NAVAL POSTGRADUATE SCHOOL

OA 4820 CASE STUDIES IN DEFENSE ANALYTICS

Investigating Return on Investment for NPS Graduate Degrees

By
Capt Quinn Harrison
MAJ Janet Karanja
MAJ Ryan Kelton
LT Kurt Pasque

Advisor
LTC Nicholas Shallcross, Ph.D.

ABSTRACT

This technical report investigates the return on investment (ROI) of the Naval Postgraduate School's (NPS) Operations Research (OR) education program with a US Marine Corps perspective. This study assesses the practical value and applicability of the skills acquired through NPS education to measure the non-economic ROI in terms meaningful to senior DOD leaders. Utilizing a combination of assignment orders and survey data, we analyze the impact of NPS education on military operations and organizational effectiveness. This study develops a robust data collection plan and supporting infrastructure, initially focusing on a specific service and academic department, to facilitate broader NPS research. Preliminary findings indicate significant positive outcomes in terms of skill application and operational advancements. The study employs Microsoft Power BI to visualize disparate data sources and comprehensively represent NPS graduate education value metrics. In an era of decreasing budgets, measuring and communicating the tangible and intangible benefits of the NPS education is crucial for securing continued funding. Following validation, this methodology will assess the NPS ROI in terms relevant to the other services, providing a framework for evaluating the broader impact of NPS graduate education.

EXECUTIVE SUMMARY

This technical report investigates the return on investment (ROI) of the Naval Postgraduate Schools (NPS) Operations Research (OR) education program with a US Marine Corps perspective. The primary objective is to determine how effectively these graduates apply their education in their subsequent roles and the overall impact on military operations. The study addresses the problem of measuring the non-economic ROI of an NPS graduate degree in terms that are meaningful to senior Department of Defense (DOD) leaders. By developing a data collection plan and a supporting data infrastructure scoped to a specific service and academic department, this study sets conditions to assess ROI and enable continuing NPS research.

Utilizing several different methods, the study combines quantitative data from duty orders, thesis research data, and begins setting conditions for surveys targeting the commanders of NPS graduates. This sets conditions to assess the impact of NPS educational outcomes on Joint Force operational requirements, by leveraging Power BI and Python for dynamic and interactive data visualization. Initial findings indicate that Marine Corps OR graduates are effectively utilizing their acquired skills in follow-on assignments, contributing to improved operational outcomes. Commanders perceive these officers as well-prepared to support a wide range of military operations. The use of Power BI allows us to examine various performance metrics, enabling the quantification of the ROI. Source code and materials related to this work are located here: https://github.com/KurtPask/NPS-ROI-Capstone.

The preliminary results suggest that NPS graduate education, particularly within the OR department, offers significant value to the Marine Corps. The positive impact on operational effectiveness and skill application highlights the benefits of investment in NPS education. In an era of budget competition, measuring and communicating the tangible and intangible benefits of the NPS education is crucial for securing continued funding. Following validation, this methodology can be expanded to other services and NPS programs, providing a framework for evaluating the broader impact of NPS graduate education.

INTRODUCTION

The Naval Postgraduate School (NPS) offers specialized graduate programs designed to enhance the skills and knowledge of military officers across various branches of the United States Armed Forces. As the demands on military operations evolve, it becomes increasingly important to assess the value and effectiveness of these educational investments. This report focuses on evaluating the Return on Investment (ROI) for Marine Corps graduates from the Operations Research (OR) department at NPS. The study's objective is to determine how effectively these graduates apply their education in their subsequent roles and the overall impact on military operations. By developing a robust data collection plan and supporting infrastructure, this study aims to provide actionable insights into the non-economic ROI of NPS graduate degrees in terms that are meaningful to senior Department of Defense (DOD) leaders.

Background

The impetus for this study stems from the need to quantify the non-economic ROI of graduate education for military officers. Traditional metrics often focus on economic benefits, such as salary increases and career advancement, but these do not fully capture the value provided to the military and the DOD. This research aims to fill that gap by assessing the practical application of skills acquired through NPS education and their impact on military operations.

Previous studies have explored various aspects of graduate education within a military context. For instance, Lindsay M. O'Sullivan's thesis measured the value of the Manpower Systems Analysis Curriculum at NPS (O'Sullivan, 2006), while Kenneth Rhee's paper examined the development of transformational leaders through graduate education (Rhee & Sigler, 2020). Similarly, Terry L. Branstetter's study evaluated the Information Systems Technology curriculum's alignment with Marine Corps operational needs (Branstetter, 2002), and William R. Bowman's research analyzed the economic ROI of different graduate education pathways for Surface Warfare Officers (Bowman & Mehay, 2004). Duquesne Louidor's thesis evaluated the effectiveness of Navy's Graduate Education Programs and suggested policy reforms for better management (Louidor, 2012). Additionally, RAND Corporation's report assessed the cost-effectiveness and strategic value of the Navy's funded graduate education programs, recommending improvements for alignment with strategic needs (Kamarck et al., 2010). These studies underscore the importance of specialized education in enhancing operational effectiveness and career progression.

Building on this foundation, our study focuses specifically on Marine Corps graduates from the OR department. By examining assignment orders and survey data we assess graduate preparation for and effectiveness in their follow-on assignments. The use of Power BI for data visualization enables a comprehensive analysis of various performance metrics, providing a clear picture of the ROI for an NPS education. Given the stringent budgetary environment, it is essential to demonstrate the tangible and intangible benefits of NPS education to ensure continued funding. Once validated, this model will be extended to other services, facilitating a broader understanding of the impact of NPS graduate education across the DOD.

MODELING AND DATA

Data Collection

To evaluate the ROI of NPS graduate degrees for Marine Corps officers in the OR department, we collect data from various sources. Primary data sources include 125 duty orders and assignment data that track whether Marine graduates are placed in positions aligned with their specialized education. Other data sources include survey data from NPS graduates, which provides historical insights into the effectiveness of all NPS curriculums, and the perceived value of the skills acquired. Additionally, we created a comprehensive set of questions aimed at commanders of recent OR graduates to enable future research. This survey will assess their perceptions of the graduates' readiness, skill application, and overall impact on their organizations. Finally, we analyze thesis data from the past five years. This dataset includes attributes such as thesis titles, abstracts, advisors, departments, and sponsors. Through exploratory data analysis, we examine the theoretical impact of thesis research on the Navy and the DOD, focusing on key topics and sponsorships. Given the limited availability of thesis data, we include all available data points in our analysis, not just those for the OR department.

Data Analysis and Modeling

This study uses a combination of qualitative and quantitative methods to provide a comprehensive understanding of the ROI for NPS graduate degrees. For quantitative analysis, assignment data is examined to determine the alignment between the graduates' education and their subsequent assignments. Metrics such as the percentage of graduates placed in OR-related roles, the rank progression of OR graduates, and number of utilization tours completed are examined. We conduct a statistical analysis of the survey data to identify trends and patterns in graduate perceptions of their education's value. This includes satisfaction rates, perceived skill application, and career impact. For qualitative analysis, the study prepares a survey targeting commanders. This survey is designed to collect data on aspects such as the perceived readiness of graduates, their impact on unit performance, and their high-value skill sets. This feedback will provide a deeper understanding of the non-economic ROI, while also enabling targeted engagements between NPS leadership and DOD senior leaders.

Existing thesis research data may provide critical insights into the non-economic benefits that NPS offers to both the Navy and the broader DOD. Student-conducted research can positively impact the Navy by rapidly providing findings and recommendations that can impact the force today[1]. Our thesis data analysis focuses on two key areas. First, we identify sponsored theses and determine trends in service sponsorship. We use this data to assess the breadth of the impact that sponsored theses may have. Second, we investigate the various categorical classifications of theses based on research focus, such as joint warfighting functions. We analyze this in two approaches. We categorize theses based on titles and a lexicon of words for each category. Tailored large language model (LLM) prompts also classify theses based on their abstracts. Both techniques show promise in conveying research focus areas in the aggregate for student theses, a metric not currently produced in the form we offer.

[1] Code used for analysis and deeper explanations located here: https://github.com/KurtPask/NPS-ROI-Capstone.

However, missing thesis meta data for both service and command sponsorship limits the analysis. The study team identified the requirement to improve meta data collection in NPS's Python system, by requiring students provide detailed sponsorship data.

Visualization and Reporting

This study uses a Microsoft Power BI dashboard to visualize and analyze ROI data. Power BI presents data in a user-friendly format, enabling stakeholders to explore various metrics and insights. These interactive dashboards display key metrics such as assignment alignment, retention rates, satisfaction scores, and commander feedback. Users can filter the data to gain insights or answer specific questions. The dashboard enables the analysis of temporally dynamic data to identify trends and measure the long-term impact of NPS education on the Joint Force. The final report will integrate these visualizations to provide a clear and concise presentation of the ROI analysis, highlighting key findings, actionable insights, and recommendations for future research and policy adjustments. Figure 1 is a screenshot of our final product that shows the outputs of research products from the students and faculty while they are at NPS. This is meant to convey the operational and strategic relevance of the work being done at NPS that distinguishes it from other graduate programs. Figure 1 also demonstrates how officers continue contributing to sponsored commands and organizations through impactful research, despite being away from the fleet. These officers also gain a depth of knowledge in critical defense related areas not common in civilian institutes. This kind of data is not typically available or communicated well on behalf of NPS. However, the story behind such graphics can remind stakeholders of the importance of NPS ability to educate mid-career officers.
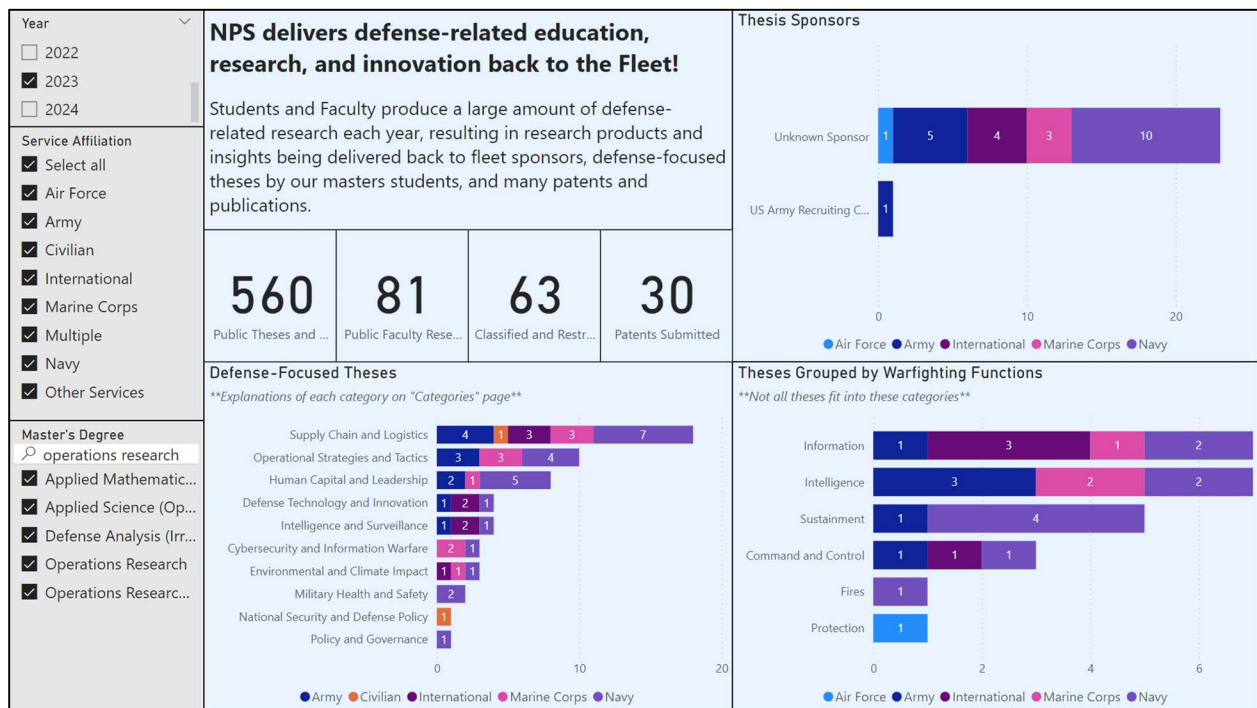
Figure 1: Screenshot of Power BI dashboard displaying research products outputs while students are at NPS, conveying value gained by services during students' time at NPS.

Figure 1 shows an example of a filtered dashboard page for impact of research products delivered by faculty and staff directly from NPS. Figure 2 shows the value NPS graduates deliver back to their services after their time at NPS. By combining officer utilization data with survey data, we can convey the story that graduates from NPS are delivering value back to the fleet after graduation.
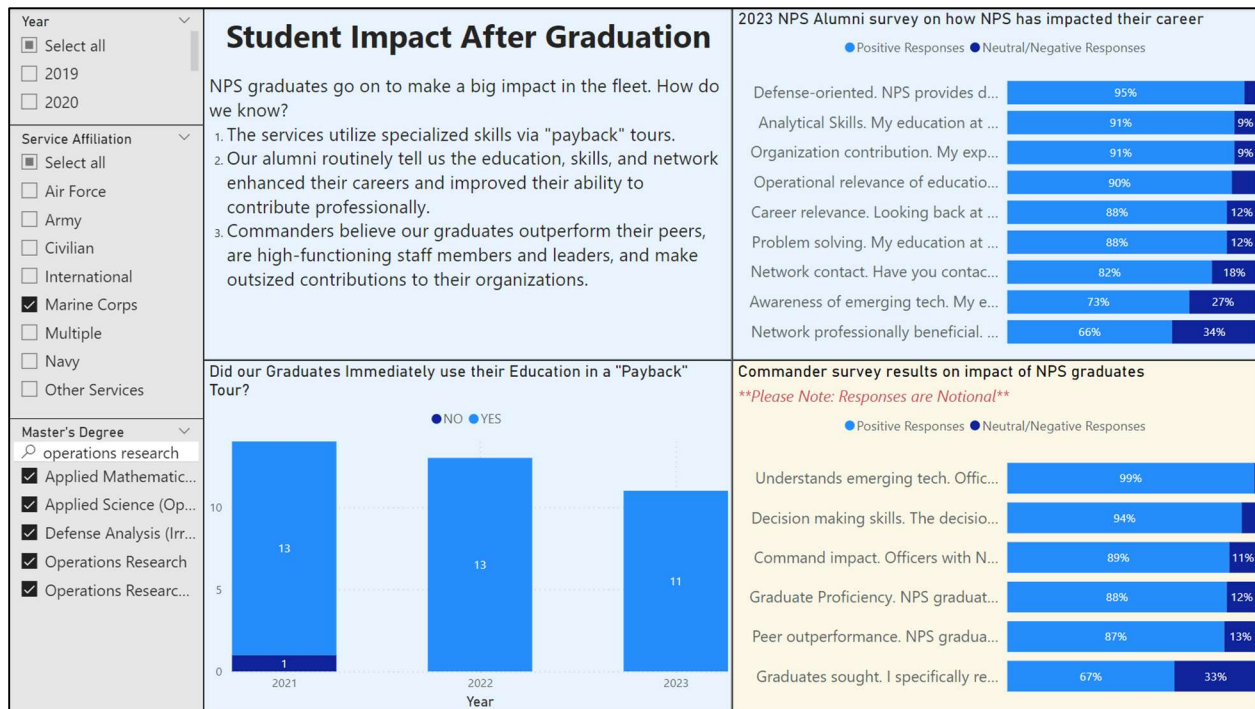

Figure 2: Screenshot of Power BI tool of page that displays key metrics and survey results relating to NPS student impact after graduation.

Analysis

Marine Corps graduates from the OR department at the NPS reveal significant benefits in terms of skill application and operational effectiveness. Initial findings indicate that the specialized skills acquired through NPS programs contribute positively to military operations, enhancing both individual and organizational performance.

Specifically, data indicates Marine Corps OR graduates have sustained ongoing career progression by either accepting orders outside of the OR community or completing multiple utilization tours. Analysis of the 125 assignment orders indicated that 48 individuals fulfilled their initial commitment after NPS and accepted orders to other duty assignments. Additionally, ten individuals completed an additional OR-related tour after their initial commitment, and three individuals embarked on their third OR-related tour. Visualizing metrics such as these can help senior leaders understand the retention, and the overall health of a given community, based on how many additional tours graduates complete.

Alumni survey data shows that most survey participants found the degree they received was defense-oriented (95%), operationally relevant (90%), improved their analytical skills (91%), contributed positively back to their organization (91%), relevant to their careers (88%), enhanced their problem solving skills (88%), made them more aware of emerging technologies (73%), and saw that they made contact with their professional network gained here (82%) after graduation and in some cases the network gained here benefitted them professionally (66%). We hope to convey similarly impactful results should a commander survey be implemented that captures how DOD leadership views NPS graduates' impact on their commands.

Moreover, thesis data provides an immediate insight into the research benefits NPS provides. For example, in the last five years, students have completed 3623 theses focused on defense related research. This research represents an important return on investment for the Navy and the Department of Defense (DOD). Furthermore, 220 theses were sponsored by commands throughout the DOD. This demonstrates an immediate benefit for those commands based on thesis research. Using advanced text analysis, theses and sponsors can be further refined and categorized, demonstrating student development in defense-related areas. Our primary conclusion is that thesis data can be refined in the system that captures metadata, Python, to provide this information more readily with less data analysis.

Future Work

Following model validation for the Marine Corps OR graduates, this study will expand the methodology to other DOD services and academic departments. This will involve expanding data collection to gather similar data from other services and NPS departments, adjusting the analysis models to account for differences in educational programs and service requirements. Additionally, future research will assess the long-term impact of NPS graduate education on military organizations and career progression. This comprehensive approach will ensure that the ROI of NPS graduate degrees is thoroughly understood and effectively communicated to senior DOD leaders. This methodology will seek to inform decision-making and ensure continued investment in military graduate education.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The evaluation of the ROI for Marine Corps graduates from the OR department at NPS demonstrates that NPS graduates are well-prepared for their roles, with a high degree of alignment between their education and subsequent assignments. The analysis underscores the importance of measuring non-economic ROI, providing insights that are meaningful to senior DOD leaders. By utilizing a mixed methods approach and leveraging advanced data visualization tools like Power BI, the study offers a comprehensive understanding of the value of NPS education. This model can be expanded to other services, ensuring a broader impact, and supporting informed decision-making regarding graduate education investments within the DOD. In an era budget competition,

measuring and communicating these tangible and intangible benefits of the NPS education is vital for securing continued funding.

Recommendations

To ensure a comprehensive evaluation, we recommend future research gathers similar data from other services and additional NPS academic departments. This expansion will validate the initial findings and provide a more extensive data set for analysis. Conducting the commander survey is crucial for understanding the practical impact of an NPS education from a supervisory perspective. Power BI dashboards will provide interactive and dynamic visualizations of key metrics, facilitating better communication of findings to stakeholders and allowing for real-time analysis and insights, and can be integrated into existing systems.

Implementing longitudinal studies to track the long-term effects of NPS education on career progression and operational effectiveness is essential. Continuous monitoring will identify trends and measure the sustained impact of graduate education. This methodology may inform future curricula adjustments to ensure alignment with the evolving DOD requirements. Incorporating feedback from graduates and commanders may help ensure NPS educational programs remain relevant and effective. Encouraging collaboration between different branches of the military to share best practices and insights gained from the study can lead to a more unified approach to military education and training, enhancing overall operational capabilities. Allocating resources to support ongoing research into the ROI of military education will help refine evaluation methods and ensure that educational programs continue to meet the strategic goals of the DOD.

Finally, implementing more refined data collection efforts for theses can improve. For example, out of the 3623 theses we examined, only 220 had sponsors listed. This is more likely due to students not entering information for a sponsor than a lack of sponsors. The process of submitting a thesis allows students to easily bypass entering a sponsor, which is likely the reason for this issue. Adding forcing functions to thesis submission for this information can benefit the theses metadata and provide a clearer picture.

APPENDIX A

Acronyms/Data Dictionary

DOD	Department of Defense
NPS	Naval Postgraduate School
OR	Operations Research
ROI	Return on Investment
LLM	Large language model

APPENDIX B

Commander Survey

You have been identified as having administrative/operational responsibility of at least one billet that requires an Operations Research graduate degree.

We would appreciate your taking the time to answer the following survey about your Operations Research (OR) graduate(s) from the Naval Postgraduate School (NPS).

The goal of this survey is to measure the perceived value of the OR Curriculum. We appreciate any insight you can share that will enable us to improve the quality of the OR curriculum, ensuring its continued relevancy to meet the needs of the Armed Forces. Thank you in advance for your participation.

The demographic questions are for statistical analysis only.

1. Full name
2. Email
3. Phone number
4. What is your paygrade?
    a) O-5
    b) O-6
    c) O-7
    d) O-8
    e) O-9
    f) GS-13
    g) GS-14
    h) GS-15
    i) SES
5. What is your current command?
6. How long have you been at your current command?
7. Are you a graduate of NPS?
8. How many NPS OR officers are currently part of your staff?
9. How many NPS OR officers have worked for you in the past?
10. Compared to other officers assigned to your command, at what proficiency level would you say your NPS OR graduate was upon arrival?
    a) Very poor
    b) Below average

    c) Average

    d) Above average

    e) Excellent

    f) Unknown

11. About how many months does it usually take for the NPS OR graduate to reach the proficiency required for their assigned billet?

    a) 0-6 mo.

    b) 7-12 mo.

    c) 13-24 mo.

    d) 25-36 mo.

    e) Unknown

12. Have the NPS OR officers who have worked for you in the past, or are working for you now, arrived with the skills necessary to enable them to perform their job sufficiently?

    a) Yes

    b) No

    c) Unknown

    d) If not, what skills are the OR graduates missing?

13. Have the NPS OR officers who have worked for you in the past, or are working for you now, arrived with the necessary warfighting function skills to enable them to perform their job sufficiently?

    a) Yes

    b) No

    c) Unknown

    d) If not, what warfighting function skills are the OR graduates missing?

14. In your current or previous supervisory positions, how would you compare the job performance of NPS OR graduates with other officers who hold a master's degree?

    a) Much better prepared than other graduates

    b) Somewhat better prepared than other graduates

    c) About the same as other graduates

    d) Somewhat less prepared than other graduates

    e) Much less prepared than other graduates

15. In your current or previous supervisory positions, how would you compare the job performance of NPS OR graduates with other officers who don't have a master's degree?

    a) Much better prepared than non-graduates

    b) Somewhat better prepared than non-graduates

    c) About the same as non-graduates

    d) Somewhat less prepared than non-graduates

    e) Much less prepared than non-graduates

16. In your current or previous supervisory positions, how would you compare the decision-making abilities of NPS OR graduates with other officers who don't have a master's degree?
    a) Poor
    b) Below average
    c) Average
    d) Above average
    e) Exceptional

17. Would you request an OR graduate from NPS for any non-subspecialty coded   billets over other master's graduates if you could?

    a) Yes, I would prefer an OR graduate degree

    b) I'm neutral. I will take any graduate degree
    c) No, I would prefer another graduate over an OR graduate degree

    d) N/A, graduate education is not needed.

    e) If no, please explain why and who you would prefer:

18. Is there anything about your NPS OR graduate that stands out from other officers you have worked with?

19. Are there any skills that your NPS OR graduate has that you feel make them valuable in their current role or another role?

20. Are there skills that your NPS OR graduate lacks that you think should be incorporated into future OR classes at NPS?

21. How often does your NPS OR graduate contribute to key decisions while serving as a member of your staff?
    a) Never
    b) 1-2 times per month
    c) 3-4 times per month
    d) 5 or more times per month

22. How often does your NPS OR graduate manage a project or lead a team?
    a) Never

b) 1-2 times per year
c) 3-4 times per year
d) 5 or more times per year

REFERENCES

Bowman, W. R., & Mehay, S. L. (2004). *Return on Investment in Navy Graduate Education*. Technical Report. Monterey, CA: Graduate School of Business & Public Policy. https://core.ac.uk/download/pdf/36718258.pdf

Branstetter, T. L. (2002). *Measuring the Value of Graduate Information Technology Education for Marine Officers: A Proof of Concept Study*. Monterey, California. Naval Postgraduate School. https://hdl.handle.net/10945/4247

Kamarck, K. N., Thie, H. J., Adelson, M., & Krull, H. (2010). *Evaluating Navy's Funded Graduate Education Program: A Return-on-Investment Framework*. RAND Corporation. https://www.rand.org/pubs/monographs/MG995.html

Louidor, D. (2012). Evaluation of Graduate Education Policy in the U.S. Navy. *Evaluation*, 06. https://apps.dtic.mil/sti/citations/tr/ADA563505

O'Sullivan, L. M. (2006). *Measuring the Value of Graduate Manpower Systems Analysis Education for Naval Officers.* Monterey, California. Naval Postgraduate School. http://archive.org/details/measuringvalueof109452809

Rhee, K. S., & Sigler, T. H. (2020, April). Transforming Graduate Education: Developing Leaders for the 21st Century. *Journal of Leadership Education*. https://journalofleadershiped.org/jole_articles/transforming-graduate-education-developing-leaders-for-the-21st-century/