be accepted through a screening process based on academic achievement prior to enrollment.[16]

Social Critiques: Criticism related to the way communities behave.[17]

STEM Education: "Teaching and learning in the fields of science, technology, engineering, and mathematics."[18]

STEM Programs: "Programs represent some of the ways in which federal resources are helping to assist educators in implementing effective approaches for improving STEM teaching and learning"[19]

Traditional JROTC Programs: Traditional programs curriculum is providing general classroom instruction in areas like citizenship, life skills, and geography, coupled with out of class room experiences, like drill and ceremony physical training.[20]

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[16] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 80-84.

[17] Michael Waltzer, Interpretation *and Social Criticism* (Cambridge, MA: Harvard University Press, 1993), 1-13.

[18] Heather Gonzalez and Jeffrey J. Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer* (Washington, DC: Congressional Research Service, August 2012), 1-8, accessed May 1, 2018, https://www.stem.org/cm/dpl/downloads/content/69/R42642.pdf.

[19] Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*, 1-8; U.S. Department of Education (DoE), "Science, Technology, Math, Engineering: Education for Global Leadership," accessed May 1, 2018. https://www.ed.gov/stem.

[20] U.S. Army Cadet Command, *Leadership Education and Training (LET), JROTC Program of Instruction (POI)* (Fort Knox, KY: United States Army Cadet Command, September 2010), 8.

Traditional STEM Education: Traditional high schools deliver STEM education in the form of regular science, mathematics, and elective courses devoted to STEM.

Underserved Populations: "Historically underserved students are Black, Hispanic/Latino, Native American, Pacific Islander, English language learners, or economically disadvantaged students."[21]

Aims of the Study

In 2016, the White House reported that ten thousand federal jobs in cyber security and Information and Technology were left vacant.[22] The projected federal STEM shortage directly impacts the Department of Defense (DoD) since the DoD employs people to work in all STEM fields (JROTC is a Department of Defense Program).[23] The DoD must have enough trained STEM professionals for the future therefore, DoD as well as the entire federal government have a vested interest in contributing to STEM education for high school students in the United States.[24]

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[21] Bridges, 11; Although there are different definitions used to describe this term, for purposes of this paper, this definition is used.

[22] Office of the Press Secretary, The White House, "Fact Sheet: President Obama Announces Computer Science for All Initiative," January 30, 2016, accessed May 1, 2018, https://obamawhitehouse.archives.gov/the-press-office/2016/01/30/fact-sheet-president-obama-announces-computer-science-all-initiative-0.

[23] U.S. Department of Defense (DoD), "About DoD STEM," accessed May 1, 2018, http://www.dodstem.us/about; Junior Officer Reserve Training Corps.

[24] Dean Hager, "The Real Reasons Behind the Tech Skills Gap," *Fortune Magazine*, May 1, 2016, accessed May 1, 2018, http://fortune.com/2016/04/27/tech-skills-gap-stem/; DoD, "About DoD STEM;" 10 United States Code § 2031, Junior Officer Reserve Training Corps, 2018.

Because of critical shortages of students in the STEM pipeline—mainly in the discipline of technology, the federal government's fiscal year 2019 budget included requests for increased funding to train high school students in the areas of emerging STEM fields through career and technical education (CTE) programs.[25] The federal government's increased devotion to CTE programs is just one example of the emphasis the federal government has placed on STEM education in an effort to promote STEM readiness in the future.[26] This study seeks to examine AJROTC programs and evaluate a potential transition in the program's curriculum to a STEM-based as a benefit to the students, government, and communities where AJROTC programs reside.

Problem Statement

As the needs of society evolve, the training and education provided to high school students should be commensurate with society's demands. The curriculum afforded to the students in AJROTC should reflect emerging societal needs and AJROTC's mission—affording students the best opportunies to achieve success and contribute to society after

[25] Barbara Means, Haiwen Wang, Xin Wei, Sharon J. Lynch. Vanessa L. Peters, Viki Young, and Carrie Allen, "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs," *Journal of Research and Science Teaching* 53, no. 5 (May 2017): 731; Association of Science, Technology, and Arts, "US Congress Votes for More Science," March 23, 2018, accessed May 1, 2018, www.astc.org/advocacy/congress-votes-for-more-science/.

[26] Stephen Sawchuck, "Trump Budget Request Prioritizes STEM and Apprenticeships. But is there a Catch?," *Education Week*, accessed May 1, 2018, http://blogs.edweek.org/edweek/curriculum/2018/02/trump_budget_stem_apprenticeship_2019.html; Tim R. Sass, "Understanding the STEM Pipeline" (CALDER Working Paper No. 1, American Institutes for Research, Washington, DC, January 2015); STEM Pipeline is a term used by researchers, projecting future STEM careers, balanced against anticipated qualified professionals who will be able to fill the vacancies in the future.

leaving high school.[27] This paper questions whether a STEM-based curriculum, coupled with AJROTC classes may further harness young talent, motivate students to serve in STEM career fields following high school, and enhance AJROTC curriculums.

Primary Research Question

Whether a greater emphasis on STEM education in Army JROTC programs would enhance the quality of AJROTC programs?

Secondary Research Question

Whether a STEM-based curriculum in Army JROTC programs enhances the federal government's strategic initiatives?[28]

Limitations and Scope

This thesis addresses both AJROTC curriculums and STEM educational programs however, this thesis does not concentrate on the creation of a specific STEM-based curriculum design for AJROTC programs. Although, this paper addresses, logistical and administrative changes that would need to be made as result from a change in AJROTC

[27] U.S. Army JROTC, "An Overview of JROTC."

[28] Federal Strategic Initiatives are further defined as previous AJROTC social initiatives implemented to establish AJROTC programs in underserved communities during President George H.W. Bush's administration. It also refers to current JROTC strategic social initiatives designed to facilitate community outreach and STEM education into JROTC programs as discussed in chapter 2 of this thesis (AJROTC strategic initiatives). This definition also refers to current STEM education federal initiatives including recruitment of minorities, women, and recruitment of those from rural communities into STEM careers, as discussed in chapter 2 of this thesis (STEM education strategic initiatives).

curriculum, this paper does not include the plan for implementation of a specific program.

Instead, this thesis focuses on a conceptual change in the AJROTC. A suggested follow on area of study can discuss program implementation necessary to provide a framework for what a STEM-based AJROTC program would encompass (including, but not limited to) inclusion of STEM resources within secondary schools, a new program curriculum, and funding considerations. Further research into the economic, and social impacts transition of AJROTC programs to STEM-based programs is needed in order to understand the cost benefit of transitioning into a such a program dependent on the community pursuing the transition. Also research evaluating the impact AFJROTC programs have on influencing student's to pursue STEM careers may help predict the overall effectiveness of transitioning AJROTC to STEM-based programs.

This thesis specifically addresses the Army's AJROTC programs and does not explore a change in the curriculum afforded in the sister service high school programs (Air Force, Navy, Marines, Cost Guard JROTC). The Navy and Air Force curriculums are mentioned in this paper in order to provide the reader with examples of STEM implementation into the AJROTC curriculum and to provide data and research regarding the effectiveness and critiques of JROTC programs.

The intent of thesis is to focus on AJROTC programs and changes to the current curriculum afforded to AJROTC students. This paper also discusses the Career Academy—type AJROTC programs—in relation to the literature review discussing

program's effectiveness, but the focus of this paper is on traditional AJROTC programs—that is programs that follows the curriculum in the Cadet Regulation.[29]

In the area of research dedicated to STEM educational program effectiveness, the research encompasses several types of STEM educational programs and is not limited to research derived from one type of STEM educational program.

In the area of research dedicated to critiques of STEM and AJROTC programs, the research is limited to one criticism, directly related to the research questions.

Conclusion

This study considers whether AJROTC Programs should be modified to focus on STEM education. By comparing AJROTC programs to STEM education programs in the United States, this study examines how AJROTC programs may benefit from a STEM-based curriculum—in order to promote federal strategic initiatives and better serve the overall mission objectives related to AJROTC.

[29] U.S. Army Cadet Command, *LET, JROTC POI*, 10-12.

CHAPTER 2

LITERATURE REVIEW

Introduction

This thesis compares AJROTC programs to high school STEM education programs in the United States, and questions how AJROTC programs may benefit from a STEM-based curriculum.

This review of literature provides a comprehensive review of prior research collected in categories relevant to both STEM education and AJROTC programs. The research collected includes: research papers, thesis, published books, memorandums, articles, information collected from web sites, and interviews. The relevant categories of STEM education and AJROTC programs researched include: the history, current operations, program's effectiveness, and criticisms. The review of literature forms the basis for the comparison research provided in chapter 3 of this research.

The history portions of the review investigate the basis for both program's inception, the original purposes of the program, and evolution of the missions of AJROTC and STEM education programs.

The current operations section of the literature review presents facts found in past research related to the following information relevant to both programs: objectives both programs seek to achieve—including strategic goals and recruitment efforts, funding to support programs, relevant demographic statistics, and a general overview of the program.

The program effectiveness portion of the review is a compilation of research discussing the following areas: educational, and academic achievement and community perceptions of programs.

Lastly, this literature review addresses critiques[30] of both programs. Both STEM education and AJROTC programs have been the subject of social concerns.[31] This research is limited to addressing one major social criticism related to each program.[32]

The AJROTC programs critiques will address concerns as to whether the programs are is recruitment programs enticing students to join the Armed Forces through a curriculum that promotes enlistment in the military.[33] The STEM critique will address concerns over the narrow focus of STEM, claiming that programs fails to develop students in other fields that are integral to our societies progression, (for example

[30] Critiques are based on the opinions of researchers, organizations, and individuals, who make arguments related to both programs.

[31] Program criticisms related to AJROTC programs include but are not limited to criticisms related to a disparity in the program's quality of instruction; states' funding concerns.

[32] Wiley Online Library, "Journal of Social Philosophy," last accessed May 1, 2018, https://onlinelibrary.wiley.com/page/journal/14679833/homepage/ProductInformation.html; Social Critiques are: critiques of the norms or the way society is behaving; The research questions are: whether a greater emphasis on STEM education in AJROTC programs would enhance the quality of AJROTC programs and whether a STEM-based curriculum in Army JROTC programs enhances the federal government's strategic initiatives.

[33] American Civil Liberties Union, *.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict: Soldiers of Misfortune – Abusive U.S. Military Recruitment and Failure to Protect Child Soldiers,*" 12, accessed May 1, 2018, https://www.aclu.org/files/pdfs/humanrights/crc_report_20080513.pdf.

humanities or anthropology).[34] Therefore, this literature review will be limited to addressing one social critique related to both STEM educational programs and AJROTC.

History of JROTC

Two years into what would become known as The Great War (World War I), President Woodrow Wilson signed the National Defense Act of 1916.[35] Terms in the National Defense Act of 1916 clearly contemplated bolstering the United States military in an effort to increase military recruits.[36] Even more pressing than the United States' imminent entry into WWI was the United States-Mexican conflict ongoing in the southwest portions of the United States.[37] In response to multi-faceted threats, President Woodrow Wilson authorized the Reserve Officer's Training Corps Program (ROTC) in order to build US Army troop levels.[38]

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[34] Fareed Zakaria, "Why America's Obsession with STEM Education is Dangerous," *New York Times*, March 26, 2015, accessed May 1, 2018, https://www.washingtonpost.com/opinions/why-stem-wont-make-us-successful/2015/03/26/5f4604f2-d2a5-11e4-ab77-9646eea6a4c7_story.html?utm_term=.b1b5f89fbcd2.

[35] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 257-259.

[36] U.S. Army JROTC, "JROTC History," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_History.html.

[37] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 257-259.

[38] Ibid.

ROTC programs curriculum included military-specific instruction at both the high school and college levels.[39] The "junior division" of ROTC was specifically designed and funded to train high school students for military service.[40]

Through the National Defense Act of 1916, AJROTC programs were funded and equipped.[41] Pursuant to this statute, students were prohibited from enlisting in the Army prior to reaching the age of 18, active-duty military commissioned and noncommissioned officers trained the students on military service, and congress authorized funding for land, equipment, and animals to help facilitate realistic military training.[42] In the early years of AJROTC, active duty and retired instructors were assigned to teach in the programs, and students could earn a reserve commission into the United States military after successful completion of the program.[43] The AJROTC curriculum was based largely on Infantry tactics and military skills necessary for combat.[44]

As the Nation scrutinized military spending, following World War II and the Korean Conflict, many AJROTC units struggled to maintain programs, mostly due to

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[39] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 257-259.

[40] The National Defense Act of 1916, Pub.L. 64-85, 39 Stat. 166.

[41] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 257-259.

[42] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 257-259; The National Defense Act of 1916, Pub.L. 64-85, 39 Stat. 166.

[43] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 257-259.

[44] Ibid.

lack of funding and inadequate areas for students to train.[45] Because of shrinking budgets, many AJROTC programs were scheduled to be defunded, however, before congress could act, citizens who were accustomed to the programs in their communities advocated to keep programs functioning (and lobbied to increase the number of AJROTC programs nation-wide).[46]

The *ROTC Vitalization Act of 1964* (hereinafter *Vitalization Act*) triggered many changes to JROTC programs (notably, expanding programs sister services).[47] In addition, regulatory guidance directed the minimum number of students that had to be enrolled in programs in order for the school to receive funding, improved academic standards, and improved standandards for instructors to train.[48] The *Vitalization Act of 1964* created a dual track system for college (preparatory) or a technical track for students wishing to transition after graduating into a technical career field.[49] Also, students were given credit

[45] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-260; Institute for Economics and Peace, *Economic Consequences of War on the U.S. Economy,* 2015, 7-14, accessed May 1, 2018, http://economicsandpeace.org/wp-content/uploads/2015/06/The-Economic-Consequences-of-War-on-US-Economy_0.pdf.

[46] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262; Institute for Economics and Peace, *Economic Consequences of War on the U.S. Economy,* 7-14.

[47] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262; U.S. Army JROTC, "JROTC History."

[48] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262; U.S. Army JROTC, "JROTC History."

[49] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262. Although the original "technical track" as discussed in this paragraph no longer exist in AJROTC curriculums; AJROTC programs do have JROTC Career Academies—that is a JROTC program that blends vocational training into its programs.

for their participation in JROTC if enlisting in the military after high school.[50] While many program enhancements came as a result of the *Vitalization Act of 1964*, AJROTC curriculums remained focused on Infantry tactics, weapons training, and soldier skills.[51]

Following the *Vitalization Act of 1964,* programs garnered more attention mainly attributed to fresh lingering memories of society's divide regarding support for the Vietnam War.[52] Critics began to alleged that JROTC programs generated child soldiers.[53] Communities across the nation began attempting to end JROTC programs in high schools.[54] After repeated and sometimes violent protest, some universities abolished college ROTC programs on their campus.[55] Therefore, although the *Vitalization Act of 1964* caused progressive strides to be made in both college and high school JROTC

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[50] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262.

[51] Ibid.

[52] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262; Allen McDuffee, "No JROTC Left Behind: Are Military Schools Recruitment Pools," *In These Times*, August 20, 2008, accessed May 1, 2018, Inthesetimes.com/article/3855; Paul Joesph, *The Sage Encyclopedia of War: Social Science Perspectives* (Thousand Oaks, CA: Sage Publications, 2017), 1078, 1124-1125, 1128; These members of society included but were not limited to congressmen, school boards, national organizations, parents, and students.

[53] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 258-262; Joseph, *The Sage Encyclopedia of War*, 1078, 1124-1125, 1128; American Civil Liberties Union, *U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict,* 12-20.

[54] Joseph, *The Sage Encyclopedia of War*, 1078, 1124-1125, 1128.

[55] Ibid.

programs, but concerns from communities triggered an evaluation, which would focus attentions on how JROTC programs trained and educated students across the nation.[56]

The next major emphasis placed on JROTC programs came with the *JROTC Improvement Plan (JRIP)*.[57] Notably and relevant to this research, the *JRIP*, adopted in 1985, implemented science and technology into programs, and changed the over-all mission of JROTC to a citizenship-based mission.[58] As part of the *JRIP*, JROTC programs published their first mission statement:

To help develop informed and responsible citizens, aid the growth of their leadership potential, strengthen their character through teaching of the values associated with Service life, acquaint them with the technology inherent to a modern Armed force, and promote an understanding of the historical role of Citizen-Soldiers and their service and sacrifice to the Nation, thereby creating an interest in military service as a career.[59]

Instead of a concentration on tactics and the military, the mission focused on building leaders, citizenship, practical life skills, and integrating technology.[60] Much of the curriculum implemented in the 1980s through the *JRIP* still exist today.[61]

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[56] Joseph, *The Sage Encyclopedia of War*, 1078, 1124-1125, 1128; Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 261-264.

[57] Joseph, *The Sage Encyclopedia of War*, 1078, 1124-1125, 1128; Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 261-264.

[58] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 263-265.

[59] Ibid.

[60] Ibid.

[61] U.S. Department of the Army (DoA), Cadet Command Regulation (CCR) 145-2, *Junior Reserve Officer Training Program, Organization, Administration, Operations,*

In 1987 the mission statement changed again, "To Motivate Young People to Be Good Americans."[62] The 1987 mission statement marked the first mission statement dedicated to citizenship without mention of military service.[63] Although the 1987 mission statement represented a clear departure from military-based recruitment program, AJROTC programs continued to be criticized by anti-war and community organizations (including school boards) for indirectly recruiting and training child soldiers.[64]

During the 1990s, the United States government grew concerned about increasing violence and gang activity, mainly in the inner cities of the United States.[65] Then, Secretary of State Colin Powell, spearheaded a initiative to increase JROTC programs in underachieving schools as a way to convince students to stay in school.[66] As a result, President George H. W. Bush approved a 42 percent increase in JROTC authorizations in

Training and Support (Fort Knox, KY: US Army Cadet Command, 2012), 54; U.S. Army Cadet Command, *LET, JROTC POI,* 8-13.

[62] Coumbes and Harford, *U.S. Army Cadet Command-The 10 Year History,* 269.

[63] Ibid.

[64] Joseph, *The Sage Encyclopedia of War*, 1078, 1124-1125, 1128.

[65] Colin Powell and Joseph Persico, *My American Journey* (New York: Ballentine Books, 1995), 555-556.

[66] Ibid.

1992.[67] Colin Powell's initiatives caused an increased emphasis on the establishment JROTC units in what was labeled as inner city, failing schools.[68]

Although AJROTC programs started with the intent to recruit students into the Armed Forces, the mission and goals of the organization evolved over the years into a citizenship, preparedness program designed to give students the tools they will need following high school. History does, however, give insight into present day concerns about the overall intent of the program and the strategic initiatives AJROTC invests in today.

Current Operations

This portion of the literature review provides relevant facts related to AJROTC current operations. The following research related to AJROTC programs is included: program objectives, program overview, funding, and demographics. The purpose of this section of the review is to provide baseline objective information about AJROTC operations today.

[67] Powell and Persico, *My American Journey,* 555-556; McDuffee, "No JROTC Left Behind: Are Military Schools Recruitment Pools." These members of society included but were not limited to congressmen, school boards, national organizations, parents, and students.

[68] Ibid; Failing schools in this context included high drop-out rates, failing academic achievement results, and high disciplinary infractions.

Program Objectives

Today the mission of JROTC is "to motivate young people to be better citizens."[69] The vision is "to instill in students in [United States] secondary educational institutions the values of citizenship, service to the United States, and personal responsibility and a sense of accomplishment."[70] The only portion of the mission that has changed to since 1987 is that "Americans" has been replaced with "Citizens"—a global perspective.[71] Current objectives (or ways to reach program goals include the following):

a. Act with integrity and personal accountability as they lead others to succeed in a diverse and global workforce.

b. Engage civic and social concerns in the community, government, and society.

c. Graduate prepared to excel in post-secondary options and career pathways.

d. Make decisions that promote positive social, emotional, and physical health.

e. Value the role of the military and other service organizations.[72]

The current mission and vision of AJROTC makes no mention about military recruitment, but sets out to train and educate students to be accountable, achieve success

[69] U.S. Army JROTC, "JROTC Program Information," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_ProgramInfo.html.

[70] Ibid.

[71] Ibid.

[72] U.S. Army JROTC, "JROTC Program Information;" DoA, CCR 145-2, 1; Current AJROTC mission philosophy also emphasizes the pursuit of careers in the areas of STEM.

through accomplishment, and be good citizens.[73] Today, DoD recognizes that JROTC programs provide positive military exposure to students in high school, but seeks to influence students, so that they can "think critically and creatively, communicate effectively, work as a team member, graduate from high school, pursue meaningful STEM careers, and become successful citizens."[74]

Program Overview

Schools that want an AJROTC programs must apply for a program and the application must be approved by the United States Cadet Command.[75] AJROTC programs are managed by Brigade managers (programs divided up into 8 regional brigades), who report to the United States Army cadet Command.[76] In order for a program to remain active, the program must have: "10 percent of the number of students enrolled in the institution who are in a grade above the 8th grade, or 100 students, whichever is less."[77] The National Defense Authorization Act (NDAA) does not limit the amount of JROTC units each service can administer; however, each service caps the amount of programs they are willing to fund, based on yearly authorizations.[78] Due to

[73] U.S. Army JROTC, "JROTC Program Information;" DoA, CCR 145-2, 1.

[74] DoA, CCR 145-2, 1.

[75] DoA, CCR 145-2, 8-11; U.S. Army JROTC, "Establish a JROTC Program," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_EstablishProgram.html.

[76] DoA, CCR 145-2, 8-13; U.S. Army JROTC, "Establish a JROTC Program."

[77] DoA, CCR 145-2, 8; 10 United States Code § 2031, Junior Officer Reserve Training Corps, (a)(2)(1) (2018).

[78] DoA, CCR 145-2, 23-23; U.S. Army JROTC, "Establish a JROTC Program."

demand, Cadet Command maintains a waiting list for those wishing to establish a program.[79]

Program Overview: Instructors

AJROTC units normally have one retired officer and one retired non-commissioned officer teaching the classes.[80] The senior officer is called the Senior Army Instructor (SAI) and the other is the Army Instructor (AI).[81] The DoD covers half of instructor's salaries on a reimbursable basis, meaning the school districts are responsible for instructor's salaries and can request reimbursement from the government for a portion of the instructors pay.[82] Instructors go through a screening process however, instructors do not need to be licensed teachers or have any other specialized training in education in order to be a AJROTC instructor.[83] Instructors must meet minimum standards related to physical fitness and pass criminal background checks.[84]

Program Overview: Traditional JROTC Curriculum and Other Types of JROTC Programs

The traditional AJROTC program's curriculum emphasizes critical thinking and preparing students (who are called cadets while in the program) for real-life experiences

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[79] DoA, CCR 145-2, 23-23; U.S. Army JROTC, "Establish a JROTC Program."

[80] DoA, CCR 145-2, 24-29.

[81] Ibid.

[82] Ibid.; each instructor must agree to serve in the position for at least 2-years.

[83] DoA, CCR 145-2, 24-29.

[84] Ibid.

by developing their core competencies in the following courses: leadership, civics, geography and global awareness, health and wellness, language arts, life skills, and US history.[85] Courses are broken down into Leadership, Education, and Training Modules (LETs), numbered 1-4.[86] Cadets must complete modules sequentially, but there is no timing requirement as to when students must enter AJROTC.[87] Therefore JROTC cadets can remain in the program for as many as 4-years and finish the program on a compressed schedule, or drop the program after completing a single LET.[88]

Cadets attend AJROTC class daily for 45-50 minutes or every other day for 90-100 minutes.[89] In addition to the core curriculum, programs may offer co-curricular activities.[90] Co-curriculum activities are not required for LET completion but are normally implemented into AJROTC curriculums.[91] Co-curriculum courses include but are not limited to: AJROTC Leadership Challenge and Academic Bowl, STEM programs, fitness programs, Rifle Competitions, and Drill Competitions.[92]

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[85] U.S. Army Cadet Command, *LET, JROTC POI*, 8-17.

[86] Ibid.

[87] Ibid.

[88] U.S. Army Cadet Command, *LET, JROTC POI*, 8-19; Missouri JROTC Senior Instructor, telephone interview with author, April 11, 2018. Some cadets may elect to drop the course after taking one LET.

[89] U.S. Army Cadet Command, *LET, JROTC POI*, 8-19.

[90] Ibid.

[91] Ibid.

[92] Ibid.

Table 1. Sample Weekly Schedule for AJROTC Program	
Day	Courses
Monday	Drill and ceremony
Tuesday	Academic classes, (ex. Leadership or history).
Wednesday	Academic classes, (ex. Leadership or history).
Thursday	Uniform Inspection Day
Friday	Sports Activity Day

Source: Missouri JROTC Senior Instructor, telephone interview with author, 11 April 2018.

Program flexibility affords cadets' credits towards LETs for certain classes or activities that may be offered outside of the AJROTC program as part of the traditional curriculum model.[93] This means that cadets may earn credit for the AJROTC program, while simultaneously working on a non-AJROTC class/program or visa-versa.[94] Offering credit to the students, especially when courses appear to be duplicative, allows students the opportunity to broaden their experience, enhance their cognitive capability, and earn credit towards completion of their LETs.[95] For example, the state of Georgia allows AJROTC students to participate in AJROTC programs under the Career, Technical, and

[93] U.S. Army Cadet Command, *LET, JROTC POI*, 8-19; Missouri JROTC Senior Instructor interview.

[94] Muscogee School District, "Career Technical Agricultural Education (CTAE)-JROTC," accessed May 1, 2018, https://www.muscogee.k12.ga.us/p/Divisions/TeachingandLearning/CTAE/JROTC; U.S. Army Cadet Command, *LET, JROTC POI*, 30; Missouri JROTC Senior Instructor interview.

[95] Muscogee School District, "Career Technical Agricultural Education (CTAE)-JROTC;" U.S. Army Cadet Command, *LET, JROTC POI*, 12.

Agricultural Division—meaning that satisfaction of a JROTC course gives credit to students in Georgia's Career, Technical and Agricultural Educational programs.[96]

In addition to traditional AJROTC programs, JROTC Career Academies (JROTCCA) provide cadets with a vocational alternative to the traditional high school curriculum.[97] There are approximately 38 JROTCCA.[98] Unlike traditional AJROTC programs, JROTCCA are a hybrid of traditional AJROTC and technical schools, because they train cadets on a skill or trade that can be employed following high school graduation.[99] Career academies serve a multipurpose mission, because cadets are encouraged to be better citizens and offered a skill set to help them achieve their career goals following high school.[100] Career Academies integrate the business community, the schools, and AJROTC into one program—emphasizing occupational development through business partnerships and leadership training at the same time.[101]

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[96] Muscogee School District, "Career Technical Agricultural Education (CTAE)-JROTC."

[97] Robyn Abbey and Lawrence M. Hanser, *JROTC Career Academies Guidebook* (Santa Monica, CA: Rand Corporation, 1995), iii, accessed May 1, 2018, https://www.rand.org/pubs/monograph_reports/MR573/index2.html.

[98] Abbey and Hanser, *JROTC Career Academies Guidebook*, iii; Marc N. Elliott, Lawrence M. Hanser, and Curtis L. Gilroy, *Evidence of Positive Student Outcomes in JROTC Career Academies* (Santa Monica, CA: RAND Corporation, 2000), VII, accessed May 18, 2018, https://www.rand.org/pubs/monograph_reports/MR1200.html.

[99] Abbey and Hanser, *JROTC Career Academies Guidebook*, iii, 3.

[100] Ibid.

[101] Ibid.

JROTCCA are growing in popularity across the United States, since they provide practical skills for students to use following high school.[102] The RAND Cooperation conducted a study assessing the effectiveness of vocational-themed JROTC programs within high schools.[103] The study found that in comparison with non JROTCCA, Career Academy cadets had higher graduation rates, higher attendance rates, higher GPAs, and higher graduation rates than non JROTCCA students.[104]

Lastly, the National Defense Cadet Corps, another type of AJROTC program, follows a traditional AJROTC program curriculum, except that the schools fund the programs in entirety.[105] While DoD provides resources such as the curriculum and regulatory guidance, the schools are fiscally responsible for resourcing these programs.[106]

Funding

In Fiscal Year 2017, congress spent about $370 million dollars on all JROTC programs—about $670 per cadet (mostly to cover salaries for instructors and program

[102] National Career Academy Coalition, "About Career Academies," accessed May 1, 2018, https://www.ncacinc.com/nsop/academies.

[103] Elliott, Hanser, and Gilroy, *Evidence of Positive Student Outcomes in JROTC Career Academies,* VII.

[104] Elliott, Hanser, and Gilroy, *Evidence of Positive Student Outcomes in JROTC Career Academies,* VII. JROTCCA resemble STEM Career Technical Educational (CTE) programs, in that they both offer practical work-related experience in addition to class room training on the profession, so that students can graduate with a learned skill. CTEs will further be discussed in this chapter—STEM programs overview.

[105] U.S. Army JROTC, "Establish a JROTC Program."

[106] Ibid.

administration).[107] The majority of JROTC spending goes to AJROTC instructor's pay.[108]

Demographics[109]

According to Human Resources Command (HRC), as of 2017, the following information was reported:

a. 40% Army AJROTC programs are in inner city neighborhoods.

b. 50% of the AJROTC population is made up of minorities.

c. 40% of the AJROTC population are females.

d. Approximately 314, 000 students are enrolled in AJROTC.

e. There are approximately 4000 instructors teaching AJROTC.[110]

In 2015, Congress questioned the demographic representativeness of JROTC units.[111] Consistent with the data reported by Human Resources Command, the study found

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[107] 10 United States Code § 2031, Junior Officer Reserve Training Corps (2018); Charles A. Goldman, Jonathan Schweig, Maya Buenaventura, and Cameron Wright, *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps* (Santa Monica, CA: RAND Corporation, 2017), ix.

[108] U.S. Army JROTC, "Instructor Pay," accessed, May 1, 2018, https://www.usarmyjrotc.com/JROTC_InstructorPay.html.

[109] Goldman et al., *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps*, iii; defining demographics based on "race, ethnicity, and income."

[110] U.S. Army JROTC, "JROTC History," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_History.html.

[111] Goldman et al., *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps,* ix; this study applied to all JROTC programs—but is applicable to AJORTC programs as AJROTC make up the majority of DoD-JROTC programs.

JROTC programs are represented in "larger-than average minority populations."[112] However, the study noted that JROTC programs are not as well represented in rural areas—further explaining, "JROTC has been more successful in addressing demographic representativeness than it has been in addressing geographic representativeness."[113] The study also concluded that programs are underrepresented in rural communities, noting that the majority of JROTC programs are in urban areas located in the southern portions of the United States.[114] Lastly, the study indicates that changes to strategic service policies could positively influence JROTC programs ability to maintain programs.[115] The current demographics present in AJROTC programs appear to be a direct result of social initiatives implemented during President George H.W. Bush's administration. While AJROTC programs are demographically diverse, programs need to address *geographic* diversity in the future.[116]

Strategic Initiatives

Recent AJROTC strategic initiative involve the promotion of STEM education through community partnerships and public service tours.[117] For example, as a co-

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[112] Ibid.

[113] Ibid.

[114] Ibid.

[115] Ibid.

[116] Powell and Persico, *My American Journey,* 555-556.

[117] Fort Worth Independent School District, "FWISD JROTC" (PowerPoint Presentation), accessed May 1, 2108, https://www.fwisd.org/cms/lib/TX01918778/Centricity/Domain/174/STEM%20BRIEF%20%203.pdf, 1; Michael Maddox, "New Program Promotes STEM Initiatives in JROTC

curricular activity, AJROTC offers an opportunity for cadets to attend STEM Camps.[118] These camps are normally week-long summer camps, sponsored by private organizations.[119] Co-curriculars are designed to introduce students to STEM career fields and give cadets a hands on opportunity to develop a STEM project during summer programs.[120] These opportunities also promote teamwork and leadership skills.[121]

In response to his program's involvement in a STEM robotics competition, Col. Lance Oskey, Cadet Command 7th Brigade commander stated, "we're trying to determine if this is perhaps a future of all of our JROTCs where we can maybe replace an academic bowl that relies on citing information, to showcasing a STEM skill in robotics—that's something we are looking at."[122] Navy and Air Force JROTC programs have already implemented heavy doses of STEM into their curriculums offering both summer opportunities and a STEM-based curriculum for their students.[123]

Programs," U.S. Army, accessed May 1, 2108, https://www.army.mil/article/197782/new_program_promotes_stem_initiatives_in_jrotc_programs.

[118] U.S. Army JROTC, "Co-Curricular Events," accessed May 1, 2018, https://www.usarmyjrotc.com/cadetPortal/cadetCoCurrucularEvents.html.

[119] Ibid.

[120] Ibid.

[121] Ibid.

[122] Maddox, "New Program Promotes STEM Initiatives in JROTC Programs;" U.S. Army JROTC, "Co-Curricular Events."

[123] U.S. Army JROTC, "The U.S. Army JROTC Curriculum," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_Curriculum.html. Air Force JROTC curriculums are based on STEM—mainly aerospace training in order to "instill values of citizenship, service to the United States, personal responsibility and sense of accomplishment garnering the support of their communities." Similarly, Navy JROTC

A separate, but ever present initiative of all JROTC programs is to gain and maintain local community support for their programs.[124] As discussed in the history portion of this literature review, the communities where units reside influence AJROTC programs with their resources and their public opinions.[125] Strategic leaders believe that when AJROTC programs are able to successfully garner the support of their communities—a tangible connection in between the community and the units are established. If support is established, program stability and positive relationship within the communities are likely to remain.[126] Further, community support for AJROTC programs is important, because studies conclude that there is a widening gap in between the military and society.[127] Therefore, communities that support Department of Defense

programs have a citizenship mission, with a curriculum based on Naval science. Both Navy and Air Force JROTC programs have survived training students on STEM-based curriculums since the mid-1960s—despite funding challenges and program criticisms. These programs will be discussed in more detail as part of the STEM programs portion of this literature review.

[124] DoA, CCR 145-2, 22; Rachel Tolliver, "Thanks to Community Support JROTC Cadets Travel To D-Day," U.S. Army Cadet Command, May 22, 2014, accessed May 1, 2018, https://www.army.mil/article/126615/thanks_to_community_support_jrotc_cadets_travel_to_d_day.

[125] DoA, CCR 145-2, 22.

[126] DoA, CCR 145-2, 22; Michael S. McFadden, "Civil and Military Relations Gap America's Disconnect with Its Military" (Civilian Research Project, US Army War College, Institute for National Security and Counterterrorism, Syracuse University, Syracuse, NY, 2017), 2.

[127] DoA, CCR 145-2, 22; McFadden, "Civil and Military Relations Gap America's Disconnect with Its Military," 2.

programs, like AJROTC (where there is a clear military influence), help to create positive impressions resulting in positive relations between the military and society.

Program Effectiveness[128]

This portion of the literature review includes an assessment of thesis, research papers, studies, and articles published regarding the effectiveness of JROTC (with an emphasis on AJROTC programs). In order to narrow the focus of the comparison method used in chapter 4 of this research and to identify specific areas of effectiveness relevant to the research questions, this portion of the literature review reports on the following categories: Educational, and academic achievement and community perceptions of JROTC programs.

Educational and Academic Achievement

The Army concludes that its JROTC programs are "successful" programs.[129] By measuring success, the Army reports that students enrolled in AJROTC programs have better attendance rates, graduation rates, lesser disciplinary infractions, lower dropout rates, and higher grade point averages (GPAs) than students who were not enrolled in AJROTC.[130] Although these results have been published to provide the site picture of the

[128] Although, it is critical, when conducting a comparison study to comment on results related to impacts and effectiveness of programs, this area of research is not well defined with depth in relation to AJROC. Therefore, this research will comment on some of the existing research for all JRTC programs in the area of effectiveness—noting that the quantity, quality, and the breadth of research into specific areas of program effectiveness needs to be expounded upon with further research.

[129] U.S. Army JROTC, "JROTC Program Information."

[130] Ibid.

overall effectiveness of AJROTC programs, these results, were not published with methodologies used to assess the data. The reports are, however, useful in comparing research and studies conducted into specific areas of educational and academic achievement to the Army's measures.

At least one study comparing academic achievement amongst AJROTC students, student athletes, and other students in urban high schools—where 98 percent of the students in the sample school were African American concluded no discernable differences in academic achievement or in leadership skills when evaluating the groups against each other.[131]

A separate study evaluating all JROTC students concluded that JROTC students had lower GPAs and less success on standardized test than non JROTC students.[132] The same study concluded that JROTC students were less likely to attend a program (college or other) following high school than their peers, but that African American cadets enrolled in the JROTC program were less likely to drop out of school as a result of being enrolled in JROTC.[133] Note, data from that study was taken over 15-years ago.[134]

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[131] Carmen Williams-Bonds, "A Comparison of the Academic Achievement and Perceptions of Leadership Skills and Citizenship Traits of JROTC, Student Athletes, and Other Students in an Urban High School" (Ed.D. diss., Lindenwood University, St. Charles, MO, 2013), 1-10.

[132] Elda Pena and Stephen Mehay, "The Effect of High School JROTC on Student Achievement Educational Attainment, and Enlistment," *Southern Economic Journal* 76, no. 2 (October 2009): 533-552.

[133] Ibid.

[134] Ibid.

It is also important to note that students may spend as little as one year in AJROTC programs or as many as four years in the programs.[135] Results related to attendance, GPAs, disciplinary concerns, and testing all are largely dependent on the amount of years a student spends in the program.[136] Research related to the correlation of student success in AJROTC programs based on the amount of time spent in the program was supported by an interview conducted with an AJROTC senior instructor—reiterating that the longer cadets remain in the program the better chances there are to positively impact students and mentor them.[137]

Some researchers believe studies and reports concentrated on evaluating the success of JROTC programs based on results related to academic GPA and success on standardized tests, without considering the time a student spends in a program or in absence of considering intangible factors, including personal interviews.[138] Without that evidence, some researchers believe that the data may present distorted view regarding the

[135] Missouri JROTC Senior Instructor interview.

[136] Missouri JROTC Senior Instructor interview; Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," 229-247.

[137] Missouri JROTC Senior Instructor interview; Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," *Defense and Peace Economics* 21, no. 3 (2010): 229.

[138] John J. Mulholland, "'Tangibles and Intangibles': The Search for an Effective and Comprehensive Evaluation of JROTC" (Diamond Scholar Research, Temple Honors Program, Temple University, Philadelphia, PA, 2005), 5; Missouri JROTC Senior Instructor interview.

effectiveness of programs.[139] More recent lines of AJROTC research measuring program effectiveness stresses evaluating the intangible factors that may not be evident through evaluation of test scores and GPAs.[140]

In its explanation of intangible as a noun, *Dictionary.com* explains that "intangibles are hard to value."[141] In "*Tangibles and Intangibles," The Search for an Effective and Comprehensive Evaluation of JROTC*, the author concludes that analysis surrounding JROTC programs academic achievement, "rarely responds to socio-economic variables."[142] Economic variables includes, but is not limited to, a family's monthly income, educational the level of parents, and status of the family.[143] This study specifically concluded that the nature of AJROTC programs required a comprehensive qualitative review of programs (including a review of tangible and intangible factors) to determine, program's effectiveness.[144] Social variables include a student's maturity, self-control, ability to control stress levels, and mental stability, and are more conclusive in

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[139] Mulholland, "Tangibles and Intangibles," 5; Missouri JROTC Senior Instructor interview.

[140] Mulholland, "Tangibles and Intangibles," 5.

[141] Dictionary.com, "Intangible."

[142] Mulholland, "'Tangibles and Intangibles,' The Search for an Effective and Comprehensive Evaluation of JROTC," 5.

[143] Mulholland, "Tangibles and Intangibles," 5; Krishna Duhan Savita and Shanti Balda, "Socio-Economic Variables: A Contributing Factor for Adolescent's Personality Development," *Journal of Psychology* 3, no. 1 (2012): 47-50.

[144] Mulholland, "'Tangibles and Intangibles," 5.

determining the effectiveness of programs than measuring GPAs or standardized test results.[145]

For example, although, *The Effect of High School JROTC on Student Achievement Educational Attainment, and Enlistment* as mentioned above found evidence of lower, GPAs and standardized tests scores for JROTC students, the same study found that JROTC students resulted in higher "self-esteem" values amongst females—an intangible value.[146] A separate, but similar study noted "a positive correlation between AJROTC participation and assertiveness, caring, social integration, and demographic values scores," when compared with non-AJROTC scores—both studies displaying intangible factors directly related to achievement.[147]

According to JROTC historians Corbett and Coumbes (2001), JROTC was not designed to emphasize academic achievement, but designed to give student opportunities outside of drugs, gangs, and violence prevalent in their communities, building on their self-confidence and motivations to achieve higher standards.[148] This argument further dilutes theories that seek to measure the success of AJROTC programs based on GPA and standardized test success. A sense of identity can further be described as an

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[145] Savita and Balda, "Socio-Economic Variables: A Contributing Factor for Adolescent's Personality Development,"45-50.

[146] Pena and Mehay, "The Effect of High School on JROTC Student Achievement, Educational Attainment, and Enlistment," 2, 22-25.

[147] Janet H. Days and Yee Ling Ang, "An Empirical Examination of the Impact of JROTC Participation on Enlistment, Retention and Attrition" (Thesis, Naval Postgraduate School, Monterey CA), 108.

[148] John W. Corbett and Arthur T. Coumbes, "JROTC: Recent Trends and Developments," *Military Review* 81, no. 1 (January-February 2001): 45.

intangible attribute that may not be measurable through standardized testing or reviewing student's grade point averages GPA.

Similar to other researchers arguments stressing the value of intangibles in JROTC programs, Corbett and Coumbes argue that the programs should be evaluated based on factors that eliminate disruptions and improve the overall quality of the school, rather than based on evaluation of academic achievement.[149] Their arguments are consistent with historical AJROTC initiatives and studies concentrating on intangible factors related success support the trending research measuring AJROTC effectiveness in high schools.[150] Implementation of AJROTC programs in schools during the Bush administration was directed at improving disciplinary infractions and as a way to convince "at risk" students to stay in school.[151] Therefore, studies emphasizing researching intangible factors to determine AJROTC success, instead of through traditional academic measures, seem to be directly related to historical program goals and is consistent with research supporting AJROTC programs as an effective tool to manage disciplinary infractions, while building on student's values.

The Corbettt and Coumbes lines of logic are supported by research further identifying intangible factors of success—skills dedicated to fostering student's

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[149] Corbett and Arthur T. Coumbes, "JROTC: Recent Trends and Developments," 45.

[150] Ibid.

[151] Days and Ang, "An Empirical Examination of the Impact of JROTC Participation on Enlistment, Retention and Attrition," 108.

emotional intelligence.[152] According scholars, Emotional Intelligence (EI) is: "being aware that emotions can drive our behavior and impact people (positively and negatively), and learning how to manage those emotions – both our own and others – especially when we are under pressure."[153] Some theorist believe that EI may be more important to a person's success than a person's scholarly achievement or their intelligence quotient (IQ).[154] As the figure below explains, EI concentrates on emotional regulation over self-awareness, self-management, social awareness, and relationship management, while IQ captures a person's overall intelligence.[155] These EI attributes appear to be closely related to the intangible results research reports AJROTC programs provide.

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[152] Marc A. Brackett, Susan E. Rivers, and Peter Salovey, "Emotional Intelligence: Implications for Personal, Social, Academic, and Workplace Success," *Journal of Social and Personality Psychology* 5, no. 1 (2011), 88-103; Donna Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for EDU" (Ph.D. diss., Capella University, Minneapolis, MN, 2006), 9; Frank Romanelli, Jeff Cain, and Kelly M. Smith, "Emotional Intelligence as a Predictor of Academic and/or Professional Success," *Pharmaceutical Education* 70, no. 3 (June 2006). There are varying definitions of emotional intelligence. For purposes of this research, EI is supported by Daniel Goleman's re-stated definition; Corbett and Coumbes.

[153] Goleman, *Emotional Intelligence, why it Can Matter More Than IQ*, 1-20; Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for EDU," 9.

[154] Goleman, *Emotional Intelligence, why it Can Matter More Than IQ;* Daniel Goleman, "Emotional Intelligence," April 21, 2015, accessed May 1, 2018, http://www.danielgoleman.info/daniel-goleman-how-emotionally-intelligent-are-you/.

[155] Goleman, *Emotional Intelligence, why it Can Matter More Than IQ;* Dictionary.com, "Intelligence Quotient."

An Examination of Emotional Intelligence questioned whether AJROTC instruction improved emotional intelligence amongst cadets.[156] Research shows strong correlations between student achievement and development of the "whole" person as opposed to strictly focusing IQ through academic achievement—in short showing that AJROTC programs promote emotional intelligence.[157] The same research attributed student achievement to enhanced opportunities for students to engage in leadership positions and engage in service learning opportunities.[158] Service learning opportunities are "hands-on opportunities" for AJROTC students to engage in service projects after they learn about the project's usefulness during class-room instruction.[159]

Intangibles fostered through AJROTC programs include opportunities for students to engage learning opportunities that teach them how to lead, collaborate with classmates, exercise self-discipline, set attainable goals, and learn how to serve others.[160] These intangible attributes are consistent with EI competencies, that instructors seek to develop

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[156] Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for EDU," 9; Missouri JROTC Senior Instructor interview.

[157] Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for EDU," 9-29; Missouri JROTC Senior Instructor interview. The "whole" person is a term that was frequently used during the interview with the AJROTC Senior Instructor.

[158] Ibid., 31

[159] Missouri JROTC Senior Instructor interview; DoA, CCR 145-2, 6; Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for EDU," 29-31.

[160] Missouri JROTC Senior Instructor interview; DoA, CCR 145-2; Mulholland, "Tangibles and Intangibles," 5.

in students during their time in AJROTC programs.[161] EI competencies include attributes related to: self-awareness, self-management, social awareness, and relationship management.[162] Engaging in service learning projects like participating in neighborhood trash pick-up, voter registration drives, or blood donation support drives coupled class room instruction related to personal responsibility, civics, leadership help develop student's EI competencies and further develop positive intangible attributes.[163]

During the interview with the AJROTC instructor, he reiterated that a least 2 times a week, the student leadership have opportunities to instruct and teach the other students (i.e. uniform inspection day or drill and ceremony).[164] The instructor noted that with service learning, first, students in the program receive in class instruction, and later apply what they learn in classes through hands-on opportunities or service projects.[165] These "service learning" and hands on experiences help motivate the students and foster EI attributes.[166]

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[161] Missouri JROTC Senior Instructor interview.

[162] Goleman, "Emotional Intelligence."

[163] Missouri JROTC Senior Instructor interview; Goleman, "Emotional Intelligence;" Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for EDU," 9-29.

[164] Missouri JROTC Senior Instructor interview.

[165] Ibid.

[166] DoA, CCR 145-2, 6.

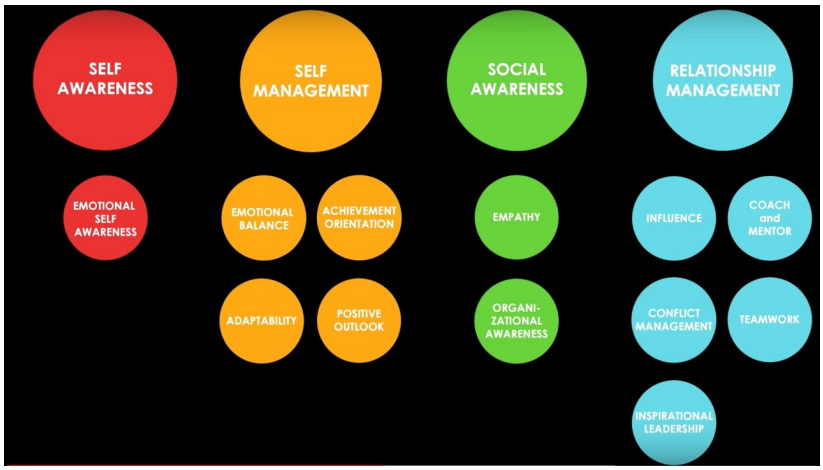

Figure 1. Critical Competencies of EI

Source: Daniel Goleman, "Emotional Intelligence," April 21, 2015, accessed May 1, 2018, http://www.danielgoleman.info/daniel-goleman-how-emotionally-intelligent-are-you/.

Community Perceptions of AJROTC Programs

Evidence related to how administrators and principals perceive AJROTC programs appeared consistent with Corbett and Coumbes theories on the effectiveness of programs, in that studies show school administrators and principals believe JROTC programs have beneficial impacts on students.[167] For example, a qualitative study indicated that administrators from a large Florida school district perceived that AJROTC cadets, who were affiliated with the AJROTC program for at least one year, had less

[167] Lawrence Marks, "Perceptions of High School Principals and Senior Army Instructors Concerning the Impact of JROTC on Rates of Dropout and Transition to College," (Ed.D. diss., East Tennessee State University, Johnson City, TN, 2004), 2; Amy Minkin, "Perceptions of High School Administrators on JROTC in Secondary Schools" (Ed.D. diss., Barry University, Miami Shores, FL, 2014), 114; Corbett and Coumbes, "JROTC: Recent Trends and Developments," 45.

behavioral infractions, disciplinary issues, and attendance issues.[168] It is important to note that these were the administrator's perceptions prior to review of actual evidence.[169]

Although, a similar body of research related to dropout frequency and transition to college, reporting results related to perceptions of high school principals and Senior Army Instructors indicated that in at least one school, AJROTC cadets were more likely to drop out of high school and less likely to go to college than other students in the schools.[170] Again, despite the actual data, administrators perceived AJROTC programs as a cost-efficient program for reducing dropout rates and transitioning students to college.[171] In this study, the administrator's perceptions were not consistent with the data.[172]

Part of the reason, school administrators perceptions concerning the impact of JROTC may be positive despite review of the actual data could be attributed to the Coumbes and Corbett theories reflecting the immeasurable benefits attributed to JROTC programs as discussed previously.[173] When specifically asked about intangible benefits of

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[168] Patty Jean Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program" (Ed.D. diss., Graduate College of Marshall University, Huntington, WV, 2016), ix.

[169] Ibid.

[170] Marks, "Perception of High School Principals and Senior Army Instructors Concerning the Impact of JROTC on Rates of Dropout and Transition to College," 105-107.

[171] Ibid.

[172] Ibid.

[173] Mulholland, "Tangibles and Intangibles," 1; Corbett and Coumbes, "JROTC: Recent Trends and Developments," 45.

JROTC principals and instructors commented on things like appearance, integrity, and a sense of citizenship, confidence—qualities which may not show up in narrow statistical research aimed at dropout rates and college entry.[174] Also, several of these studies fail to consider the actual time a student spends in the AJROTC program, meaning that students who are in the program for 4 years may be more likely to graduate and attend college than students who only stay in the program for 1 year.[175]

Previous researchers recommended several changes related to tracking success in AJROTC programs—for one prioritizing efforts to attract students with pre-existing high academic standards.[176] The author in *Principals Perception of the Effectiveness of JROTC Program* specifically recommends increased emphasis on quality of the instructors to ensure that the delivery of the curriculum met education standards.[177]

Bottom line is that high school administrator's attitudes pay a large role in the success of AJROTC programs, noting that administrator's values normally mirror the community's desires and are closely aligned with the acceptance of the AJROTC mission and philosophy.[178] In an environment where school districts are constantly cutting

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[174] Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program," ix; Mulholland, "Tangibles and Intangibles," 1.

[175] Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," 229-247.

[176] Mulholland, "Tangibles and Intangibles;" Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program," 122; Corbett and Coumbes, "JROTC: Recent Trends and Developments," 45.

[177] Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program," 122.

[178] Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program," 122; Ulises Miranda III, "Exploring the Essence of the Civil–Military Gap: An

programs that are not a part of the core curriculum (math, science, English, social studies, and science), AJROTC programs have to maintain relevance, produce results, and maintain positive relations with administrators and communities.[179] Misunderstandings in program's purposes and goals can negatively impact access to JROTC programs—further noting that negative perceptions by administrators further widen the operational gap (as to how the programs operate) in between communities servicing AJROTC units and the military.[180]

Trends consistent with the evidence related to academic effectiveness of JROTC program derives from measuring the value of intangible and tangible factors gained as a result of program enrollment weighed in conjunction with the timing a student spends in the program.[181] Research shows results related to EI and academic achievement improve

Interpretative Phenomenological Study of High School Administrators' Feelings Related to JROTC" (Ed.D. diss., St John Fisher College, Rochester, NY, 2014), 174.

[179] Missouri JROTC Senior Instructor interview; Miranda, "Exploring the Essence of the Civil–Military Gap: An Interpretative Phenomenological Study of High School Administrators' Feelings Related to JROTC," 16, 174.

[180] Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program;" Miranda, "Exploring the Essence of the Civil–Military Gap: An Interpretative Phenomenological Study of High School Administrators' Feelings Related to JROTC," 16.

[181] Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," 229-247; Missouri JROTC Senior Instructor interview; Mulholland, "Tangibles and Intangibles."

dependent on the timing and quality of instruction, and support administrators have for AJROTC programs.[182]

Program Critiques

Despite the reported positive impacts related to AJROTC programs; community's criticisms are voiced objecting to certain aspects of the AJROTC program.[183] Critics, like the American Civil Liberties Union (ACLU), politicians, national organizations opposing JROTC programs, and community members claim AJROTC programs mirror military recruiting programs[184]

This section of the research reports on a deeply rooted critique concerning AJROTC programs—the allegation that AJROTC programs are alleged to be de facto

[182] Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," 229-247; Missouri JROTC Senior Instructor interview; Mulholland, "Tangibles and Intangibles."

[183] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict;" Ann Jones, "America's Child Soldiers: JROTC and the Militarizing of America," *Truth Out*, December 16, 2013, accessed May 1, 2018, http://www.truth-out.org/news/item/20657-americas-child-soldiers-jrotc-and-the-militarizing-of-america; Sonia Nazario, "Junior ROTC Takes a Hit in LA: At Roosevelt High, a coalition of teachers and students works to end the program, and its numbers are dropping," *Los Angeles Times*, February 19, 2007, accessed May 1, 2018, http://articles.latimes.com/2007/feb/19/local/me-jrotc19; Sandra Mattheson and Wayne E. Ross, eds., *Battleground Schools* (Westport, CT: Greenwood Press, 2008), 420-430; National Network Opposing the Militarization of Youth, "JROTC," accessed May 1, 2018, https://nnomy.org/en/resources/school-militarization/by-program/jrotc.html; Amber Athey, "Code Pink Wants to Remove JROTC From Schools After Parkland Shooting," *The Daily Caller*, March 15, 2018, accessed May 1, 2018, http://dailycaller.com/2018/03/14/code-pink-remove-jrotc-from-schools/.

[184] U.S. Army JROTC, "An Overview of JROTC."

recruiting grounds for the military.[185] Although, there are other documented comments related to the program, this section of the literature review, specifically limits discussion of critiques on the above mentioned concern since this particular critique is directly related to the research questions: whether a greater emphasis on STEM education in Army JROTC programs would enhance the quality of AJROTC programs? (2) whether a STEM-based curriculum in AJROTC programs enhances the federal government's strategic initiatives? This critique is directly relating to research question number one, as greater emphasis on STEM education in AJROTC programs may generate heightened scrutinized views of the AJROTC programs mirroring military recruitment program—given an effort to increase emphasis on technical training via AJROTC. The critique is also relevant to question two of the research since, AJROTC programs are demographically situated in areas where STEM education is currently being heavily promoted, potentially impacting strategic initiatives related to STEM and AJROTC.[186]

Once referred to by the United States Defense Secretary as "one of the best recruiting devices that we could have," AJROTC programs are often perceived, even today, as recruiting programs.[187] In a United States Cadet Command Memo, dated 30

[185] Mattheson and Ross, *Battleground Schools*, 420-430; U.S. Department of the Army (DoA), Policy Memorandum 50*, US Army Recruiting Command (USAREC) Partnership Initiative* (Washington, DC: Government Printing Office, March 1999), accessed May 1, 2018, http://grannypeacebrigade.org/wp-content/uploads/JROTC_recruiting_memo.pdf.

[186] U.S. Army JROTC, "An Overview of JROTC."

[187] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict," 1-13; Jones, "America's Child Soldiers: JROTC and the Militarizing of America;" Mattheson and Ross, *Battleground Schools*

March 1999, JROTC instructors were encouraged to "maximize recruiting efforts, exchange quality referrals, and educate all on both recruiting and ROTC programs and benefits."[188] When considering the actual percentage of students who enlist in the military following high school, exact percentages reported vary.[189] According to the ACLU, citing Karen Houppert, 45 percent of high school cadets participating in JROTC enlist in the military following graduation from high school.[190] Several studies examining AJROTC programs also found that AJROTC cadets were more likely to enlist in the military following high school than students who had not participated in AJROTC.[191] However, several studies report that the actual enlistment rates are very low, under 5 percent.[192]

The DoD does not classify AJROTC as a recruitment program for the military.[193] However, critics complain that DoD JROTC's training and curriculum is tantamount

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420-430; National Network Opposing the Militarization of Youth, "JROTC;" Athey, "Code Pink Wants to Remove JROTC From Schools After Parkland Shooting."

[188] DoA, Policy Memorandum 50.

[189] Missouri JROTC Senior Instructor interview.

[190] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict,"13.

[191] Pena and Mehay, "The Effect of High School JROTC on Student Achievement Educational Attainment, and Enlistment," 2; Days and Ang, "An Empirical Examination of the Impact of JROTC Participation on Enlistment, Retention and Attrition," 108; Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," 229-247.

[192] Callahan, "Impact of JROTC on Educational and Socio-Economic Outcomes," 82; Missouri JROTC Senior Instructor interview.

[193] Missouri JROTC Senior Instructor interview.

recruiting, in violation of the law.[194] Critics also claim that AJROTC programs are inherently militaristic—designed to groom child soldiers.[195] This literature review will explore and define definitions related to child-soldiers and recruitment, in order to provide a better understanding of the basis for the criticisms related to AJROTC programs.

International law prohibits nations from recruiting child soldiers to directly participate in conflicts.[196] According to the Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict (OPAC):

"A child associated with an armed force or armed group refers to any person below 18 years of age who is, or who has been, recruited or used by an armed force or armed group in any capacity, including but not limited to children, boys and girls, used as fighters, cooks, porters, spies or for sexual purposes."[197]

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[194] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict," 13; Jones, "America's Child Soldiers: JROTC and the Militarizing of America;" Mattheson and Ross, *Battleground Schools*, 420-430; National Network Opposing the Militarization of Youth, "JROTC;" Athey, "Code Pink Wants to Remove JROTC From Schools After Parkland Shooting."

[195] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict,"13; Nathan A. Long, "The Origins, Early Developments, and Present-Day Impact of the Junior Reserve Officers' Training Corps on the American Public Schools" (Ed.D. diss., University of Cincinnati, Cincinnati, OH, 2003), accessed May 1, 2018, https://etd.ohiolink.edu/.

[196] Office of the United Nations High Commissioner for Human Rights (OHCHR), *Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict* (Geneva, Switzerland: United Nations, 2000), accessed May 1, 2018, http://www.refworld.org/docid/47fdfb180.html.

[197] United Nations (UN) General Assembly, *Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict* (New York:

Pursuant to United States law, the *Child Soldier Prevention Act of 2008* authorizes nation-states some deference to OPAC regarding the appropriate recruiting age.[198] Similar the Protocol, the United States defines "children" for purposes of direct participation in hostilities and involuntary recruitment is 18 years of age.[199] However, the *Child Soldier Prevention Act* further defines the United States' stance on recruitment by, prohibiting children under the age of 15 from being recruited by a military force.[200] The United States' military recruits at the age of 17, but most soldiers are 18, prior to starting their service obligation.[201]

OPAC also prohibits children from directly participating in hostilities and prohibits involuntary service for children (a draft).[202] As a matter of policy, obligations to serve may begin prior to a Service Member's 18th birthday, however, the United States does not normally send children under the age of 18 to combat or hazard zones.[203]

United Nations, 25 May 2000), accessed May 1, 2018, http://www.refworld.org/docid/47fdfb180.html.

[198] Ibid.

[199] Child Soldiers Prevention Act of 2008, 22 USC 2370c1, section 402 (2008).

[200] Ibid.

[201] U.S. Department of State (DoS), "US Written Replies to OPAC List of Issues," March 14, 2017, accessed May 1, 2018, https://www.state.gov/j/drl/rls/268590.htm; Child Soldiers International, "International Laws and Child Rights," accessed May 1, 2018, https://www.child-soldiers.org/interantional-laws-and-child-rights.

[202] OHCHR, *Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict*.

[203] DoS, "US Written Replies to OPAC List of Issues (number 5)."

AJROTC is a DoD program, funded pursuant to the National Defense Authorization Act, under Operations and Maintenance—training and recruiting.[204] Since JROTC programs are offered to students starting in 9th grade (who may be as young as 14 years old), critics claim that JROTC programs violate International Treaties and domestic laws.[205] Standing behind the premise that JROTC is a citizenship program—creating "favorable attitudes," towards the military, the DoD recognizes that cadets participating in JROTC may gravitate towards a career in the military, but contend that the program does not amount to recruitment or direct participation in the military.[206]

Concerns about the military's influence on cadets stem from the history of the programs and student's exposure to the military via AJROTC.[207] Because cadets wear military uniforms to classes (on designated days), study military history, are instructed by retired military officers, and participate in military drills and ceremonies as a part of some programs of instruction, critics are concerned about the program's intent.[208] As

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[204] 10 USC Section 4301, NDAA.

[205] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict," 13.

[206] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict," 13; Jones, "America's Child Soldiers: JROTC and the Militarizing of America;" Mattheson and Ross, *Battleground Schools*, 420-430; National Network Opposing the Militarization of Youth, "JROTC;" Athey, "Code Pink Wants to Remove JROTC From Schools After Parkland Shooting."

[207] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict," 3.

[208] American Civil Liberties Union, "U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict," 13; Karen Houppert, Who's Next?, *The Nation,* September 12, 2005, accessed May 1, 2018, https://www.thenation.com/article/whos-next/.

recent as 2005, a school in New York came under scrutiny for making JROTC instruction a mandatory portion of the curriculum—delaminating the voluntary nature of the Defense program.[209] Although voluntary in other schools, the militaristic nature of all of the JROTC programs have caused some school districts to ban JROTC programs from being offered in their districts, while other communities have strongly opposed JROTC programs, but been unsuccessful at removing them.[210]

A review of the AJROTC Program of Instruction indicates the LET includes: civics, language arts, geography, health, physical education, United States history, and life skills courses.[211] Life skills courses include classes devoted towards: life work, self-regulation, thinking and reasoning, and working with others.[212] In addition to the LET, many AJROTC instructors elect to participate in co-curriculum activities.[213] Co-curriculum activities may include drill and ceremony, safety, and civilian marksmanship, but they may also include non-militaristic programs as well.[214] After review of the AJROTC program, and critics arguments against them, it appears that the co-curricular

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[209] National Network Opposing the Militarization of Youth, "JROTC." In a New York high school, JROTC was a "mandatory" class.

[210] National Network Opposing the Militarization of Youth, "JROTC."

[211] U.S. Army Cadet Command, *LET, JROTC POI*, 14-17.

[212] Ibid., 15.

[213] U.S. Army Cadet Command, *LET, JROTC POI,* 14-17; U.S. Army JROTC, "An Overview of JROTC."

[214] U.S. Army Cadet Command, *LET, JROTC POI,*14-17; U.S. Army JROTC, "An Overview of JROTC."

activities (of a military nature) and military influences nested within the program directly correlate to critics complaints.

Conclusion of Literature Review-JROTC Portion

This portion of the review provides a qualitative comprehensive review of prior research collected in categories relevant to AJROTC programs. The research collected includes: research papers, thesis, published books, memorandums, articles, information collected from web sites, and interviews. The relevant categories discussed during this portion of the literature review included a compilation of research related to: the history, current operations, program's effectiveness, and critiques of AJROTC programs. The next portion of the review will discuss the same relevant categories, relevant to STEM education programs. These programs will be compared to each other in chapter 4, which will include an analysis of the relevant categories related to both programs. Chapter 5 will follow with recommendations based on the comparative analysis of the programs in consideration of the research questions.

History of STEM

"STEM education" refers to teaching and learning in the fields of science, technology, engineering, and mathematics."[215] An emphasis on STEM education can be traced back to George Washington in his first address to congress, urging our nation to invest in science and mathematics.[216] Therefore, STEM has arguably always played

[215] Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*, 1.

[216] Ibid.

strong role in our nation's training and education.[217] Increased government funding and policies devoted to STEM education came after the launch of Sputnik,[218] which triggered major education reform in the United States.[219]

After Sputnik, the United States passed the *National Defense Act of 1958*—devoting over a billion dollars to science and technology programs in order to address the perceived gaps in science and technology education.[220] Although the *National Defense Act of 1958* increased funding for science and technology, a report published in 1983 by President Ronald Regan's Commission on Excellence in Education—*A Nation at Risk*, portrayed dire outlook on student's achievement in math, verbal skills, and reading, (raising questions about the United States' ability to produce STEM professionals in the future).[221]

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[217] The American Presidency Project, "George Washington," accessed May 1, 2018, http://www.presidency.ucsb.edu/ws/?pid=29431; Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*, 1.

[218] Alvin Powell, "How Sputnik changed U.S. Education," *The Harvard Gazette*, October 11, 2017, accessed May 1, 2018, https://news.harvard.edu/gazette/story/2007/10/how-sputnik-changed-u-s-education/; the United States wanted to maintain competitiveness with the Soviet Union, who were successful at launching the satellite—Sputnik into space.

[219] Powell, "How Sputnik changed U.S. Education;" Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*, 1.

[220] Preceden, "History of Science Education," accessed May 1, 2018, https://www.preceden.com/timelines/68269-history-of-science-education; Rodger Bybee, *The Case for STEM Education: Challenges and Opportunities* (National Science Teachers Association Press, 2013).

[221] The National Commission on Excellence in Education, *A Nation at Risk: The Imperative for Educational Reform* (Washington, DC: National Commission on Excellence in Education, April 1983), 11.

As a result, the federal government developed curriculum content standards relevant to several academic areas (including math and computer science), increased funding devoted to the programs, and implemented standards relevant to educational practices.[222] It would not be until the1990s, that the acronym SMET (Science, Mathematics, Engineering, and Technology) would be born—a formalize term to focus on the educational fields where the United States needed to appropriate funding to STEM program management.[223]

In 2001, the highly controversial *No Child Left behind Act* (NCLB) was passed.[224] *NCLB* designated proficiency standards in math and reading in an attempt to ensure that public schools were providing equal education to students, with goals for all students to attain math and reading proficiency by 2014.[225] *NCLB* set proficiency standards that some educators found to be unattainable and scrutinized underperforming schools, by

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[222] The National Commission on Excellence in Education, *A Nation at Risk: The Imperative for Educational Reform,* 11.

[223] William F. McComas, ed., *The Language of Science Education* (Rotterdam, The Netherlands: Sense Publishers, 2014), 20; SMET would eventually be reorganized into STEM (which is the term used today).

[224] National Public Radio, "No Child Left Behind Act of 2001; NPR, No Child Left Behind, What Worked What Didn't," Video, Title 2, Part B, Sections 2201-2203, October 27, 2015, accessed at May 1, 2018, https://www.npr.org/sections/ed/2015/10/27/443110755/no-child-left-behind-what-worked-what-didn't"; American Institute of Physics, "FY 17 STEM Education," accessed May 1, 2018, https://www.aip.org/fyi/2017/final-fy17-appropriations-stem-education.

[225] Thomas S. Dee and Brian A. Jacob, "The Impact of No Child Left Behind on Students, Teachers, and Schools," *Brookings Papers on Economic Activity* (Fall 2010): 149; Most states also test student's proficiency in science.

measuring student achievement with test scores.[226] Critics of *NCLB* claimed that the *Act* caused teachers to be more concerned about the test measures than ensuring that students understood the material.[227]

Several researchers have concluded that *NCLB*'s standards were unattainable given the tools some schools were given to deliver education to their students.[228] A direct result of *NCLB* was that the federal government increased oversight on the results of standardized tests—a measure of achievement used by educators today.[229] Since the *NCLB* required periodic reporting of schools' standardized tests scores, school's underperformance in math and science became increasingly magnified.[230]

Although educators had previously identified educational gaps in STEM education, the 2005 report *Rising Above the Gathering Storm*, by United States National Academies of Science, Engineering and Medicine outlined a pattern of underachievement in America's abilities compete in STEM globally—further expounding on questions raised in *A Nation at Risk*.[231] *Rising Above the Gathering Storm* report highlighted key areas (related to STEM) in where the United States was falling behind—from automobile

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[226] Dee and Jacob, "The Impact of No Child Left Behind on Students, Teachers, and Schools," 149.

[227] Ibid.

[228] Ibid.

[229] Ibid.

[230] Dee and Jacob, "The Impact of No Child Left Behind on Students, Teachers, and Schools."

[231] The National Commission on Excellence in Education, *A Nation at Risk: The Imperative for Educational Reform,* 1-18.

manufacturing to the problems with the quality of STEM instruction afforded to children attending in public schools.[232] The *report*, which was directed to congress, highlighted implementation actions that should be taken if the United States was going to tighten the STEM gap and be competitive with other nations in the future.[233] This comprehensive report recommended wide spread implementation actions in the area of STEM.[234]

Following the *Rising Above the Gathering Storm* report, the *America Competes Act* of 2007 was implemented, "to invest in innovation through research and development, and to improve the competitiveness of the United States."[235] After this report, congress authorized $136 billion to STEM education programs and research.[236] Congress continues to authorize billions of dollars to STEM education today.[237]

Since Sputnik, if there has been one single catalyst that has magnified STEM education progress in the United States, *Rising Above the Gathering Storm* is central to discussion. Arguments have been made that the STEM crisis today, should be viewed in an historical context, recalling the very concerns the United States had after the Soviet

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[232] Members of the 2005 "Rising Above the Gathering Storm" Committee Rapidly Approaching Category 5, *Rising Above the Gathering Storm Revisited: Rapidly Approaching Category 5* (Washington, DC: The National Academies Press, 2010), 26, 68-104, accessed May 1, 2018, https://www.nsf.gov/attachments/117803/public/3b--RAGS_Revisited.pdf.

[233] Ibid.

[234] Ibid., 162-181.

[235] America Competes Act of 2007, Title 1.

[236] America Competes Act of 2007, Title 1; Preceden, "History of Science Education."

[237] Ibid.

Union launched Sputnik are the same concerns the federal government about the state of STEM education today—noting that the outlook may not be as dire as presented in the report.[238] Despite arguments against America's investments in STEM education, the United States government remains vitally concerned about the quality and progress of STEM education.[239]

STEM-Current Operations

This portion of the literature review provides relevant facts related to STEM educational programs current operations, including: program objectives, program overview, funding, and demographics.

Program Objectives[240]

The federal government's clearly stated STEM educational goal is "to ensure young Americans, the skills they need to be competitive in the job market."[241] This effort requires that the K-12 public educational systems are representative of federal STEM goals.[242] According to the Department of Education, schools must place an emphasis on

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[238] Zakaria, "Why America's Obsession with STEM Education is Dangerous."

[239] The White House, "President Trump Signs Memorandum for STEM Education Funding," September 26, 2017, accessed May 1, 2018, https://www.whitehouse.gov/articles/president-trump-signs-memorandum-stem-education-funding/.

[240] Recently, educators have added an "A" to STEM, (STEAM)—to include "art—design" into the term; Janelle Cox, "STEM vs. STEAM: What's Better?," Teach Hub.Com, last accessed May 1, 2018 at Teachhub.com

[241] The White House, "President Trump Signs Memorandum for STEM Education Funding."

[242] Ibid.

training children to apply their critical thinking skills to solve complex issues and problems.[243] Researchers also see STEM education as an avenue to success, especially for students from underserved areas.[244] The 5-year Strategic STEM education plan (developed during the previous administration) is consistent with the current administration's strategic plan and lists the following national goals in the plan to address the STEM mission:

a. Improving STEM instruction in preschool through 12th grade.
b. Increasing and sustaining public and youth engagement with STEM.
c. Improving the STEM experience for undergraduate students.
d. Better serving groups historically underrepresented in STEM fields.
e. Designing graduate education for tomorrow's STEM workforce. [245]

Despite legislative funding and oversight devoted to high school STEM education (mostly in science and math), researchers and educators report that the quality of high school STEM education is not commensurate with STEM career field forecasts.[246] Due to

[243] DoE, "Science, Technology, Engineering and Math: Education for Global Leadership."

[244] Sharon J. Lynch, Erin Peters Burton, Tara Behrend, Ann House, Michael Ford, Nancy Spillane, Shari Matray, Edmund Han, and Barbara Means, "Understanding Inclusive STEM High Schools as Opportunity Structures for Underrepresented Students: Critical Components," *J Res Sci Teach* 55 (2018): 712-748. https://doi.org/10.1002/tea.21437.

[245] DoE, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10. The five-year plan was set by President Obama and portions of the 5-year plan have been adopted under the current administration.

[246] Specialized STEM Secondary Schools, "STEM Smart Brief, STEM Smart: Lessons from Successful Schools," 1, accessed May 1, 2018, https://successfulstemeducation.org/resources/specialized-stem-secondary-schools.

the gaps in current education standards and opportunities, analyst have concluded that many STEM jobs will remain vacant, (since there will not be skilled workers ready to fulfill the positions).[247]

Converse to the bleak outlook on STEM jobs, there are a healthy segment of researchers refuting the argument that the United States is falling behind in STEM education—claiming the STEM gap is not as dire as presented.[248] However, the United States government remains on a trajectory to increase STEM education, opportunities, and programs, in order to increase student's readiness to work in STEM fields in the future.[249]

STEM Program Overview

The delivery of STEM education in high schools can differ from school to school, district to district, and from state to state.[250] Part of the confusion over funding, goals, and objectives can be attributed to the various definitions used to describe the different

[247] Specialized STEM Secondary Schools, "STEM Smart Brief, STEM Smart: Lessons from Successful Schools, 1; The White House, "President Trump Signs Memorandum for STEM Education Funding."

[248] Robert N. Charette, "The STEM Crisis Is a Myth," Spectrum, August 30, 2013, accessed May 1, 2018, https://spectrum.ieee.org/at-work/education/the-stem-crisis-is-a-myth; Bureau of Labor Statistics, "STEM Crisis or STEM Surplus, Yes and Yes," May 2015, accessed May 1, 2018, https://www.bls.gov/opub/mlr/2015/article/stem-crisis-or-stem-surplus-yes-and-yes.htm.

[249] The White House, "President Trump Signs Memorandum for STEM Education Funding."

[250] Specialized STEM Secondary Schools, "STEM Smart Brief, STEM Smart: Lessons from Successful Schools," 1.

types of STEM education and what educator qualify as STEM.[251] How STEM education establishes performance parameters through curriculums in individual schools can be directly attributed to how STEM education is defined and delivered in a particular high school.[252] Although high school STEM education can be delivered in different forms, researchers have set "specialized STEM schools"—that is schools that dedicate the curriculum to an emphasis on at least one STEM discipline, in a category of their own.[253] Although the federal government maintains oversight over the progress all public high schools make in the areas of STEM, specialized STEM schools differ from traditional high schools (that may offer STEM courses, but are not devoted to STEM), in that the emphasis and program objectives of specialized STEM schools is designed to produce STEM graduates, who are prepared to work in STEM fields or who are being groomed to major in a STEM discipline in college.[254] Traditional high schools (for the purposes of understanding this research) deliver STEM education in the form of regular science,

[251] Specialized STEM Secondary Schools, "STEM Smart Brief, STEM Smart: Lessons from Successful Schools," 1.

[252] Specialized STEM Secondary Schools, "STEM Smart Brief, STEM Smart: Lessons from Successful Schools," 1; Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*, 1.

[253] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; Dana Theus, "Why STEM leaders need emotional intelligence training," Smart Brief, March 29, 2016, 1-4, accessed May 1, 2018, https://www.smartbrief.com/original/2016/03/why-stem-leaders-need-emotional-intelligence-training.

[254] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 80-84; National Research Council, *Successful STEM Education: A Workshop Summary*, 7-14.

mathematics, technology and elective courses devoted to STEM, but do not emphasize STEM disciplines over other disciplines like English or reading.

Specialized STEM schools are further broken down into separate categories: Elite or Selective STEM schools (herein after Selective STEM schools), Inclusive STEM schools (ISTEM), and Career Technical schools (CTE).[255]

Selective STEM schools specialize in at least one discipline and normally require students to be accepted into private and or public schools through a screening process based on academic achievement prior to enrollment.[256] While ISTEM schools set out to achieve similar goals as selective STEM schools, ISTEM schools focus less on past academic performance and more on a student's overall potential to succeed.[257] ISTEM schools often offer open-enrollment on a space available basis.[258] In addition to preparing students with a rigorous academic schedule, these schools seek to offer students real-

[255] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 80-84; National Research Council, *Successful STEM Education: A Workshop Summary*, 7-14.

[256] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; National Research Council, *Successful STEM Education: A Workshop Summary*, 7.

[257] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; National Research Council, *Successful STEM Education: A Workshop Summary*, 7.

[258] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; Benjamin Herold, "Model 'Inclusive' STEM High Schools Share Common Traits, Researchers Say," *Education Week*, May 1, 2014, accessed at May 1, 2018, http://blogs.edweek.org/edweek/DigitalEducation/2014/04/model_inclusive_stem_high_scho.html.

world STEM experiences.[259] (3) STEM focused Career Technical Education (CTE) programs prepare students for a career in STEM following high school or for entry into college—mainly producing "occupationally proficient workers".[260]

Similar to JROTC programs, both ISTEM and CTE programs appeal to students who are "at risk for dropping out of high school" or living in economically disadvantaged areas.[261] These schools often offer "hands-on opportunities" for students, so that they can gain practical experience in a STEM field.[262] Both programs integrate the traditional high school day with a half day CTE schedule.[263] For example, a student may go to their neighborhood high school for half of the day and then go to a CTE Regional Technical

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[259] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs;" Lynch et al., "Understanding Inclusive STEM High Schools as Opportunity Structures for Underrepresented Students: Critical Components," 731.

[260] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; National Research Council, *Successful STEM Education: A Workshop Summary,* 14.

[261] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; National Research Council, *Successful STEM Education: A Workshop Summary,* 14.

[262] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; Missouri Assistant Principal—Inclusive STEM School, telephone interview with author, April 10, 2018.

[263] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; Brian A. Jacobs, "What We Know About Career and Technical Education in High School," Brookings, October 5, 2017, 1-4, accessed May 1, 2018, https://www.brookings.edu/research/what-we-know-about-career-and-technical-education-in-high-school/.

Center for training as part of an apprenticeship, internship, or to participate in a research project.[264]

In an interview with the Dean of Academics at an inner city ISTEM high school located in Missouri, the administrator noted that there was no specific academic selection criteria for students to enroll in the school.[265] Students could "apply" to the school on a space available basis.[266] Academic standards of achievement for freshman and sophomores at the school were similar to what students could find in their neighborhood traditional high schools (core-math, science, English, physical education, and history); however, the administrator noted that Juniors and Seniors could select a "major" in a STEM field and work towards certification in that field (i.e. Emergency Medical Training), perform an internship (i.e. Certified Nurse Assistant) or take advanced level STEM courses (i.e. Advanced placement mathematics).[267] Any three of these tracks could lead to a major for the student in their field of STEM study.[268]

While some specialized STEM schools offer a more robust hands-on experiences for freshman and sophomores to gain practical STEM experience in conjunction with their course work.[269] Most specialized STEM schools will offer additional STEM

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[264] Jacobs, "What We Know About Career and Technical Education in High School," 1-4.

[265] Missouri Assistant Principal interview.

[266] Ibid.

[267] Ibid.

[268] Ibid.

[269] Ibid.

opportunities to upper level high school students in and out of the class room.[270] In addition, specialized STEM schools receiving state funds must still meet state requirements ensuring that students meet requirements in classes, notwithstanding, STEM, (i.e. the completion of mandatory physical education requirements prior to graduation).[271]

Another example, capturing the integration of STEM education into a traditional curriculum is through Air Force and Navy JROTC programs.[272] Most Air Force and Navy JROTC programs have a curriculum based on STEM, but offer a mix of traditional citizenship-type classes. For example, the mission of Air Force JROTC is to "develop citizens of character dedicated to serving their nation and community," however, emphasis on the Air Force curriculum is in the area of Aero Space.[273] Air Force JROTC programs are designed to prepare students to enter into "a highly-technical" civilian or military work-force following high school.[274] Subjects such as history of fight, flight and the human body, and space are taught to the students in conjunction with field trips or

[270] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 81-84; Jacobs, "What We Know About Career and Technical Education in High School," 1-4.

[271] Missouri Assistant Principal interview.

[272] Air University, "Welcome to Air Force JROTC," accessed May 1, 2018, http://www.airuniversity.af.mil/Holm-Center/AFJROTC; Navy Junior ROTC, "Curriculum," accessed May 1, 2018, http://www.njrotc.navy.mil/curriculum.html.

[273] Air University, "Welcome to Air Force JROTC;" Harlington High South, "Typical Week Schedule," accessed May 1, 2018, http://www.hcisd.org/Page/18538.

[274] Air University, "Welcome to Air Force JROTC."

learning activities to reinforce aerospace class room instruction.[275] The figure below denotes a schedule from the Harlington High School Air Force JROTC program, where aero Space education comprises of 40 percent of the program and the overall grade.[276]

Table 2. Sample Schedule Harlington High School South Air Force JROTC Program, Harlington, TX

Day	Curriculum
Monday	Academics (40% of curriculum focus on Aero Space)
Tuesday	Uniform Inspection Day
Wednesday	Physical Fitness
Thursday	Academics (40% of curriculum focus on Aero Space)
Friday	Physical Fitness

Source: Harlington High South, "Typical Week Schedule," accessed May 1, 2018, http://www.hcisd.org/Page/18538.

The delivery and methods used to promote STEM education in high schools vary from school to school and state to state.[277] While some schools may base their curriculums on STEM and offer hands on learning opportunities in STEM occupations, some traditional high schools limit education in STEM to specific programs where STEM may be emphasized, but offered in conjunction with some other program, (similar to Air

[275] Air University, "Curriculum," October 26, 2016, accessed May 1, 2018, http://www.airuniversity.af.mil/Holm-Center/AFJROTC/Display/Article/987799/.

[276] Harlington High South, "Typical Week Schedule."

[277] S. Leonard Gelfand Center for Service Learning and Outreach at Carnegie Mellon University and The Intermediate Unit 1 Center for STEM Education, *STEM Education in Southwestern Pennsylvania*, 6, accessed May 1, 2018, https://www.cmu.edu/gelfand/documents/stem-survey-report-cmu-iu1.pdf.; Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer,* 16.

Force JROTC or after school program).[278] If the Army were to transition its JROTC programs into STEM based programs, then following the CTE, Air Force, or specialized (ISTEM) models may be more suitable, since AJROTC programs do not set rigorous entry requirements for students desiring to enter the programs, like elite specialized STEM schools mandate.

Funding

Funding for STEM education is provided to no less than 15 federal agencies.[279] However, just a few federal agencies receive the majority of funding allocated to STEM education.[280] The Department of Education, a major recipient of federal STEM funding, provides STEM educational support through various programs, including, but not limited to: state grants and educational programs for all ages.[281] In fiscal year 2017, the Department of Education received over 4 billion dollars for STEM programs.[282] The National Science Foundation National Science Foundation also receives substantial portion of the federal budget for STEM education (about 1 billion dollars), and with that money, the National Science Foundation mainly provides science and engineering

[278] Air University, "Welcome to Air Force JROTC;" Missouri Assistant Principal interview.

[279] Library of Congress, *Selected STEM Education Legislative Activity in the 112th Congress*, 7.

[280] American Institute of Physics, "FY 18 STEM Education."

[281] DoE, "Science, Technology, Math, Engineering: Education for Global Leadership."

[282] National Science Foundation, "About Funding," accessed May, 1, 2018, https://www.nsf.gov/funding/aboutfunding.jsp.

support to K-12 schools, post-secondary schools, and other businesses and organizations.[283]

The federal government provides funding to other agencies to promote STEM education including the Department of Defense, the National Institute of Health, and National Aeronautical Space Administration; however, the majority of STEM education resources deriving from the federal government go to the Department of Education and the National Science Foundation.[284] In addition to the federal government's allocations, individual states allocate money dedicated to STEM education.[285]
Congress provides oversight over STEM achievement since they appropriate money to for STEM education programs.[286]

Demographic Information

Analyst project STEM interests (student's likelihood to enter into a STEM profession) educational achievement is normally predicted by achievement on standardized test (in Math and Science), enrollment in advanced science and mathematics

[283] National Science Foundation, "About Funding;" Library of Congress, *Selected STEM Education Legislative Activity in the 112th Congress*, 7.

[284] American Institute of Physics, "FY 18 STEM Education."

[285] Gelfand Center and The Intermediate Unit 1 Center, *STEM Education in Southwestern Pennsylvania*, 6; Gonzalez and Kuenzi, *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer,* 16.

[286] Krista Mattern, Justine Radunzel, and Paul Westrick, ACT Research Report Series 2015 (3), *Development of STE Readiness Benchmarks to Assist Educational and Career Decision Making* (Columbus, IN: ACT Research Co., 2015), accessed May 1, 2018, 1-3, https://www.act.org/content/dam/act/unsecured/documents/ACT_RR2015-3.pdf.

classes during high school, and by monitoring enrollment into STEM degree programs at postsecondary institutions—although some studies report that students who enroll in a STEM degree program may not pursue a STEM occupation following college.[287] While analyst attempt predict who will pursue a STEM career in the future by monitoring achievement on standardized test and degree enrollment, data is also regularly published denoting the demographics related to the United States' STEM job market.

Although data (numerically) can fluctuate depending on the agency reporting the demographic information, three themes remain persistent related to STEM demographics. First, demographic numerical representation in STEM careers varies, and is largely dependent on the way the reporting agency defines STEM education and careers. For example, one study reports women are overrepresented in the area of health care, but underrepresented in computer technology and engineering—therefore if healthcare is characterized under Science, then women would be adequately represented in the area of Science and underrepresented in Technology and Engineering occupations.[288]

In a separate study, the United States Census Bureau collected demographic data using three major categories of STEM occupations, narrowing the focus to employment in computer and mathematics, engineers, life scientist, physical scientist, and social

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[287]Mattern, Radunzel, and Westrick, ACT Research Report Series 2015 (3), 1-3.

[288] Cary Funk and Kim Parker, "Diversity in the STEM Workforce Varies Widely Across Jobs," Pew Research Center, January 9, 2018, 25, accessed May 1, 2018, http://www.pewsocialtrends.org/2018/01/09/diversity-in-the-stem-workforce-varies-widely-across-jobs/. Many analysts do not include healthcare professions in STEM but leave healthcare professions separate. Liana Christin Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin*, American Community Survey Report (Washington, DC: U.S. Census Bureau, September 2013), accessed May 14, 2018, https://www.census.gov/prod/2013pubs/acs-24.pdf.

scientist, excluding other STEM occupations occupations (i.e. Healthcare).[289] The distinctions in definitions make a difference, because the defining characteristics of career fields can change demographic representation regarding field in question.[290] If a field appears to be adequately represented then it may cause confusion over whether an agencies requests for additional funding support federal strategic initiatives.

Second, in general women, African Americans, Hispanics, and students residing in rural communities are underrepresented in most STEM career fields (not including healthcare) and are less likely to pursue STEM education than men and other races.[291] Lastly, those employed in STEM occupations are more likely to have attained postsecondary education, than others who are employed in fields unrelated to STEM.[292]

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[289] Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin,* 4; Joshua Bolkan, "Americans See Range of Problems laguing STEM Education," Campus Technology, 2-25, January 12, 2018, accessed May 1, 2018, https://campustechnology.com/articles/2018/01/12/americans-see-range-of-problems-plaguing-stem-education.aspx; Lamar Smith, R-Texas, "To Fill STEM Jobs, Federal Programs Need to Focus on Results," *The Hill*, December 19, 2017, accessed May 1, 2018, http://thehill.com/blogs/congress-blog/technology/365565-to-fill-stem-jobs-federal-programs-need-to-focus-on-results.

[290] Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin*, 4; Bolken, "Americans See Range of Problems Plaguing STEM Education," 2-25; Smith, "To Fill STEM Jobs, Federal Programs Need to Focus on Results."

[291] Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin,* 4; Bolken, "Americans See Range of Problems Plaguing STEM Education"; Smith, "To Fill STEM Jobs, Federal Programs Need to Focus on Results;" Shalina Chatlani, "Minorities are Making Waves in STEM, But Still Face significant Challenges in Entering the Field, Experts Say," *Education Dive*, June 26, 2017, accessed May 1, 2018, https://www.educationdive.com/news/minorities-are-making-waves-in-stem-but-still-face-significant-challenges/445875/.

[292] Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin,* 4; Bolken, "Americans See Range of Problems Plaguing STEM Education;" Smith, "To Fill STEM Jobs, Federal Programs Need to Focus on Results;" Chatlani,

This indicates that those with post-secondary degrees are more likely to fulfill STEM positions.[293]

Strategic Initiatives

Recent administrations have placed an emphasis on enhancing general STEM education proficiency in K-12 schools for everyone; however, a trend of recent administrations has been to focus on providing quality STEM educational opportunities to underserved populations, mainly minorities, women, and those living in rural communities.[294] Federal administrators note that public schools lack spaces, teachers, equipment, and capabilities to deliver quality STEM instruction in underserved areas.[295] In addition to recruiting and retaining those from underrepresented populations into STEM occupations, the current national strategy emphasizes computer science education throughout schools, regardless the economic make-up of the schools.[296] Studies show that economically disadvantaged school's problems are likely to further magnify deficiencies

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"Minorities are Making Waves in STEM, But Still Face Significant Challenges in Entering the Field, Experts Say."

[293] Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin,* 4; Bolken, "Americans See Range of Problems Plaguing STEM Education," 2-25.

[294] U.S. President, *Presidential Memorandum for the Secretary of Education* (Washington, DC: The White House, September 25, 2017), accessed May 1, 2018, https://www.whitehouse.gov/presidential-actions/presidential-memorandum-secretary-education/.

[295] Bolken, "Americans See Range of Problems Plaguing STEM Education."

[296] U.S. Prsident, *Presidential Memorandum for the Secretary of Education;* Failing schools indicate that schools are not meeting federal achievement standards.

related to STEM education, unless adequate funding is devoted to resolving preexisting problems in the school's curriculums.[297] Since "failing" schools do not meet basic achievement standards (outside of STEM), placing increased emphasis on STEM may cause further deterioration of the school's overall curriculum.[298] Many of these struggling schools do not offer advance science, mathematics, and laboratories otherwise available at "achieving" schools—which places students attending these schools at a STEM educational disadvantage.[299]

Consistent with the current administration, STEM literacy (namely in the area of technology) should be a basic resource provided at all schools.[300] Emphasis on computer science literacy in the current administration is likely due to statistics published showing computer science occupations are outpacing potential employees with the requisite skills to perform the jobs—meaning there is a projected lack of computer technology experts available in the STEM pipeline.[301]

Lastly, recognizing that STEM education requires teachers who have the requisite qualifications to teach in STEM areas, the national strategy targets recruiting and training

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[297] Change the Equation, *Ending the Double Disadvantage: Ensuring STEM Opportunities in Our Poorest Schools*, 1-18, accessed May 1, 2018, https://www.ecs.org/wp-content/uploads/CTE_STEM-Desert-Brief_FINAL.pdf.

[298] Ibid.

[299] Ibid.

[300] U.S. President, *Presidential Memorandum for the Secretary of Education.*

[301] Funk and Parker, "Diversity in the STEM Workforce Varies Widely Across Jobs."

qualified STEM professionals to educate the youth.[302] During the interview with the Dean of Academics, she noted that their school consistently has issues finding qualified teachers to teach STEM, because many qualified STEM professionals enter the private sector and can make 30-40 thousand dollars more than what her school could pay.[303] In her eyes at least, public and charter school pay is not competitive with the private sector, when it comes to recruiting qualified professionals.[304]

Consistent with the Nation's strategic initiatives, DoD has recognized that STEM education is critical to the United States military mission.[305] The DoD STEM strategic plan seeks to develop diverse STEM talent in an effort to "enrich the current and future DoD workforce."[306] In order to achieve the desired end state, the DoD has implemented over 20 STEM educational programs designed to introduce STEM to students (with an emphasis on serving underrepresented populations).[307] For example, Missile Defense Agency Engineering in Art: "provide robotics grants to K-12 students, to develop

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[302] U.S. President, *Presidential Memorandum for the Secretary of Education.*

[303] Missouri Assistant Principal interview.

[304] Ibid.

[305] C. Todd Lopez, "STEM Grads Critical to U.S. Military Mission," US Army, August 14, 2013, accessed May 1, 2018, https://www.army.mil/article/109326/stem_grads_critical_to_us_military_mission.

[306] Department of Defense, DoD STEM, *DoD STEM Strategic Plan FY 2016-FY 2020* (Alexandria, VA: DoD STEM Development Office, 2015), 1-5, accessed May 1, 2018, https://www.acq.osd.mil/rd/publications/docs/DoD_STEM_Strategic_Plan_2015_1022_final.pdf.

[307] Ibid.

student's interest in engineering at an early age."[308] Similarly, the DoD offers various STEM education programs for high school students including, mathematics and science camps, robotics, and cyber camps to name a few.[309] Also, private organizations, like the Air Force Association host the Cyber Patriot Competition—a STEM program designed to build interest in student's desires to work in the cyber security field.[310]

Strategic federal STEM initiatives promote readiness.[311] Plainly stated, the strategy prioritizes equipping students with "relevant" tools, beneficial to their ability to have a stable career and to fulfill critical employment gaps in the future.[312] STEM educational programs are available to a multitude of high school students, and can be delivered through hands on "out of class room" experiences or through additional advanced instruction.[313] Regardless of aptitude or educational background of a student, there are STEM educational programs accepting of students willing to learn in an effort to increase the pipeline of STEM employees who can contribute to the United States.[314]

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[308] Missile Defense Agency, "MDA STEM Initiatives," accessed May 1, 2018, https://mda.mil/about/STEM_initiatives.html.

[309] DoD STEM, "STEM Programs."

[310] Air Force Association's Cyberpatriot, "The National Youth Cyber Education Program," accessed May 1, 2018, https://www.uscyberpatriot.org/Pages/About/What-is-CyberPatriot.aspx.

[311] U.S. President, *Presidential Memorandum for the Secretary of Education.*

[312] Ibid.

[313] Missouri Assistant Principal interview.

[314] U.S. President, *Presidential Memorandum for the Secretary of Education.*

Effectiveness of STEM Education

In order to narrow the focus of the comparison method used in chapter 4 of this research and to identify specific areas of effectiveness relevant to the research questions, this portion of the literature review reports on the following categories: educational, and academic achievement, and community perceptions of programs. Similar to research collected in the AJROTC-program effectiveness portion of this literature view, the depth and breadth of research collected in this area was limited. This portion of the literature review will cover very broad areas focusing on a very narrow body of research.

Educational and Academic Achievement

Studies show that students who are enrolled in specialized STEM schools are more likely to take advanced science and mathematics classes in their high school careers and are more likely to engage in hands on STEM experiences than students who do not attend specialized high schools.[315] This study finding supports the implementation of STEM-based programs in high schools. Research also shows, that students participating in "applied," hands-on approaches in STEM (i.e. STEM in conjunction with hands on experiences) enhances math and science efficacy in students (but not in females or students with disabilities).[316]

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[315] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs," 731; Barbara Means, Haiwen Wang, Xin Wei, Sharon J. Lynch. Vanessa L. Peters, Viki Young, and Carrie Allen, "Expanding STEM Opportunities Through Inclusive STEM-Focused High Schools," *Science Education* 101, no. 5 (September 2017): 681-715, accessed May 1, 2018, https://onlinelibrary.wiley.com/doi/abs/10.1002/sce.21281.

[316] Cameron Sublett and Jay Stratte Plasman, "Applied Stem and Math and Science Self-Efficacy," *Journal of Career and Technical Education* 32, no. 1 (2017): 29-

Research also indicates that ISTEM high schools sparks and cultivates students' interest, placing those students on a track to pursue STEM careers, however, research also shows that the quality of the STEM education delivered matters.[317] Supporting the theory that the comprehensive quality of schools matters, a quantitative study measuring student achievement found that although the school had good intentions, attendance at ISTEM highs schools (the body of high schools included in the research), negatively impacted student's academic achievement in the areas of science, math, reading, and social studies—noting that African Americans attending the schools researched were significantly impacted.[318]

A similar separate study found that the quality of instruction provided to the students, services dedicated to underrepresented students, and a college preparatory curriculum for the entire student body were several commonalities necessary to achieve

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21; "Self-efficacy is described as a personal belief in one's ability to accomplish a task or mission. "

[317] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs, " 731; National Research Council, *Successful STEM Education: A Workshop Summary*, 13; Eric Lichtenberger and Casey George-Jackson, "Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans," *Journal of Career and Technical Education* 28, no. 1 (2013); Ben Dalton, Steven J. Ingels, Laura Fritch, and Elise M. Christopher, *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcript Study: A First Look at Fall 2009 Ninth-Graders in 2013,* (Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, April 2018), accessed May 1, 2018, https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2015037rev; Weis, et al., "In the Guise of STEM Education Reform: Opportunity Structures and Outcomes in Inclusive STEM-Focused High Schools," 1024-1059.

[318] Gnagey and Lavertu, "The Impact of Inclusive STEM High Schools on Student Achievement," 1.

success in an specialized high school.[319] The same study noted that ISTEM high schools—if ran properly, put underrepresented student's on a path to pursue STEM.[320] In further support, *The Impact of Inclusive STEM High Schools on Student Achievement* found that because of the poor planning and allocation of resources, students attending the selective STEM school in the research were at a disadvantage.[321]

This assertion further supports that attendance in a specialized STEM school cannot be the sole indicator to determine if a student will pursue a STEM career field—STEM curriculum coupled with meaningful research projects, projects, laboratories, or real-life applications, in a well-run school are sound projectors of a student's ability to achieve higher scores in STEM classes, resulting increased desire for students to pursue a STEM career.[322] Similar to service learning, promoted in AJROTC programs, applied instruction in STEM combines class room instruction with an opportunity to test student's knowledge in a field of study.[323]

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[319] Lynch et al., "Understanding Inclusive STEM High Schools as Opportunity Structures for Underrepresented Students: Critical Components."

[320] Ibid.

[321] Gnagey and Lavertu, "The Impact of Inclusive STEM High Schools on Student Achievement," 5.

[322] Bryan Goodwin and Heather Hein, "Research Says/STEM Schools Produce Mixed Results," *Educational Leadership* 72, no. 4 (December 2014/January 2015): 84-85, accessed May 14, 2088, http://www.ascd.org/publications/educational-leadership/dec14/vol72/num04/STEM-Schools-Produce-Mixed-Results.aspx; Weis et al., "In the Guise of STEM Education Reform: Opportunity Structures and Outcomes in Inclusive STEM-Focused High Schools," 1024-1059.

[323] Ibid.

CTE programs specializing in STEM provide good examples of hands on or applied learning techniques, and similar to JROTCCAs, students are afforded the opportunity to engage in learning experiences after being trained in the classroom.[324] While some studies show that applied STEM or CTE STEM students are less likely to attend college, they are likely to be employed in a technology field following high school at a higher rate than others who do not attend applied STEM schools.[325] The employment trends indicate that the training provided during high school sets students on a path to pursue a career in STEM following high school.[326] The STEM employment trends following high school were corroborated by the Dean of Academics at an ISTEM high school in Missouri who reiterated that students were offered intern and externships at their school during their junior and senior year as a mechanism to prepare graduating senior to enter the workforce in specified STEM occupations following high school.[327]

The applied approach in STEM educational programs also facilitates corporation and teamwork in students.[328] Studies show that while ISTEM and CTE students may not

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[324] Jacobs, "What We Know About Career and Technical Education in High School," 1-4.

[325] Ibid.

[326] See Eric A. Hanushek, Ludger Woessman, and Lei Zhang, "General Education, Vocational Education, and Labor-Market Outcomes over the Life-Cycle," *Journal of Human Resources* 52, no. 1 (2017): 49-88; Michael A. Gottfried and Jay Stratte Plasman**,** "Linking the Timing of Career and Technical Education Course taking With High School Dropout and College-Going Behavior," *American Educational Research Journal 55, no. 2 (*October 2017): 325-361.

[327] Missouri Assistant Principal interview.

[328] Outlier Research and Evaluation, "STEM School Study (S3)," accessed May 1, 2018, http://outlier.uchicago.edu/s3/findings/classroom-behaviors/.

necessarily receive higher test scores on standardized test in math or science, specialized STEM programs, who combine an applied approach to STEM programs with quality instruction are more likely to retain students in STEM high school classes and attract them into STEM careers following graduation.[329]

Community Perceptions

Generally, parents and students support STEM education in schools.[330] According to one study, although most parents of primary and secondary students see the importance of STEM education in schools and would like to see their children pursue a STEM career, the majority of parents are not willing to devote additional funding to STEM educational programs.[331] Although the government has a burgeoning concern involving the future of STEM career gaps in the United States, the willingness to provide financial support for additional programs to address the STEM deficit may be lacking.

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[329] See Hanushek, Woessman, and Zhang, "General Education, Vocational Education, and Labor-Market Outcomes over the Life-Cycle," 49-88; Gottfried and Plasman, "Linking the Timing of Career and Technical Education Course taking With High School Dropout and College-Going Behavior," 325-361.

[330] Cary Funk and Kim Parker, "Most American Evaluate STEM Education as Middling Compared with Other Developed Nations," Pew Research Center, January 9, 2018, accessed May 1, 2018, http://www.pewsocialtrends.org/2018/01/09/5-most-americans-evaluate-stem-education-as-middling-compared-with-other-developed-nations/.

[331] Harris Interactive, "STEM Perceptions: Student and Parent Study Parents and Students Weigh in on How to Inspire the Next Generation of Doctors, Scientists, Software Developers and Engineers," Survey Commissioned by Microsoft Corp, 3-6, accessed May 1, 2018, https://news.microsoft.com/download/archived/presskits/citizenship/docs/STEMPerceptionsReport.pdf.

Other research regarding perceptions report that students have a lack of interest in STEM fields, because STEM is not promoted at an early age in their communities, or students simply feel as though they are not "smart enough" to pursue a STEM career.[332] This body of research is consistent with studies showing that underserved students do not show interest in STEM, because of a lack of opportunities available to them to explore STEM early in their educational career.[333] These self-defeating attitudes are perpetuated in schools do not have the funding or resources to provide a quality education to students, further limiting students options, before they have an opportunity to experiment with STEM.[334]

Critiques of STEM Education Programs

Similar to AJROTC programs, there are several criticisms related to STEM education; however, this literature review will only address one, which is directly related to the secondary research question. The critique revolves around the promotion of STEM

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[332] Lisa Henley and Phyllis Roberts, "Perceived Barriers to Higher Education in STEM Among Disadvantaged Rural Students: A Case Study," *The Journal of the Virginia Community Colleges* 20, no. 1 (2016):19-38; Alexandra Osssola, "Too Many Kids Quit Science Because They Don't Think They're Smart," *The Atlantic*, November 3, 2014, accessed May 1, 2018, https://www.theatlantic.com/education/archive/2014/11/too-many-kids-quit-science-because-they-dont-think-theyre-smart/382165/.

[333] National Academies of Sciences, Engineering and Medicine, *Barriers and Opportunities for 2-Year ad 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways* (Washington, DC: National Academies Press, 2016), accessed May 1, 2018, https://www.ncbi.nlm.nih.gov/books/NBK368176/.

[334] National Academies of Sciences, Engineering and Medicine, *Barriers and Opportunities for 2-Year ad 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways;* Change the Equation, *Ending the Double Disadvantage: Ensuring STEM Opportunities in Our Poorest Schools*, 1-18.

education de-emphasizing other important attributes, fields, and characteristics students obtain through other degree fields, like liberal arts—further developing the "whole" student.[335]

Mark Zuckerberg—founder of Facebook, Carly Fiorina—former Hewlett-Packard CEO, and Stewart Butterfield—co founder of Slack Technology were all liberal arts majors who have thrived in STEM occupations.[336] Butterfield claims that his degree program in philosophy helped him to improve his writing skills, which ultimately helped him become an effective communicator.[337] Zuckerberg said, "it's in Apple's DNA that technology alone is not enough — that it's technology married with liberal arts, married with the humanities, that yields us the result that makes our hearts sing."[338]

Others claim that force feeding STEM-based education causes an unbalanced student or students who are underdeveloped in social sciences, creative arts, innovation, and working with others in diverse settings.[339] For example, in some areas of technology,

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[335] Educational Support Professionals, "Meeting the Needs of the Whole Student," assessed May 1, 2018, 1-8, https://www.nea.org/assets/docs/150306-ESP_DIGIBOOK.pdf; Whole student is a term used to explain concentration on all attributes, intellectually and emotionally to develop a well-rounded citizen.

[336] George Anders, "That 'Useless' Liberal Arts Degree Has Become Tech's Hottest Ticket," *Forbes*, July 29, 2015, accessed May 1, 2018, https://www.forbes.com/sites/georgeanders/2015/07/29/liberal-arts-degree-tech/#7c3a0a87745d.

[337] Ibid.

[338] Zakaria, "Why America's Obsession with STEM Education is Dangerous."

[339] Jennifer Weaver, PhD, "Diversity Can Benefit Teamwork in STEM," Berkeley Center for Teaching and Learning, accessed May 1, 2018, https://teaching.berkeley.edu/diversity-can-benefit-teamwork-stem.

competence in one's ability to perform the specified tasks may be favored over emotional intelligence or a person's ability to regularly interact with others.[340]

Consistent with Zuckerberg and Butterfield, educators profess that some students need a "broad-based" education—exposure to a variety of subjects better fosters creativity and advancement.[341] Educators promoting the broad-based or whole-student theory recognize that although the United States is ranked 27th in Math and 21st in science internationally, America has never achieved high results related to standardized test (dating back to the 1960s)—which begs the question as to why the United States attempts to predict future achievement based on how well students fair on standardized test in the areas of math and science?[342] Despite the outcome of bleak standardized test results, the United States has continued to produce leaders who have been at the forefront of innovation and economic success in various fields.[343]

Lack of a broad exposure to academic areas outside of STEM and lack of diversity in the field of STEM have caused critics to question the emphasis placed on generating more STEM professionals—at the detriment to other fields.[344] While the

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[340] Theus, "Why STEM Leaders Need Emotional Intelligence Training."

[341] Zakaria, "Why America's Obsession with STEM Education is Dangerous;" Larry D. Shinn, "Liberal Education vs. Professional Education: The False Choice," *Trusteeship Magazine*, January/February 2014, accessed May 1, 2018, https://www.agb.org/trusteeship/2014/1/liberal-education-vs-professional-education-false-choice.

[342] Zakaria, "Why America's Obsession with STEM Education is Dangerous."

[343] Ibid.

[344] Ibid.

criticism is noted, a legitimate concern continues to dedicate efforts on producing STEM professionals to fulfill future STEM jobs.

Conclusion-Chapter 2

This review of literature provides a comprehensive review of prior research collected in categories relevant to both STEM education and AJROTC programs. The research collected includes: research papers, thesis, published books, memorandums, articles, information collected from web sites, and interviews. The relevant categories of STEM education and AJROTC programs researched and discussed in this chapter include: the history, current operations, program's effectiveness, and criticisms. Next chapter 3, provides the research methodology used to compare both programs. Chapter 4 analyzes both programs using the comparison method followed by recommendations in chapter 5.

CHAPTER 3

RESEARCH METHODOLOGY

The purpose of this conceptual qualitative study is to compare two federally supported programs prevalent in United States secondary schools—STEM and AJROTC. A comprehensive comparison of both programs' history and mission, operations, program effectiveness, and criticisms will identify similarities and differences in both programs, ultimately addressing the mutual benefits and recommendations for improvement regarding both programs. This study addresses whether AJROTC programs could benefit from curriculum changes applicable to federal STEM initiatives today. Steps to complete this study were as follows:

1. First, review of the research questions directed the required research. The primary research question is: whether a greater emphasis on STEM education in Army JROTC programs would enhance the quality of AJROTC programs? The secondary research question is: whether a STEM-based curriculum in AJROTC programs enhances the federal government's strategic initiatives? To answer the primary and secondary questions, qualitative research was conducted into the entire scope of both questions. Research included: review of laws, statutes, thesis, research papers, case studies, articles, and interviews, covering AJROTC and STEM programs.

2. After conducting the qualitative research, concepts were developed based on the information collected.[345] After the data was collected and analyzed, categories

[345] Juliet Corbin and Anselm Strauss, *Basics of Qualitative Research, Techniques and Procedures for Developing Grounded Theory* (Thousand Oaks, CA: Sage Publications, 2015), 6-7.

relevant to both programs were created to make the data manageable and understandable as a part of the comparison.

3. The following provides an explanation about each category derived based on the evidence collected and analysis of the data:

History of AJROTC and STEM Educational Programs: A comparison of the history of both programs provides a holistic approach to understanding the inception and present-day nature of both programs.[346] Viewing the similarities and differences of the history offers explanations to how both programs developed that may not otherwise apparent to the reader.

Operations: This category specifically provides an overview of how each program is managed. In order to further limit operations, the following subcategories were developed based on the data: program objectives, funding, demographics, and strategic initiatives. These subcategories further define who is involved with both programs, the costs of running both programs management, the overall current mission, and goals for each program. Through and understanding and comparison of current operations, further analysis can be conducted discussing the immediate impacts any change to curriculum may cause on day-to-day operations in AJROTC programs.

Program Effectiveness specifically compares research taken from both STEM educational and AJROTC programs. The topic program effectiveness is broad in nature. In the area of research dedicated to program effectiveness, the author recognizes that there is not a breadth of qualitative or quantitative research discussing a specific area of

[346] Corbin and Strauss, *Basics of Qualitative Research, Techniques and Procedures for Developing Grounded Theory*.

effectiveness (i.e. Effectiveness in relation to GPAs only). It is, however, critical, when conducting a comparison study to comment on results related to impacts and effectiveness of programs. Therefore, this research will comment on some of the existing research—noting that the scope of research into specific areas of program effectiveness needs to be expounded upon with further research.

Program Critiques: A comparison of the critiques of both programs helps provide pertinent responses to both research questions. Comparison in this category balances legitimate strategic concerns related to both programs in an effort to consider how STEM education implementation may impact present concerns. It was also important in the research to provide oppositions to both programs in order to prevent bias in the comparison—favoring one program over the other.

4. Also, to prevent biased results regarding the impact, effectiveness, this research analyzes multiple resources on JROTC programs (emphasis on Army programs) and STEM programs (different types of STEM programs). The reviews included multiple authors, who cited multiple view points on the programs. Case studies, longitudinal studies, empirical research, interviews and articles were all a part of the research.

5. After analyzing literature relevant to the categories, this research discusses the similarities and differences in both programs. Ultimately, by comparing the specific categories, this research addresses the benefits and criticisms of both programs and whether JROTC programs should place a greater emphasis on STEM education programs.

Table 3. Categories to be Compared in Chapter 4 Analyzing the Research Provided in Chapter 2				
Category	JROTC Program	STEM Education Programs	Similarities	Differences
History of Programs				
Operations				
Effectiveness-Education and Academic Achievement				
Criticisms				

Source: Created by author.

CHAPTER 4

ANALYSIS

This thesis compares and contrast AJROTC programs to high school STEM education programs in the United States, and questions how AJROTC programs may benefit from a STEM-based curriculum. Each research question will be examined based on the literature review presented in chapter two. This chapter will further synthesize evidence gathered as a result of research into both STEM and AJROTC programs by comparing categories of research. The categories are as follows: history, current operations, strategic initiatives, program effectiveness, and program criticisms.

Primary Research Question

Whether a greater emphasis on STEM education in Army JROTC programs would enhance the quality of AJROTC programs?

Secondary Research Question

Whether a STEM-based curriculum in Army JROTC programs enhances the federal government's initiatives?

History Comparison

STEM educational and AJROTC programs were both reactionary, in that the federal government responded to questions regarding the United States' readiness to face adversaries.[347] By creating programs to address deficiencies in the United States Army

[347] U.S. Army JROTC, "An Overview of JROTC;" Dee and Jacob, "The Impact of No Child Left Behind on Students, Teachers, and Schools."

and STEM, the federal government responded to gaps in recruitment.[348] Both programs were focused on steering student's career choices following high schools to enhance student's opportunities to be productive members of society following high school (with a meaningful career) and as a way to increase the United States readiness to respond to outside threats.[349] Furthermore in the 1990s, JROTC programs were strategically placed in underserved communities in an effort to encourage high school students to stay in school.[350] Consequently, AJROTC programs enroll a *demographically but not necessarily geographically* diverse population of students, while STEM educational programs look to recruit a *demographically* and *geographically* diverse population of students.[351]

Comparing the history of both programs reveals that readiness has been at the forefront of both programs since their inceptions. Although implementation of both programs have historically followed different paths, a major catalyst of both programs can be attributed to our nation's readiness to respond to foreign threats. More importantly, AJROTC programs were strategically placed in demographically diverse populations, which is the very population of students' federal social initiatives related to recruitment seek to attract.[352] This means that AJROTC programs may be made up of

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[348] U.S. Army JROTC, "An Overview of JROTC;" Dee and Jacob, "The Impact of No Child Left Behind on Students, Teachers, and Schools."

[349] Ibid.

[350] Powell and Persico, *My American Journey,* 555-556.

[351] U.S. Army JROTC, "JROTC History."

[352] Powell and Persico, *My American Journey,* 555-556.

students, who could fulfill federal STEM initiatives, as it relates to those initiatives designed to attract diverse populations of students.

Current Operations Comparison-Objectives

Program goals include developing integrity, social, and emotional attributes in students.[353] Note, ARJOTC programs are not recruitment programs, but are designed to ensure that students are prepared to explore post graduate opportunities and careers following high school and prepared to be a part of the "global workforce."[354] In addition, AJROTC places an emphasis on STEM proficiency.[355] STEM educational programs are clearly designed to attract students into STEM careers, in an effort to address impending STEM career gaps.[356] While STEM educational program's intent are narrowly focused on cultivating STEM professionals, AJROTC programs seek to address the whole student—offering a wider range of citizenship-based classes and a curriculum.[357]

[353] U.S. Army Cadet Command, *LET, JROTC POI,* 8-13.

[354] U.S. Army JROTC, "JROTC Program Information."

[355] DoA, CCR 145-2, 1.

[356] DoE, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10.

[357] U.S. Army Cadet Command, *LET, JROTC POI,* 8-13; DoE, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10.

Table 4. Army JROTC Curriculum and Federal STEM Strategic Plan, 2013

AJROTC Program Goals	STEM Education Program Goals
a. Act with integrity and personal accountability as they lead others to succeed in a diverse and global workforce. b. Engage civic and social concerns in the community, government, and society. c. Graduate prepared to excel in post-secondary options and career pathways. d. Make decisions that promote positive social, emotional, and physical health. e. Value the role of the military and other service organizations.	a. Improving STEM instruction in preschool through 12th grade. b. Increasing and sustaining public and youth engagement with STEM. c. Improving the STEM experience for undergraduate students. d. Better serving groups historically underrepresented in STEM fields. e. Designing graduate education for tomorrow's STEM workforce.

Source: U.S. Department of Education, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10, accessed May 1, 2018, https://www.ed.gov/stem; U.S. Army JROTC, "JROTC Program Information," accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_ProgramInfo.html. NOTE: AJROTC Program Goals data from U.S. Army Cadet Command, *Leadership Education and Training (LET), JROTC Program of Instruction (POI)* (Fort Monroe, VA: U.S. Army Cadet Command, 2010), 8-13; U.S. Army JROTC, "JROTC Program Information;" accessed May 1, 2018, https://www.usarmyjrotc.com/JROTC_ProgramInfo.html; U.S. Department of the Army, Cadet Command Regulation 145-2, *Junior Reserve Officer Training Program, Organization, Administration, Operations, Training and Support* (Fort Knox, KY: U.S. Army Cadet Command, 2012), 1; STEM Education Program Goals data from U.S. Department of Education, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10, accessed May 1, 2018, https://www.ed.gov/stem.

The goals of AJROTC programs address employment readiness following high school in a multitude of fields, as well as development of EI and intangible attributes that ultimately contribute to forming a better citizen who can contribute to society.[358]

Similar to their goals at inception (historically), both programs still place an emphasis on providing career opportunities to high school students in an effort to ensure

[358] Mulholland, "Tangibles and Intangibles."

students are ready to contribute as citizens of the United States, and globally as leaders, after leaving high school.[359] Both programs place an emphasis on teamwork, applied "hands on" instruction during high school, meaningful employment following high school, and developing critical thinking skills.[360] Although the *ways* to achieve results differ (STEM has a narrow focus), both programs are focused on preparing well- high school students, who can first realize their talents, and then employ their talents on behalf of the United States following high school.

Although the goals of AJROTC programs have some cross-over similarities as seen in STEM education programs, the purpose and intent of AJROTC programs is to develop the whole person and not to train STEM professionals. This means that if AJROTC programs emphasized a STEM curriculum, program goals may need to be reorganized. A relook at program goals can ensure that a new curriculum considers training opportunities that foster EI and captures the intangible benefits AJROTC provides to students.

Current Operations Comparison-Overview

STEM education is a loosely defined term, meaning that there is a lack of consistency as to how educators define and deliver STEM education in secondary

[359] DoE, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10; U.S. Army Cadet Command, *LET, JROTC POI,* 1-13.

[360] DoE, "Science, Technology, Math, Engineering: Education for Global Leadership," 1-10; U.S. Army Cadet Command, *LET, JROTC POI,* 1-13.

schools.[361] STEM education can be offered: as a part of the schools' traditional curriculum (i.e. Chemistry class), in an applied educational setting (i.e. Robotics club), or through a specialized STEM educational program (Inclusive STEM, CTE, or Selective STEM schools).[362] Unlike STEM teachers, it is not necessary that AJROTC instructors have specialized training in any educational discipline.[363] However, where there may be a surplus of instructors willing to serve in certain AJROTC programs, finding qualified STEM educators to teach STEM has been reported as a challenge.[364]

Both programs currently offer applied instruction—that is a blend of classroom instruction with an opportunity to exercise competencies with a hands-on approach. Research supports that where applied education is offered in conjunction with classroom instruction, students are more likely to stay engaged and achieve better academic results than they would without applied instruction.[365] Both programs seek to offer students experiences that can be applied to every-day situations. For example, some AJROTC programs offer map reading as a part of the core curriculum and some STEM educational

[361] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs," 731.

[362] Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 80-84; National Research Council, *Successful STEM Education: A Workshop Summary*, 7-14.

[363] DoA, CCR 145-2, 24-29.

[364] Missouri Assistant Principal interview.

[365] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs," 731.

programs offer internships in applied science fields—both scenarios designed to introduce students to concepts trained.[366]

Since both programs see the importance of applied instruction, AJROTC programs may consider developing curriculums inclusive of STEM educational opportunities available in their high schools (existing STEM opportunities) or in their communities (partnerships). This may strengthen AJROTC ties to the community and offer a viable way for AJROTC programs to offer additional STEM education to students without hiring additional instructors.

Conversely, if the high school where the AJROTC program is affiliated has a failing overall educational program (outside AJROTC) then, a combination of STEM educational efforts into the AJROTC program could impair the student's educational experience. If a STEM-based program was implemented in a failing school, then it would be unlikely that the program would garner the appropriate emphasis and resources necessary to achieve positive results.[367]

Current Operations Comparison-Funding

According to the *National Defense Authorization Act* for Fiscal Year 2017, the Department of Defense expended approximately $370 million dollars on all JROTC

[366] U.S. Army Cadet Command, *LET, JROTC POI,* 18.

[367] Change the Equation, *Ending the Double Disadvantage: Ensuring STEM Opportunities in Our Poorest Schools*, 1-18.

programs.[368] The majority of funding is dedicated to paying instructor's salaries for about 4000 instructors worldwide.[369] The money spent on JROTC programs pales comparison to the amount of money the federal government spends on STEM educational programs.[370] Both programs receive state's funding; although, states paying JROTC instructors can seek reimbursement for instructors pay (about 4000 instructors) from the federal government.[371]

Despite the billions of dollars devoted to STEM education; a major concern rest in the high school administrator's ability to find qualified STEM professionals to teach STEM.[372] If AJROTC programs modified their curriculums to focus on STEM education, then AJROTC programs would need additional funding devoted to training their curriculum, and there may not be enough available in federal funds to implement the changes to the AJROTC instruction. Plainly stated, unless a well thought out curriculum with adequate funding, is provided to support a STEM-based AJROTC curriculum, such change in the program may not be attainable.

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[368] 10 United States Code § 2031, Junior Officer Reserve Training Corps, (2018); Goldman et al., *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps*, ix.

[369] U.S. Army JROTC, "Apply: Before You Get Started," accessed May 14, 2018, https://www.usarmyjrotc.com/JROTC_Apply.html.

[370] National Science Foundation, "About Funding;" Library of Congress, *Selected STEM Education Legislative Activity in the 112th Congress*; Primary and secondary educational programs are lumped into federal spending.

[371] U.S. Army Cadet Command, *LET, JROTC POI,* 12.

[372] Missouri Assistant Principal interview.

Since the federal government devotes billions of dollars to STEM education, allocating federal funds for STEM education may be possible. For example, the Air Force allocated 2.4 million dollars in scholarships for Air Force JROTC cadets who showed an interest in learning to fly.[373] Although school districts and JROTC programs may not have the funding available, other federal entities interested in collaborating to promote STEM education may work in conjunction with STEM-based AJROTC programs.

Current Operations Comparison-Demographics

Both AJROTC programs and STEM educational programs are challenged at reaching rural communities.[374] However, the very population as it relates to minority and female students enrolled in JROTC programs, are the population of students the federal government hopes to attract into meaningful STEM careers in the future. Although there are only approximately 157, 000 minority cadets and approximately 125, 600 female cadets in AJROTC, offering a STEM-based AJROTC curriculum to these students could help achieve the federal government's STEM education initiatives by introducing an enhanced STEM education to students who are otherwise underrepresented in STEM careers.[375]

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[373] Gideon Grudo, "USAF Drops $2.4 Million in Scholarships to Get Cadets Private Pilot Licenses," *Air Force Magazine*, January 11, 2018, accessed May 1, 2018, http://www.airforcemag.com/Features/Pages/2018/January%202018/USAF-Drops-24-Million-in-Scholarships-To-Get-Cadets-Private-Pilot-Licenses.aspx.

[374] Goldman et al., *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps*, ix; U.S. President, *Presidential Memorandum for the Secretary of Education.*

[375] U.S. Army JROTC, "JROTC History."

The nature of JROTC programs is structured around close-knit relationships in between the instructors and the cadets.[376] Normally the instructors know all of the cadet's names, interest, and family members.[377] The close—knit familial relationship bears importance because, studies indicate that self-efficacy and confidence are important factors in maintaining a student's in STEM.[378]

A STEM-based curriculum could offer cadets introduction to STEM early in their high school careers (during LET 1), giving them a higher probability for success in STEM fields. Early introduction to a STEM curriculum, coupled with the close attention and mentorship afforded by AJROTC instructors could bolster student's self-efficacy and result in increased STEM interest amongst the underrepresented STEM demographic population. The nature of AJROTC programs promote self-confidence and build on attributes that may help students to be successful in a STEM-heavy curriculum.

Strategic Initiatives Comparison

As reported in the literature review portion related to demographics, women, minorities, those from rural communities are underrepresented in STEM career fields (when healthcare is not included in STEM).[379] Therefore, major federal STEM initiatives

[376] Missouri JROTC Senior Instructor interview.

[377] Ibid.

[378] Pena and Mehay, "The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter," 229-247; Missouri JROTC Senior Instructor interview.

[379] Landivar, *Disparities in STEM Employment by Sex, Race, and Hispanic Origin,* 4.

revolve around engaging women, minorities and those from rural communities to participate in STEM education programs in hopes that they will later pursue a STEM career.[380] There is also an emphasis on computer technology literacy in schools, and on recruiting and retaining educators willing to teach STEM education in schools.[381]

In a 2017, article about a JROTC program's involvement in a STEM robotics competition, Col. Lance Oskey, Cadet Command 7th Brigade commander stated, "we're trying to determine if this is perhaps a future of all of our JROTCs where we can maybe replace an academic bowl that relies on citing information, to showcasing a STEM skill in robotics -- that's something we are looking at."[382] AJROTC programs have implemented STEM education into daily instruction with "leading edge" technology and offer co-curricular opportunities devoted to STEM, like the one week-robotics summer competition mentioned above.[383]

In addition to an increase emphasis on offering STEM opportunities, AJROTC programs continue to seek to engage the community where they reside.[384] Positive engagements in the community build support for AJROTC programs—which may help build positive relationship in between the community and the military.

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[380] U.S. President, *Presidential Memorandum for the Secretary of Education.*

[381] Ibid.

[382] Maddox, "New Program Promotes STEM Initiatives in JROTC Programs."

[383] Ibid.

[384] U.S. Army JROTC, "JROTC Program Information;" DoA, CCR 145-2, 1.

Implementation STEM-based AJROTC programs could bolster AJROTC and STEM education strategic initiatives since, students in AJROTC programs would be beneficiaries of STEM education. This means that STEM education would be provided to the population of students strategic STEM education initiatives intend to reach (if the same demographic population of students remained in AJROTC programs).

However, since JROTC programs survive off of communities' support, offering a STEM-based curriculum should consider the communities and the students' support for the change in the program's curriculum. Both parents and administrators currently have positive perceptions of AJROTC programs.[385] Also, change to a STEM-based curriculum could turn students away from AJROTC if they were looking for a traditional experience or if they fear that they will not be able to understand the curriculum.[386] Since AJROTC students can take AJROTC courses at any point during their time in high school; the quality of a STEM-based AJROTC curriculum may be diluted.[387] Since both programs are lacking a desired presence in rural communities, offering a new hybrid AJROTC may satisfy AJROTC and STEM strategic initiatives, since programs have been have not had a presence in rural communities in the past.[388]

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[385] Marks, "Perceptions of High School Principals and Senior Army Instructors Concerning the Impact of JROTC on Rates of Dropout and Transition to College," 2; Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program."

[386] Missouri JROTC Senior Instructor interview.

[387] Missouri JROTC Senior Instructor interview; Mulholland, "Tangibles and Intangibles," 1-5.

[388] Goldman et al., *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps*, ix; Noonan, *STEM Jobs: 2017 Update*.

Most importantly, as it relates to a STEM-based AJROTC curriculum, a major change should only come after understanding the impacts on the communities supporting the AJROTC programs. Failure to gain the communities support could severely impact AJROTC programs core continuing strategic initiative, that is gaining and maintaining the communities' support in an effort to build relations in between the Army (using AJROTC as a conduit) and society.

Program's Effectiveness-Educational and Academic Achievement Comparison

Research into the effectiveness of AJROTC programs shows that AJROTC programs were designed to produce intangible results, like self-confidence, motivation, responsibility.[389] By focusing on intangible attributes, AJROTC programs foster EI—that is the development of: self-awareness, self-management, social awareness, and relationship management.[390] Through AJROTC's combination of service learning and class room curriculum, instructors concentrate efforts on training the whole student, as some researchers have concluded that EI is more important than IQ when it comes to employability.[391]

[389] Mulholland, "Tangibles and Intangibles," 1-5; Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for Education," 9.

[390] Rice, "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for Education," 9; Goleman, "Emotional Intelligence."

[391] Ibid.

Most public schools do offer some form of STEM education, but the level of education, type, and quality all differ. Because STEM education can be delivered in various forms, results related to the effectiveness of STEM educational programs vary.[392]

Research shows that students who attended ISTEM schools were more likely to enroll in advanced science and mathematics classes later in high school, and more likely to engage in applied STEM experiences during high school than those who did not attend ISTEM or specialized STEM high schools.[393] However, attendance at a specialized STEM (no matter what type) schools cannot be the only measure of effectiveness—the quality of program, intensity of the instruction, and resources devoted to learning, play a large role in the effectiveness of non-selective STEM education programs.[394] This means that if non-selective STEM schools do not offer a combination of a quality applied curriculum and are not properly resourced, then students attending these specialized

[392] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs," 731; Erdogan and Stuessy, "Modeling Successful STEM High Schools in the United States: An Ecology Framework," 8.

[393] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs, " 731; National Research Council, *Successful STEM Education: A Workshop Summary*, 13; Lichtenberger et al., "Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans;" Dalton et al., *(HSLS:09) 2013 Update and High School Transcript Study*.

[394] Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs, " 731; National Research Council, *Successful STEM Education: A Workshop Summary*, 13; Lichtenberger et al., "Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans;" Dalton et al., *HSLS:09 2013 Update and High School Transcript Study*.

STEM schools may be at a disadvantage.[395] Non-selective STEM programs' students are most similar to the type of students enrolled in AJROTC, in that there is no application process or screening required to enter either programs.

The integration of a STEM-based curriculum into AJROTC programs would require additional funding and resources dedicated to program instruction. Since studies reveal that the quality of the delivery of STEM education matters, adding STEM to the curriculum, without properly resourcing the changes made to the program could result in a decline in student's GPAs, chances of enrollment in advanced STEM classes, and performance on standardized test results.[396].

Further, if the curriculum is shaped to focus on STEM then some portion of the AJROTC curriculum will have to be cut, which means that the program may no longer be useful in developing all of the whole-student. The essence of applied STEM educational curriculum requires some service learning, teamwork, self-awareness, self-management, social awareness, and relationship management; however, if these characteristics are to

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[395] Gnagey and Lavertu, "The Impact of Inclusive STEM High Schools on Student Achievement." 1-21; Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs, " 731; National Research Council, *Successful STEM Education: A Workshop Summary*, 13; Lichtenberger et al., "Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans;" Dalton et al., *HSLS:09 2013 Update and High School Transcript Study*.

[396] Gnagey and Lavertu, "The Impact of Inclusive STEM High Schools on Student Achievement," 1-21; Means et al., "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs, " 731; National Research Council, *Successful STEM Education: A Workshop Summary*, 13; Lichtenberger et al., "Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans;" Dalton et al., *HSLS:09 2013 Update and High School Transcript Study*.

remain a part of the AJROTC instruction, then close attention must be afforded to creating a STEM/AJROTC curriculum that facilitates applied/service-learning STEM instruction and incorporates EI into to the curriculum. This will ensure that students are not disadvantaged and trained as a whole-student after the curriculum change.

Program's Effectiveness-Community Perceptions Comparison

Administrators support the intangible benefits AJROTC programs bring to their school.[397] However, administrators are most concerned with providing meaningful opportunities for their students to develop and ensuring that the curriculum and goals nest with standards.[398]Although administrators and communities generally support AJROTC programs, some communities, politicians, and organizations do not support AJROTC, as they claim that the programs are illegal recruiting operations.[399]

Regarding STEM, parents and students support STEM education in schools.[400] However, bringing quality STEM programs into high schools is a major issue and when it comes to spending, some educators believe that other programs and initiatives are more

[397] Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program;" Miranda, "Exploring the Essence of the Civil–Military Gap: An Interpretative Phenomenological Study of High School Administrators' Feelings Related to JROTC," 174.

[398] Blake, "Principals' Perceptions of the Effectiveness of the JROTC Program;" Miranda, "Exploring the Essence of the Civil–Military Gap: An Interpretative Phenomenological Study of High School Administrators' Feelings Related to JROTC," 174; Funk and arker, "Most American Evaluate STEM Education as Middling Compared with Other Developed Nations."

[399] National Network Opposing the Militarization of Youth, "JROTC."

[400] Funk and Parker, "Most American Evaluate STEM Education as Middling Compared with Other Developed Nations."

important than spending on STEM education.[401] Also, while the federal government may be spending billions of dollars on STEM education, studies show that in order to build the STEM pipeline, emphasis must be placed on attracting students to STEM, who would otherwise be uninterested.[402] Even if there are quality STEM educational opportunities available, sometime must be spent building students confidence in their abilities to pursue a STEM career—which should happen early in a student's education (primary) and not later.[403] It is questionable as to if STEM indoctrination in high school through AJROTC programs may be too little too late. With the limited time, AJROTC programs have with students (weekly), a STEM-based curriculum may not be enough to prepare students to enter the STEM career pipeline following high school.

Since extra-curricular classes are constantly being cut in an effort to meet local budget expectations, AJROTC programs have to justify the quality and importance of their programs.[404] Although, school districts are reimbursed by the DoD for the portion of the salary paid by the district and despite support from the communities, AJROTC programs still require school resources not funded by the federal government.[405]

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[401] Funk and Parker, "Most American Evaluate STEM Education as Middling Compared with Other Developed Nations."

[402] National Science Foundation, "About Funding;" Library of Congress, *Selected STEM Education Legislative Activity in the 112th Congress.*

[403] Henley and Roberts, "Perceived Barriers to Higher Education in STEM Among Disadvantaged Rural Students: A Case Study," 19-38.

[404] Missouri JROTC Senior Instructor interview.

[405] U.S. Army Cadet Command, *LET, JROTC POI,* 8.

AJROTC programs may potentially benefit from curriculum changes that cut cost for the district, but strengthen a students' competencies in core curriculum subjects, such as science and mathematics. By consolidating program instruction in some STEM areas, AJROTC programs may combine efforts on STEM instruction and attract a wider pool of students. For example, if a student could receive AJROTC elective credit for attending coding or a computer programing class, already offered at the school, as opposed to attending drill and ceremony day, then a part of AJORTC requirements for that LET could be fulfilled. The LET would be fulfilled, while the student is integrating applied STEM into their schedule and utilizing resources available from within the school. Note, this example would require a cut to a portion of the AJROTC class in exchange for technical, applied STEM instruction. Also note, drill and ceremony develop intangibles and EI traits that may not necessarily be replicated with a coding class.

Critiques Comparison

Federal STEM initiatives seek to "recruit, attract, and retain" high school students to consider STEM employment following high school.[406] The DoD strategic plan for STEM seeks to develop a diverse pool of STEM talent in an effort to "enrich the current and future DoD workforce."[407] If AJROTC programs enhanced STEM training, making it a part of the standard curriculum afforded to cadets, then it may increase concerns regarding the militaristic nature of AJROTC programs. The STEM-training may have

[406] Air University, "Welcome to Air Force JROTC;" Navy Junior ROTC, "Curriculum."

[407] DoD STEM, *DoD STEM Strategic Plan FY 2016-FY 2020,* 1-5.

criticized as training, tantamount to recruitment for the military, since a STEM-based curriculum takes on a more specialized approach.

However, with a citizenship/life-skills mission, 40 percent of the Air Force JROTC curriculums are dedicated to aerospace training in order to "instill values of citizenship, service to the United States, personal responsibility and sense of accomplishment garnering the support of their communities."[408] Similarly, Navy JROTC programs have a citizenship mission, with a curriculum based on Naval science.[409] Both Navy and Air Force JROTC programs have successfully trained students on STEM-based curriculums since the mid-1960s—despite funding challenges and similar program criticisms.[410] Conversely, this also means that it is unlikely that an induction of a STEM-based program into the AJROTC curriculum would quell criticisms related to the "militaristic nature" of AJROTC programs.

Lastly, a STEM-based program may diminish the broad-based approach AJROTC programs offer. Introduction of a STEM curriculum into the program will have to come at a cost—cutting some portion of the AJROTC curriculum. Close attention to the changes could foster development of a curriculum that emphasizes STEM but builds on other activities and portions of the program, so that programs could maintain some of the intangible characteristics that make them successful.

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[408] Air University, "Welcome to Air Force JROTC."

[409] Air University, "Welcome to Air Force JROTC;" Navy Junior ROTC, "Curriculum."

[410] Air University, "Welcome to Air Force JROTC;" Navy Junior ROTC, "Curriculum."

Table 5. Comparison Chart

Category	AJROTC Program	STEM Education Programs	Similarities	Differences
History of Programs	- Recruitment Program for war in its inception -Targeted high school kids -Curriculum originally focused on military training	-The US need to compete and stay ahead of other countries STEM -Targeted K-12 kids	Readiness for students to contribute following high school was key in both programs.	STEM programs target a wider audience and delivering a wide range of different types of instruction
Current Operations	-Motivating students to be better citizens -A sense of accomplishment -Teamwork -Nesting between programs and the military -Promotion of STEM-based activities in programs, with demographically diverse population of students	-Mission is to feed the STEM pipeline with talent -Looking to attract minorities, women, rural community	-Building student's readiness to contribute -Both programs support teamwork and collaboration -Both programs are looking to place a greater emphasis in rural communities -Both programs recognize the importance of STEM	-STEM funding is much higher than AJROTC program and afforded to K-12 students -Demographic representations are different in both programs -Skilled/educated/qualified teachers need to teach STEM, whereas AJROTC instructors do not require the same skills or education
Category	AJROTC Program	STEM Education Programs	Similarities	Differences
Effectiveness-	-Intangible attributes -Helps students to stay in school and graduate -The longer students stay in the program, the more likely they are to achieve program success -Administrators and communities generally have positive perceptions of programs	-Achievement in STEM is dependent on the quality programs- may vary -The longer students stay in achieving programs, more likely to achieve success -Parents additional in STEM may not be supporting -Some students are intimidated by STEM and therefore never consider a career in STEM	-Timing and applied instruction benefit of both programs	AJROTC measures of effectiveness-intangibles and tangibles. Focused on the development of EQ, while STEM measure of effectiveness-focus on tangible results and IQ
Criticisms	Some consider it as a recruitment tool	By emphasizing STEM, students miss out on other	Critics of both programs are concerned about	AJROTC has developed into a citizenship—whole student program, although critics do not comment on

Source: While the chart was created by the author, the content in the chart was taken from information derived during the research for this thesis—found in the literature review and bibliography.

Conclusion

After review and analysis of the research into the question: whether a greater emphasis on STEM education in Army JROTC programs would enhance the quality of AJROTC programs, the research shows that there are benefits inherent in emphasizing STEM education in AJROTC programs, although detailed planning considerations should be implemented prior to any change.

Although STEM educational goals are narrowly focused to train students to be proficient in STEM and fulfill STEM jobs in the future, strategically, both programs seek target the same demographic audience and currently both programs seek to train "global leaders" to pursue meaningful careers following high school. Therefore, while AJROTC programs could benefit from increased STEM initiatives, important aspects of AJORTC programs may be lost if STEM is implemented as the base curriculum. The very portions of the AJROTC programs that seek to give students opportunities to build on EI may go neglected in an effort to train technically sound students. Also, funding, resourcing, and community support towards a STEM-based education should be evaluated prior to changing the curriculum. If STEM education is properly resourced, has community support, and offers a proper balance of service learning opportunities, then a STEM-based JROTC program may be effective in serving federal STEM and JROTC goals. The effectiveness of the program would be largely based on resources, and methodology applied to the program.

After review and analysis of the research into the question: whether a STEM-based curriculum in AJROTC programs enhances the federal government's strategic initiatives, while change from a traditional AJROTC curriculum to a STEM-based

curriculum may offer STEM opportunities to an underserved and underrepresented population of students, there is no guarantee that students, who have historically underperformed in academics, would be attracted to STEM-based AJROTC programs. Heavy recruitment and advertising would need to be done in order to encourage students to sign up for a STEM-based AJROTC. Further, something would need to be done to keep students involved in programs form the entirety of their high school careers. Timing and intensity when it comes to STEM education and AJROTC programs matter, and implementation of a STEM-based program late in a student's career may not be helpful in filling the STEM pipeline.

Lastly, a gauge of community support for the program's change should be taken into consideration prior to implementation. Without community support for AJROTC programs, programs fail, and where there is no support in between communities and AJROTC programs, there is a deepening concern for support of the Army (at least as it relates to that specific community). Therefore, support of the community is key, prior to implementation of an AJROTC STEM-based program. A way to test the STEM JROTC could be through the start of pilot programs. Pilot programs could not only test the community support for such an initiative, but also further explore the strengths and weakness of the program's effectiveness.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This thesis compares AJROTC programs to high school STEM education programs in the United States, and questions how AJROTC programs may benefit from a STEM-based curriculum. Each research question was examined based on the literature review presented in this thesis. This chapter gives recommendations and conclusions based on the evidence collected in chapter 2 and the comparative method analysis provided in chapter 4.

Further research should look to other DoD JROTC programs to see how STEM can best be implemented through JROTC. For example, consider expansion of AJROTCCA in order to afford students early opportunities at "applied STEM" courses within AJROTC programs, where students have the opportunity to engage in hands on activities. Also, building on STEM competence early could help students succeed in a STEM-based AJROTC program. Review Air Force and Navy AJROTC programs to look at the benefits and disadvantages present in those STEM-based educational programs.

Consider how the DoD could address funding shortages necessary to transition a traditional AJROTC program into a STEM-based JROTC program. This could be done using community partnerships (subject to legal requirements), collaborating services from within the school district, or by qualifying for federal STEM education funds that the school may not already be receiving.

Strengthen community outreach programs and build community partnerships where students can engage in STEM service learning within the community in order to build on STEM interest early in student's careers. Ensure that the community and the

administration is supportive of the initiative, both within and outside of the schools. These efforts could help to fill the STEM pipeline and also help to bridge gaps in understanding between the military and civilian communities.

Give students an option to earn AJROTC credit for STEM education in lieu of traditional AJROTC credited classes while incorporating STEM in AJROTC curriculums that build on student's emotional intelligence. Lastly, more STEM-based educational opportunities, similar to the summer STEM training offered.

Conclusion

This thesis compared AJROTC programs to high school STEM education programs in the United States and questioned how AJROTC programs may benefit from a STEM-based curriculum. After review, AJROTC programs could benefit from a STEM-based curriculum, but not without resourcing and additional research prior to implementation.

BIBLIOGRAPHY

Books

Bandura, A. "Self-efficacy." In *Encyclopedia of Human Behavior*, edited by V. S. Ramachaudran, 71-81. New York: Academic Press, 1994. Reprinted in H. Friedman, ed. *Encyclopedia of Mental Health*. San Diego: Academic Press, 1998.

Bybee, Rodger. *The Case for STEM Education: Challenges and Opportunities*. Arlington, VA: National Science Teachers Association Press, 2013.

Corbin, Juliet, and Anselm Strauss. *Basics of Qualitative Research, Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks, CA: Sage Publications, 2015.

Coumbes, Arthur T., Lee S. Harford, and Paul N. Kotakis. *U.S. Army Cadet Command-The 10 Year History*. Fort Monroe, VA: U.S. Army Cadet Command, 1996.

Goleman, Daniel. *Emotional Intelligence: Why It Can Matter More Than IQ*. New York: Bantam Books, 1995.

Joseph, Paul. *The Sage Encyclopedia of War: Social Science Perspectives*. Thousand Oaks, CA: Sage Publications, 2017.

Mattheson, Sandra, and Wayne E. Ross, eds. *Battleground Schools.* Westport, CT: CT: Greenwood Press, 2008.

McComas William F., ed. *The Language of Science Education*. Rotterdam, The Netherlands: Sense Publishers, 2014.

Powell, Colin, and Joseph E. Persico. *My American Journey*. New York: Ballentine Books, 1995.

Waltzer, Michael. *Interpretation and Social Criticism*. Cambridge, MA: Harvard University Press, 1993.

Government Documents

Office of the United Nations High Commissioner for Human Rights. *Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict.* Geneva, Switzerland: United Nations, 2000. Accessed May 1, 2018. http://www.refworld.org/docid/47fdfb180.html.

U.S. Army Cadet Command. *Leadership Education and Training (LET). JROTC Program of Instruction (POI)*. Fort Monroe, VA: U.S. Army Cadet Command, 2010.

U.S. Department of the Army. Cadet Command Regulation 145-2, *Junior Reserve Officer Training Program, Organization, Administration, Operations, Training and Support*. Fort Knox, KY: U.S. Army Cadet Command, 2012.

———. Policy Memorandum 50, *US Army Recruiting Command (USAREC) Partnership Initiative*. Washington, DC: Government Printing Office, March 1999. Accessed May 1, 2018, http://grannypeacebrigade.org/wp-content/uploads/JROTC_recruiting_memo.pdf.

U.S. Department of Defense, DoD STEM. *DoD STEM Strategic Plan FY 2016-FY 2020.* Alexandria, VA: DoD STEM Development Office, 2015. Accessed May 1, 2018. https://www.acq.osd.mil/rd/publications/docs/DoD_STEM_ Strategic_Plan_2015_1022_final.pdf.

United Nations General Assembly. *Optional Protocol to the Convention on the Rights of Child on the Involvement of Children in Armed Conflict*. New York: United Nations, 25 May 2000. Accessed 28 April 2018. http://www.refworld.org/docid/47fdfb180.html.

Periodicals

Brackett, Marc A., Susan E. Rivers, and Peter Salovey. "Emotional Intelligence: Implications for Personal, Social, Academic, and Workplace Success." *Journal of Social and Personality Psychology* 5, no.1 (2011): 88-103.

Corbett, John W., and Arthur T. Coumbe. "JROTC: Recent Trends and Developments." *Military Review* 81, no. 1 (January-February 2001): 40-45.

Dee, Thomas S., and Brian A. Jacob. "The Impact of No Child Left Behind on Students, Teachers, and Schools." *Brookings Papers on Economic Activity* (Fall 2010): 149-207.

Erdogan, Niyazi, and Carol L. Stuessy. "Modeling Successful STEM High Schools in the United States: An Ecology Framework." *International Journal of Education in Mathematics Science and Technology* 3, no. 1 (January 2015): 77-92.

Freeman, Scott, Sarah L. Eddy, Miles McDonough, Michelle K. Smith, Nnadozie Okoroafor, Hannah Jordt and Mary Pat Wenderoth. "Active Learning Increases Student Performance in Science, Engineering, and Mathematics. *PNAS* 111, no. 23 (June 2014): 8410-8415.

Gnagey, Jennifer, and Stéphane Lavertu. "The Impact of Inclusive STEM High Schools on Student Achievement." *AERA Open* 2, no. 2 (April-June 2016): 1-20.

Goodwin, Bryan, and Heather Hein. "Research Says/STEM Schools Produce Mixed Results." *Educational Leadership* 72, no. 4 (December 2014/January 2015): 84-85. Accessed May 1, 2018. http://www.ascd.org/publications/educational-leadership/dec14/vol72/num04/STEM-Schools-Produce-Mixed-Results.aspx.

Gottfried, Michael A., and Jay Stratte Plasman. "Linking the Timing of Career and Technical Education Course taking With High School Dropout and College-Going Behavior." *American Educational Research Journal* 55, no. 2 (October 2017): 325-361.

"Guise of STEM Education Reform: Opportunity Structures and Outcomes in Inclusive STEM-Focused High Schools." *American Educational Research Journal* 52, no. 6 (December 2015): 1024-1059.

Hanushek, Eric A., Ludger Woessman, and Lei Zhang, "General Education, Vocational Education, and Labor-Market Outcomes over the Life-Cycle." *Journal of Human Resources* 52, no. 1 (2017): 49-88.

Henley, Lisa, and Phyllis Roberts. "Perceived Barriers to Higher Education in STEM Among Disadvantaged Rural Students: A Case Study." *The Journal of the Virginia Community Colleges* 20, no. 1 (2016): 19-38.

Lichtenberger, Eric and Casey George-Jackson. "Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans." *Journal of Career and Technical Education* 28, no. 1 (2013).

Lynch, Sharon J., Erin Peters Burton, Tara Behrend, Ann House, Michael Ford, Nancy Spillane, Shari Matray, Edmund Han, and Barbara Means. "Understanding Inclusive STEM High Schools as Opportunity Structures for Underrepresented Students: Critical Components." *J Res Sci Teach* 55 (2018): 712-748. DOI: 10.1002/tea.21437.

Means, Barbara, Haiwen Wang, Viki Young, Vanessa L. Peters, and Sharon J. Lynch. "STEM Focused High Schools as a Strategy for Enhancing Readiness for Postsecondary STEM Programs." *Journal of Research and Science Teaching* 53, no. 5 (May 2017): 709-736.

Means, Barbara, Haiwen Wang, Xin Wei, Sharon J. Lynch. Vanessa L. Peters, Viki Young, and Carrie Allen. "Expanding STEM Opportunities Through Inclusive STEM-Focused High Schools. *Science Education* 101, no. 5 (September 2017): 681-715. Accessed May 1, 2018. https://onlinelibrary.wiley.com/doi/abs/10.1002/sce.21281.

Pena, Elda, and Stephen Mehay. "The Effect of High School JROTC on Student Achievement Educational Attainment, and Enlistment." *Southern Economic Journal* 76, no. 2 (October 2009): 533-552.

———. “The Impact of The High School JROTC Program: Does Treatment, Timing and Intensity Matter.” *Defense and Peace Economics* 21, no. 3 (2010): 229-247.

Romanelli, Frank, Jeff Cain, and Kelly M. Smith. “Emotional Intelligence as a Predictor of Academic and/or Professional Success.” *Pharmaceutical Education* 70, no. 3 (June 2006): 69.

Savita, Krishna Duhan, and Shanti Balda. “Socio-Economic Variables: A Contributing Factor for Adolescent’s Personality Development.” *Journal of Psychology* 3, no. 1 (2012): 47-50.

Sublett, Cameron, and Jay Stratte Plasman. “Applied Stem and Math and Science Self-Efficacy.” *Journal of Career and Technical Education* 32, no. 1 (2017): 29-50.

Reports/Papers

Abbey, Robyn, and Lawrence M. Hanser. *JROTC Career Academies Guidebook*. Santa Monica, CA: Rand Corporation, 1995. Accessed May 1, 2018, https://www.rand.org/pubs/monograph_reports/MR573/index2.html.

American Civil Liberties Union. *U.S. Violations of the Optional Protocol on the Involvement of Children in Armed Conflict: Soldiers of Misfortune – Abusive U.S. Military Recruitment and Failure to Protect Child Soldiers*. Accessed May 1, 2018 https://www.aclu.org/files/pdfs/humanrights/crc_report_20080513.pdf.

Blake, Patty Jean. “Principals’ Perceptions of the Effectiveness of the JROTC Program.” Ed.D. diss., Graduate College of Marshall University, Huntington, WV, 2016.

Bridges, Jon P. “Preparing Historically Underserved Students for STEM Careers: The Role of an Inquiry-based High School Science Sequence Beginning with Physics.” Ph.D. diss., Portland State University, Portland, OR, 2017.

Callahan, David C. “Impact of JROTC on Educational and Socio-Economic Outcomes.” Ph.D. diss., University of Colorado, Colorado Springs, CO, 2016.

Change the Equation. *Ending the Double Disadvantage: Ensuring STEM Opportunities in Our Poorest Schools*. Accessed May 1, 2018. https://www.ecs.org/wp-content/uploads/CTE_STEM-Desert-Brief_FINAL.pdf.

Dalton, Ben, Steven J. Ingels, Laura Fritch, and Elise M. Christopher. *High School Longitudinal Study of 2009 (HSLS:09) 2013 Update and High School Transcript Study: A First Look at Fall 2009 Ninth-Graders in 2013*. Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, April 2018. Accessed May 1, 2018. https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2015037rev.

Days, Janet H., and Yee Ling Ang. "An Empirical Examination of the Impact of JROTC Participation on Enlistment, Retention and Attrition." Thesis, Naval Postgraduate School, Monterey, CA, 2004.

Elliott, Marc N., Lawrence M. Hanser, and Curtis L. Gilroy. *Evidence of Positive Student Outcomes in JROTC Career Academies*. Santa Monica, CA: RAND Corporation, 2000. Accessed May 1, 2018. https://www.rand.org/pubs/monograph_reports/MR1200.html.

Goldman, Charles A., Jonathan Schweig, Maya Buenaventura, and Cameron Wright. *Geographic and Demographic Representativeness of the Junior Reserve Officers' Training Corps*. Santa Monica, CA: RAND Corporation, 2017. Accessed May 1, 2018. https://www.rand.org/pubs/research_reports/RR1712.html.

Gonzalez, Heather, B., and Jeffrey J. Kuenzi. *Science, Technology, Engineering, and Mathematics (STEM) Education: A Primer*. Washington, DC: Congressional Research Service, August 2012. Accessed May 1, 2018. https://www.stem.org/cm/dpl/downloads/content/69/R42642.pdf.

Institute for Economics and Peace. *Economic Consequences of War on the U.S. Economy*. 2015. Accessed May 1, 2018. http://economicsandpeace.org/wp-content/uploads/2015/06/The-Economic-Consequences-of-War-on-US-Economy_0.pdf.

Jacobs, Brian A. "What We Know About Career and Technical Education in High School." Brookings, October 5, 2017. Accessed May 1, 2018. https://www.brookings.edu/research/what-we-know-about-career-and-technical-education-in-high-school/.

Landivar, Liana Christin. *Disparities in STEM Employment by Sex, Race, and Hispanic Origin.* American Community Survey Report. Washington, DC: U.S. Census Bureau, September 2013. Accessed May 1, 2018. https://www.census.gov/prod/2013pubs/acs-24.pdf.

Library of Congress, Congressional Research Service. *Selected STEM Education Legislative Activity in the 112th Congress.* Washington, DC: Congressional Research Service, October 2011.

Long, Nathan A. "The Origins, Early Developments, and Present-Day Impact of the Junior Reserve Officers' Training Corps on the American Public Schools." Ed.D. diss., University of Cincinnati, Cincinnati, OH, 2003. Accessed May 1, 2018. https://etd.ohiolink.edu/.

Marks, Lawrence. "Perceptions of High School Principals and Senior Army Instructors Concerning the Impact of JROTC on Rates of Dropout and Transition to College." Ed.D. diss., East Tennessee State University, Johnson City, TN, 2004.

Mattern, Krista, Justine Radunzel, and Paul Westrick. ACT Research Report Series 2015 (3), *Development of STE Readiness Benchmarks to Assist Educational and Career Decision Making*. Columbus, IN: ACT Research Co., 2015. Accessed May 1, 2018. https://www.act.org/content/dam/act/unsecured/documents/ACT_RR2015-3.pdf.

McFadden, Michael S. "Civil and Military Relations Gap America's Disconnect with Its Military." Civilian Research Project, US Army War College, Institute for National Security and Counterterrorism, Syracuse University, Syracuse, NY, 2017.

Members of the 2005 "Rising Above the Gathering Storm" Committee Rapidly Approaching Category 5. *Rising Above the Gathering Storm Revisited: Rapidly Approaching Category 5*. Washington, DC: The National Academies Press, 2010. Accessed May 1, 2018. https://www.nsf.gov/attachments/117803/public/3b--RAGS_Revisited.pdf.

Minkin, Amy. "Perceptions of High School Administrators on JROTC in Secondary Schools." Ed.D. diss., Barry University, Miami Shores, FL, 2014.

Miranda III, Ulises. "Exploring the Essence of the Civil–Military Gap: An Interpretative Phenomenological Study of High School Administrators' Feelings Related to JROTC." Ed.D. diss., St. John Fisher College, Rochester, NY, 2014.

Mulholland, John J. "'Tangibles and Intangibles': The Search for an Effective and Comprehensive Evaluation of JROTC." Diamond Scholar Research, Temple Honors Program, Temple University, Philadelphia, PA, 2005.

National Academies of Sciences, Engineering and Medicine. *Barriers and Opportunities for 2-Year ad 4-Year STEM Degrees: Systemic Change to Support Students' Diverse Pathways.* Washington, DC: National Academies Press, 2016. Accessed May 1, 2018, https://www.ncbi.nlm.nih.gov/books/NBK368176/.

National Research Council. *Successful STEM Education: A Workshop Summary*. Washington, DC: The National Academies Press, 2011. https://doi.org/10.17226/13230.

Noonan, Ryan. *STEM Jobs: 2017 Update*. Washington, DC: Department of Commerce 2017. Accessed May 1, 2018, http://www.esa.gov/reports/stem-jobs-2017-update.

Rice, Donna. "An Examination of Emotional Intelligence: Its Relationship to Academic Achievement in Army JROTC and the Implication for Education." Ph.D.diss., Capella University, Minneapolis, MN, 2006.

Sass, Tim R. "Understanding the STEM Pipeline." CALDER Working Paper No. 1, American Institutes for Research, Washington, DC, January 2015.

S. Leonard Gelfand Center for Service Learning and Outreach at Carnegie Mellon University and The Intermediate Unit 1 Center for STEM Education. *STEM Education in Southwestern Pennsylvania.* Accessed May 1, 2018. https://www.cmu.edu/gelfand/documents/stem-survey-report-cmu-iu1.pdf.

The National Commission on Excellence in Education. *A Nation at Risk: The Imperative for Educational Reform*. Washington, DC: National Commission on Excellence in Education, April 1983.

Williams-Bonds, Carmen. "A Comparison of the Academic Achievement and Perceptions of Leadership Skills and Citizenship Traits of JROTC, Student Athletes, and Other Students in an Urban High School." Ed.D., diss., Lindenwood University, St. Charles, MO, 2013.

Online Sources

Air Force Association's Cyberpatriot. "The National Youth Cyber Education Program." Accessed February, 18, 2018. https://www.uscyberpatriot.org/Pages/About/What-is-CyberPatriot.aspx.

Air University. "Curriculum." October 26, 2016. Accessed April 20, 2018. http://www.airuniversity.af.mil/Holm-Center/AFJROTC/Display/Article/987799/.

———. "Welcome to Air Force JROTC." Accessed April 20, 2018. http://www.airuniversity.af.mil/Holm-Center/AFJROTC.

American Association for the Advancement of Science. "Project 2061." Accessed May 1, 2018. https://www.aaas.org/program/project2061.

American Institute of Physics. "FY 17 STEM Education." Accessed May 1, 2018. https://www.aip.org/fyi/2017/final-fy17-appropriations-stem-education.

The American Presidency Project. "George Washington." Accessed May 1, 2018. http://www.presidency.ucsb.edu/ws/?pid=29431.

Anders, George. "That 'Useless' Liberal Arts Degree Has Become Tech's Hottest Ticket." *Forbes*, July 29, 2015. Accessed May 1, 2018. https://www.forbes.com/sites/georgeanders/2015/07/29/liberal-arts-degree-tech/#7c3a0a87745d.

Association of Science, Technology, and Arts. "US Congress Votes for More Science." March 23, 2018. Accessed May 1, 2018. www.astc.org/advocacy/congress-votes-for-more-science/.

Athey, Amber. "Code Pink Wants to Remove JROTC From Schools After Parkland Shooting." *The Daily Caller*, March 15, 2018. Accessed May 1, 2018, http://dailycaller.com/2018/03/14/code-pink-remove-jrotc-from-schools/.

Baron, Kathryn. “Most Parents View STEM in After-School as Elementary, Survey Finds.” *Education Week,* September 30, 2015. Accessed May 1, 2018. http://blogs.edweek.org/edweek/time_and_learning/2015/09/parents_rate_homework_help_physical.html.

Bolken, Joshua. “Americans See Range of Problems Plaguing STEM Education.” January 12, 2018. Accessed May 1, 2018. https://campustechnology.com/articles/2018/01/12/americans-see-range-of-problems-plaguing-stem-education.aspx.

Bureau of Labor Statistics. “STEM Crisis or STEM Surplus, Yes and Yes.” May 2015. Accessed May 1, 2018. https://www.bls.gov/opub/mlr/2015/article/stem-crisis-or-stem-surplus-yes-and-yes.htm.

Charette, Robert N. “The STEM Crisis Is a Myth” Spectrum, August 30, 2013. Accessed May 1, 2018. https://spectrum.ieee.org/at-work/education/the-stem-crisis-is-a-myth.

Chatlani, Shalina. “Minorities are Making Waves in STEM, But Still Face Significant Challenges in Entering the Field, Experts Say.” *Education Dive*, June 26, 2017. Accessed May 1, 2018. https://www.educationdive.com/news/minorities-are-making-waves-in-stem-but-still-face-significant-challenges/445875/.

Child Soldiers International. “International Laws and Child Rights.” Accessed May 1, 2018. https://www.child-soldiers.org/interantional-laws-and-child-rights.

Code. “Leaders and Trend-Setters All Agree on One Thing.” Accessed May 1, 2018. https://code.org/quotes.

Dictionary.Com. “Intelligence Quotient.” Accessed May 1, 2018. http://www.dictionary.com/browse/intelligence quotient.

———. “Intangible.” Accessed May 1, 2018. http://www.dictionary.com/browse/intangible.

Drucker, Peter F. “Quotable Quotes.” Accessed May 1, 2018. https://www.goodreads.com/quotes/420819-if-you-want-something-new-you-have-to-stop-doing.

Educational Support Professionals. “Meeting the Needs of the Whole Student.” Accessed May 1, 2018. https://www.nea.org/assets/docs/150306-ESP_DIGIBOOK.pdf.

Funk, Cary, and Kim Parker. “Diversity in the STEM Workforce Varies Widely Across Jobs.” Pew Research Center. January 9, 2018. Accessed May 1, 2018. http://www.pewsocialtrends.org/2018/01/09/diversity-in-the-stem-workforce-varies-widely-across-jobs/.

———. “Most American Evaluate STEM Education as Middling Compared with Other Developed Nations.” Pew Research Center. January 9, 2018. Accessed May 1, 2018. http://www.pewsocialtrends.org/2018/01/09/5-most-americans-evaluate-stem-education-as-middling-compared-with-other-developed-nations/.

The Glossary of Education Reform. “At Risk.” August 29, 2013. Accessed May 1, 2018. https://www.edglossary.org/at-risk/.

———. “Standardized Test.” November 12, 2015. Accessed May 1, 2018. https://www.edglossary.org/at-risk/.

Goleman, Daniel. “Emotional Intelligence.” April 21, 2015. Accessed May 1, 2018. http://www.danielgoleman.info/daniel-goleman-how-emotionally-intelligent-are-you/.

Grudo, Gideon. “USAF Drops $2.4 Million in Scholarships to Get Cadets Private Pilot Licenses.” *Air Force Magazine*, January 11, 2018, Accessed May 1, 2018. http://www.airforcemag.com/Features/Pages/2018/January%202018/USAF-Drops-24-Million-in-Scholarships-To-Get-Cadets-Private-Pilot-Licenses.aspx.

Hager, Dean. “The Real Reasons Behind the Tech Skills Gap.” *Fortune Magazine*, April 27, 2016. Accessed May 1, 2018. http://fortune.com/2016/04/27/tech-skills-gap-stem/.

Harlington High South. “Typical Week Schedule.” Accessed May 1, 2018. http://www.hcisd.org/Page/18538.

Harris Interactive. “STEM Perceptions: Student and Parent Study Parents and Students Weigh in on How to Inspire the Next Generation of Doctors, Scientists, Software Developers and Engineers.” Survey Commissioned by Microsoft Corp. Accessed May 1, 2018. https://news.microsoft.com/download/archived/presskits/citizenship/docs/STEMPerceptionsReport.pdf.

Herold, Benjamin. “Model ‘Inclusive’ STEM High Schools Share Common Traits, Researchers Say.” *Education Week,* April 7, 2014. Accessed May 1, 2018. http://blogs.edweek.org/edweek/DigitalEducation/2014/04/model_inclusive_stem_high_scho.html.

Houppert, Karen. “Who’s Next?” *The Nation*, September 12, 2005, Accessed May 1, 2018, https://www.thenation.com/article/whos-next/.

Jones, Ann. “America's Child Soldiers: JROTC and the Militarizing of America.” *Truth Out,* December 16, 2013. Accessed May1, 2018, http://www.truth-out.org/news/item/20657-americas-child-soldiers-jrotc-and-the-militarizing-of-america.

Lopez, C. Todd. “STEM Grads Critical to U.S. Military Mission.” US Army. August 14, 2013. Accessed May 1, 2018. https://www.army.mil/article/109326/stem_grads_critical_to_us_military_mission.

Maddox, Michael. “New Program Promotes STEM Initiatives in JROTC Programs.” U.S. Army. Accessed April 26, 2108. https://www.army.mil/article/197782/new_program_promotes_stem_initiatives_in_jrotc_programs.

McDuffee, Allen. “No JROTC Left Behind: Are Military Schools Recruitment Pools.” *In These Times,* August 20, 2008. Accessed May 1, 2018. Inthesetimes.com/article/3855.

Missile Defense Agency. “MDA STEM Initiatives.” Accessed May 1, 2018. https://mda.mil/about/STEM_initiatives.html.

Muscogee School District. “Career Technical Agricultural Education (CTAE)-JROTC.” Accessed May 1, 2018. https://www.muscogee.k12.ga.us/p/Divisions/TeachingandLearning/CTAE/JROTC.

National Career Academy Coalition. “About Career Academies.” Accessed May 1, 2018. https://www.ncacinc.com/nsop/academies.

National Network Opposing the Militarization of Youth. “JROTC.” Accessed May 1, 2018. https://nnomy.org/en/resources/school-militarization/by-program/jrotc.html.

National Public Radio. “No Child Left Behind Act of 2001; NPR, No Child Left Behind, What Worked What Didn’t.” Video, Title 2, Part B, Sections 2201-2203. October 27, 2015. Accessed May 1, 2018. https://www.npr.org/sections/ed/2015/10/27/443110755/no-child-left-behind-what-worked-what-didn’t.

National Science Foundation. “About Funding.” Accessed https://www.nsf.gov/funding/aboutfunding.

Navy Junior ROTC. “Curriculum.” Accessed May 1, 2018. http://www.njrotc.navy.mil/curriculum.html.

Nazario, Sonia. “Junior ROTC Takes a Hit in L.A: At Roosevelt High, a coalition of teachers and students works to end the program, and its numbers are dropping.” *Los Angeles Times*, February 19, 2007. Accessed May 1, 2018. http://articles.latimes.com/2007/feb/19/local/me-jrotc19.

Office of the Press Secretary, The White House. “Fact Sheet: President Obama Announces Computer Science For All Initiative.” January 30, 2016. Accessed May 1, 2018. https://obamawhitehouse.archives.gov/the-press-office/2016/01/30/fact-sheet-president-obama-announces-computer-science-all-initiative-0.

Osssola, Alexandra. “Too Many Kids Quit Science Because They Don’t Think They’re Smart.” *The Atlantic*, November 3, 2014. Accessed May 1, 2018. https://www.theatlantic.com/education/archive/2014/11/too-many-kids-quit-science-because-they-dont-think-theyre-smart/382165/.

Outlier Research and Evaluation. “STEM School Study (S3).” Accessed May 1, 2018. http://outlier.uchicago.edu/s3/findings/classroom-behaviors/.

Powell, Alvin. “How Sputnik changed U.S. Education.” *The Harvard Gazette*, October 11, 2017. Accessed May 1, 2018. https://news.harvard.edu/gazette/story/2007/10/how-sputnik-changed-u-s-education/.

Preceden. “History of Science Education.” Accessed May 1, 2018. https://www.preceden.com/timelines/68269-history-of-science-education.

Sawchuck, Stephen. “Trump Budget Request Prioritizes STEM and Apprenticeships. But is there a Catch.” *Education Week,* Accessed May 1, 2018. http://blogs.edweek.org/edweek/curriculum/2018/02/trump_budget_stem_apprenticeship_2019.html.

Shinn, Larry D. “Liberal Education vs. Professional Education: The False Choice.” *Trusteeship Magazine*, January/February 2014. Accessed May 1, 2018. https://www.agb.org/trusteeship/2014/1/liberal-education-vs-professional-education-false-choice.

Smith, Lamar, R-Texas. “To Fill STEM Jobs, Federal Programs Need to Focus on Results.” *The Hill*, December 19, 2017. Accessed May 1, 2018. http://thehill.com/blogs/congress-blog/technology/365565-to-fill-stem-jobs-federal-programs-need-to-focus-on-results.

Theus, Dana. “Why STEM Leaders Need Emotional Intelligence Training.” Smart Brief, March 29, 2016. Accessed May 1, 2018. https://www.smartbrief.com/original/2016/03/why-stem-leaders-need-emotional-intelligence-training.

Tolliver, Rachael. “Thanks to Community Support JROTC Cadets Travel To D-Day.” U.S. Army Cadet Command, May 22, 2014. Accessed May 1, 2018. https://www.army.mil/article/126615/thanks_to_community_support_jrotc_cadets_travel_to_d_day.

U.S. Army JROTC. “Apply: Before You Get Started.” Accessed May 1, 2018. https://www.usarmyjrotc.com/JROTC_Apply.html.

———. “Co-Curricular Events.” Accessed May 1, 2018. https://www.usarmyjrotc.com/cadetPortal/cadetCoCurrucularEvents.html.

———. “Establish a JROTC Program.” Accessed, May 1, 2018. https://www.usarmyjrotc.com/JROTC_EstablishProgram.html.

———. “Instructor Pay.” Accessed, May 1, 2018. https://www.usarmyjrotc.com/JROTC_InstructorPay.html.

———. “JROTC History.” Accessed May 1, 2018. https://www.usarmyjrotc.com/JROTC_History.html.

———. “JROTC Program Information.” Accessed May 1, 2018. https://www.usarmyjrotc.com/JROTC_ProgramInfo.html.

———. “An Overview of JROTC.” Accessed May 1, 2018. https://www.usarmyjrotc.com/JROTC_Overview.html.

———. “The U.S. Army JROTC Curriculum.” Accessed May 1, 2018. https://www.usarmyjrotc.com/JROTC_Curriculum.html.

U.S. Department of Defense. “About DoD STEM.” Accessed May 1, 2018. http://www.dodstem.us/about.

———. DoD STEM. “STEM Programs.” Accessed May 1, 2018. https://dodstem.us/stem-programs/programs?field_programs_military_branch_tid=All&field_program_grades_tid=10&field_program_type_tid=All&=Apply.

U.S. Department of Education. “Science, Technology, Math, Engineering: Education for Global Leadership.” Accessed May 1, 2018. https://www.ed.gov/stem.

———. “STEM.” Accessed May 1, 2018. http://ed.gov/stem.

U.S. Department of State. “US Written Replies to OPAC List of Issues.” March14, 2017. Accessed May 1, 2018. https://www.state.gov/j/drl/rls/268590.htm.

U.S. President. *Presidential Memorandum for the Secretary of Education.* Washington, DC: The White House, September 25, 2017. Accessed May 1, 2018. https://www.whitehouse.gov/presidential-actions/presidential-memorandum-secretary-education/.

Weaver, Jennifer, Ph.D. “Diversity Can Benefit Teamwork in STEM.” Berkeley Center for Teaching and Learning. Accessed May 1, 2018. https://teaching.berkeley.edu/diversity-can-benefit-teamwork-stem.

The White House. “President Trump Signs Memorandum for STEM Education Funding.” September 26, 2017. Accessed May 1, 2018. https://www.whitehouse.gov/articles/president-trump-signs-memorandum-stem-education-funding/.

Wiley Online Library, “Journal of Social Philosophy.” Last accessed May 1, 2018. https://onlinelibrar.wiley.com/page/journal/14679833/homepage/ProductInformation. Html.

Zakaria, Fareed. “Why America’s Obsession with STEM Education is Dangerous.” *New York Times*, March 26, 2015. Accessed May 1, 2018. https://www.washingtonpost.com/opinions/why-stem-wont-make-us-successful/2015/03/26/5f4604f2-d2a5-11e4-ab77-9646eea6a4c7_story.html?utm_term=.b1b5f89fbcd2.

Other Sources

10 United States Code § 2031, Junior Officer Reserve Training Corps, 2018.

America Competes Act of 2015, Title 1.

Child Soldiers Prevention Act of 2008, 22 USC 2370c1, Section 402.

Fort Worth Independent School District. “FWISD JROTC.” PowerPoint Presentation. Accessed May 1, 2018, https://www.fwisd.org/cms/lib/TX01918778/Centricity/Domain/174/STEM%20BRIEF%20%203.pdf.

The National Defense Act of 1916, Pub. Law. 64-85, 39 Stat. 166.

Missouri JROTC Senior Instructor. Telephone interview with author, April 10, 2018.

Missouri Assistant Principal—Inclusive STEM School. Telephone interview with author, April 10, 2018.