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EXAMINING THE EFFECTIVENESS OF TECHNOLOGY SKILL INTEGRATION IN THE CURRICULUM FOR ENHANCING CORPORATE READINESS: A RANDOMIZED CONTROL TRIAL STUDY AT HBCU"

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Abstract

As the higher education landscape evolves, universities continuously seek innovative methods to enrich student learning experiences and equip them with valuable skills for their future careers. However, the effectiveness of such integration demands rigorous evaluation and validation. Educators and researchers are turning to randomized controlled trials (RCTs), a robust methodological approach borrowed from clinical trials and social sciences, to address this need. This research study aims to assess the impact of adding a skill-driven certification program (MS-Excel) to a Historical Black College and University (HBCU) course curriculum using a randomized controlled trial (RCT) design. The study involves two groups of students, each subjected to different incentive methods. Group A is required to complete the certification as part of their coursework, while Group B is offered bonus points contingent upon successfully obtaining the certification. Rigorous statistical methodologies, such as descriptive and inferential statistics, were used to depict the research outcome thoroughly. To conclude, ANOVA, ANCOVA, and Chi-Square methods are used. The finding from the study showed that the treatment group showed a better result with the intervention than the control group.

Keywords

Randomized Control Trial, ANOVA, ANCOVA, Technology Intervention, HBCU

Introduction

In the pursuit of preparing students for the dynamic and tech-centric landscape of the corporate world, educational institutions, mainly universities, are increasingly recognizing the importance of integrating technology skills into their curriculum. Universities constantly strive to improve teaching and learning methodologies to enhance student success and engagement in technology in education (U.S. Department of Education, 2017) and the importance of digital technology's role in education (Haleem et al., 2022). Intervention programs are commonly employed to address specific challenges faced by students and foster their academic growth by understanding the knowledge and research needs for the student's engagement (Wang et al., J. (2014). One such approach involves integrating certification programs within a Historical Black University and College (HBCU) course curriculum, enabling students to acquire industry-specific credentials alongside their academic pursuits.

In higher education, universities actively pursue innovative methodologies to enhance student learning experiences and cultivate essential skills for future professional success. This commitment to evolution ensures that students are well-equipped to thrive in an ever-evolving career landscape. However, the efficacy of these innovative approaches necessitates a rigorous evaluation and validation processes to substantiate their impact on student outcomes.

Universities are navigating this transformative journey by integrating cutting-edge teaching methods, leveraging technology, and providing experiential learning opportunities. Nevertheless, the quest for innovation is not solely about embracing new techniques; it also requires a focus on assessing their effectiveness. Robust

evaluation mechanisms are crucial for obtaining empirical evidence that illuminates the positive influence of these innovations on students' academic achievements, critical thinking capabilities, and practical skill acquisition.

In this pursuit, a commitment to evidence-based decision-making becomes paramount. Universities must implement comprehensive evaluation frameworks to measure the success of pedagogical innovations, fostering an environment of continuous improvement. This optimizes teaching strategies and refines curricular content to align seamlessly with the evolving demands of contemporary industries.

To address this imperative, educators and researchers are turning to randomized controlled trials (RCTs), a potent methodological approach borrowed from the realms of clinical trials and social sciences (Torgerson et al., D. J. (2012). RCTs provide a robust framework for assessing the effectiveness of educational interventions by employing randomized assignment of participants, thereby minimizing bias, and allowing for the establishment of causal relationships.

This research endeavor is poised to comprehensively assess the ramifications of incorporating a skill-driven certification program, centered explicitly around MS-Excel proficiency, into the curriculum of a university, with a particular focus on a Historically Black College and University (HBCU). Employing the randomized controlled trial (RCT) design, acknowledged as the gold standard for evaluating interventions, this research aims to measure the impact of integrating advanced technology skills within the educational framework.

By adopting the RCT methodology, the research aspires to provide a nuanced understanding of the causal relationships that unfold when technology skills are infused into academic experience. In essence, it seeks to unravel the intricate dynamics between technology-rich curricula and outcomes related to corporate readiness. This meticulous exploration is anticipated to yield invaluable insights, offering a profound understanding of the most effective strategies for preparing students to meet the multifaceted challenges of the modern workforce. Through this research lens, the study endeavors to contribute to the existing body of knowledge and inform pedagogical approaches that align with the evolving demands of the contemporary professional landscape.

The research explores how introducing a certification program influences students' success in achieving the certification. The study involves two groups of students, each subjected to different incentive methods. Group A is required to complete the certification as part of their course work, which is considered a treatment group. Group B is offered bonus points contingent upon successfully obtaining the certification; this group is considered the control group. The research seeks to understand which method affects the students' motivation and performance in attaining the certification. The data collected will be utilized to examine the differences in academic achievement between the control group (students following the standard instructions) and the intervention group (students participating in the certification program as a part of the course).

Implementing this new intervention program may help improve educational practices and enhance student learning experiences. Through rigorous RCT evaluation, we aim to contribute to the existing knowledge on effective educational interventions in university settings. Further, the findings may hold implications for both educational practice and policy. Understanding the impact of incorporating a certification program within university courses can inform decision-making processes, help educational institutions optimize their offerings, and provide insights into how this study can contribute to the ongoing discourse on education's role in shaping the future workforce mainly at HBCUs. By analyzing the data collected, this study will contribute to the growing body of knowledge on effective interventions in higher education and provide evidence-based recommendations for implementing and refining certification programs.

Literature Review

Randomized controlled trials have become indispensable in higher education research because they provide rigorous and credible evidence for evaluating interventions and policies. In the context of evidence-based decision-making, RCTs offer a systematic and objective framework for assessing the impact of interventions, enabling researchers and educators to make informed choices about adopting and refining educational strategies.

The application of RCTs in higher education has contributed to methodological advancements and led to actionable insights that can inform institutional policies. For instance, studies like Bettinger and Long's (2009) exploration of remedial education programs have prompted institutions to reevaluate their support structures for underprepared students, fostering a more nuanced understanding of addressing short-term needs while considering long-term outcomes. Hattie's (2008) meta-analysis of over 800 studies underscored their effectiveness in evaluating educational interventions and their impact on learning outcomes. This comprehensive review highlighted interventions such as differentiated instruction, formative assessment, and feedback, significantly improving student achievement. Carrell and West's (2010) investigation into the influence of professor quality on student learning and course outcomes has practical implications for hiring practices and professional development within academic institutions. Recognizing the significant effects demonstrated in RCTs can guide efforts to prioritize and invest in strategies that enhance the overall quality of teaching. Dynarski and Scott-Clayton's (2013) literature review on the causal impact of financial aid policies has implications for policymakers and institutional leaders.

The emphasis on well-designed experiments underscores the importance of precision and validity in shaping financial aid structures that influence college enrollment and completion rates.

Additionally, RCTs have been instrumental in assessing the efficacy of student coaching and advising services. Bettinger and Baker (2011) studied the impact of coaching on student academic performance and retention, noting positive effects, especially for underrepresented student groups. Pritchard and Wilson (2008) investigated the optimal match between instructional methods and content, using RCTs to gain insights into effective teaching strategies in higher education. In exploring the role of financial incentives on college achievement, Scott-Clayton (2011) conducted a quasi-experimental analysis, shedding light on the relationship between extrinsic motivation and student success.

Furthermore, enriching this body of knowledge, Escueta, Quan, Nickow, and Oreopoulos (2017) conducted a comprehensive examination of RCTs across various categories of education technology, including access to technology, computer-assisted learning, technology-enabled behavioral interventions in education, and online learning. Dynarski and Clarke (2018) contributed to this body of research by evaluating a college scholarship program for low-income students assessing its impact on critical student outcomes such as college enrollment, persistence, and completion rates. Noteworthy studies exemplifying the broad reach of RCTs include Duflo, Dupas, and Kremer's (2021) evaluation of the private and social benefits of free secondary education in Ghana, demonstrating that scholarships not only increase educational attainment but also enhance knowledge, skills, and preventative health behaviors.

The significance of RCTs extends to policymaking, as they have been employed in behavioral interventions within higher education (Dolan et al., 2012). Moreover, during the COVID-19 pandemic, RCTs have been used to assess the impact of different learning methods, shedding light on student adaptation and attitudes towards education (Alcott et al., 2020), adaptation of new technology (Liu, G.,2022).

A few articles also shed light on the impact of various interventions in Historically Black Colleges and Universities (HBCUs) through Randomized Control Trials (RCTs). The studies indicate that interventions such as Improving Higher Education Outcomes for Black Students (Prince & Viceisza, 2023), the study of economics at HBCUs and PWIs (Emerson et al., 2023), the development, implementation, and early learning of a training program (lent et al., 2023), Enhancing counseling services for Black college women(Jones et al., 2020), analyzing the relationship between this mindfulness, perceived stress, and blood pressure (Wright et al., 2018), mentoring programs (Rockinson-Szapkiw et al., 2021), and use of technology in peer mentoring programs (Wendt et al., et al., 2019) have positive effects on academic performance, retention rates, and graduation rates among HBCU students. Technology integration and financial literacy initiatives also enhance student knowledge, intercultural competence, and financial behavior. The findings from these studies suggest that implementing targeted interventions can improve student outcomes in HBCUs. Overall, these studies underscore the significance of evidence-based practices and tailored interventions to support the academic and personal growth of HBCU students. Further research is warranted to explore these interventions' long-term effects and scalability in the context of HBCUs. Upon completion of this study, it will provide valuable insights into the diverse applications of technology in education, shedding light on its potential impacts on student learning experiences.

Methodology

A Randomized Controlled Trial (RCT) stands as a methodological cornerstone, offering a rigorous scientific approach to assess the efficacy of interventions or treatments within diverse fields, including higher education. This experimental design hinges on the random assignment of participants to distinct groups: the treatment group, which undergoes the studied intervention, and the control group, which remains unaffected by the intervention. The widespread adoption of RCTs in higher education research is underscored by their ability to furnish robust empirical evidence, as evidenced by seminal works like Bettinger et al. (2012) and Dehejia and Wahba (1999).

Beyond their methodological rigor, RCTs have assumed a pivotal role in shaping evidence-based decision-making and policy improvement, thus contributing to the global advancement of higher education research (Younger et al., 2019). subject to reporting guidelines, such as the Consolidated Standards of Reporting Trials (CONSORT), designed to enhance the transparency and completeness of RCT reporting, underscores the commitment to methodological excellence and ethical research practices (Moher et al., 2012). Through these meticulous standards, RCTs have significantly enriched the understanding of student outcomes and propelled advancements in educational systems globally.

The current study builds upon this robust RCT methodology to investigate the impact of a certification program as a technological intervention in educational programs on students' achievement at a Historically Black College and University (HBCU). By employing the systematic and empirical framework of RCTs, this research aspires to contribute subtle insights that elevate the discourse on educational interventions at HBCUs and offer practical implications for enhancing student achievement within the higher education landscape.

Research Design

This study employs a randomized controlled trial (RCT) design to systematically investigate the impact of varying incentive methodologies on students' success in acquiring proficiency in Microsoft Excel through a certification program integrated into a course curriculum. The research comprises two distinct groups of students: a treatment group and a control group. In the treatment group, students receive comprehensive and explicit information regarding the intervention. It is communicated to them that the certification program in Microsoft Excel forms an integral component of their syllabus, emphasizing the significance of successful completion for academic advancement. In contrast, the control group receives limited instructions, being informed that completing the certification will allocate additional bonus points, which will be factored into their final grade. Notably, the certification program needs to be embedded into their syllabus, and the focus is on the bonus points' supplementary nature.

Data Collection

This study primarily focuses on students who registered for the spring semester of 2023 within the School of Business and Management at the University of Arkansas at Pine Bluff, which is a well-known HBCU in the United States of America. The students were drawn from various courses they registered for, with particular emphasis on finance subject area. The research used a cluster sampling method to collect the sample data. The cluster sampling method was chosen because the research aims to include certification as a part of student's curriculum, which may be challenging in other sampling methods. A Cluster sampling method is a sampling method where the clusters are selected randomly from the clusters. Once the cluster is selected, every individual will be considered as a part of the data, which is more appropriate for our research design.

To assess the impact of the certification program, the sample was carefully split into two categories: the Control Group and the Treatment Group. Each of these groups comprised roughly 50% of the total sample. This approach was adopted to address the challenge of limited representation within individual courses.

Control Group: This group was provided with limited instruction. Students in this group are informed that achieving certification would result in bonus points, which could subsequently enhance their overall course grades. This approach aims to gauge the influence of extrinsic motivation on student performance.

Treatment group: Students in this group are explicitly instructed that certification is a compulsory component of their course assignments. Successful certification was thus mandated to fulfill their course requirements, representing an intrinsic motivation approach to incentivizing students.

Data Analysis

Data analysis for this study involved several steps. Descriptive statistics to summarize participants based on the students' received certificates or not based on the grades they have received. In the inferential statistical viewpoints, we used several methods to analyze the data to assess the impact of the intervention on student achievement.

Contingency Table:

A contingency table is used as a valuable tool in the realm of descriptive analysis in this study. It provides a structured framework to explore and understand relationships between categorical variables used in this study. A contingency table organizes the categorical data to facilitate the examination of associations between those categorical variables.

Typically, the table presents the frequencies of observations that fall into various combinations of categories for the variables under consideration. Our study depicts the relation between the certification accomplishment between the control and treatment groups with respect to corresponding grades.

ANOVA (Analysis of variance):

In our study, we used ANOVA to analyze the impact of two distinct instructional approaches: the control group, subjected to limited instructions tied to bonus incentives upon certification, and the treatment group, receives a unique set of instructions with certification considered as part of the course assignment in the syllabus. The response variable under scrutiny is the students' final score upon completing the certification program.

ANOVA allows for the simultaneous examination of mean differences across the treatment and control groups, which is essential in determining whether variations in instructional strategies lead to statistically significant disparities in academic performance. ANOVA also assesses both within-group and between-group variability, providing insights into the overall dispersion of final scores. This analysis helps discern whether the observed differences are attributable to instructional methods or random chance.

ANCOVA (Analysis of Covariance):

The use of Analysis of Covariance (ANCOVA) in our study aims to uncover more refined insights into the impact of instructional methods on academic performance. ANCOVA extends the capabilities of ANOVA by

incorporating covariates. It is a sophisticated statistical technique that combines ANOVA and regression analysis elements. We must examine group differences while accounting for the influence of continuous covariates on the dependent variable.

The decision to incorporate ANCOVA into our analysis stems from recognizing that the number of completed courses might influence final scores independently of the instructional methods. By controlling for this covariate, we aim to isolate the actual effect of the treatment and control groups on academic performance, ensuring a more accurate and precise assessment of the impact of instructional strategies.

By accounting for the covariate, ANCOVA enhances the precision of our analysis. It provides a more accurate estimate of the treatment effect by adjusting for the covariate's influence, thereby reducing the potential for biased conclusions.

Chi-Square Test:

The Chi-Square test is a crucial analytical tool in our study because we deal with categorical variables. In our research context, where categorical variables are used, the Chi-Square test becomes instrumental in discerning whether observed distributions align with expected patterns or deviate significantly. The Chi-Square test aids in determining whether there is a significant association between categorical variables. This test is a valuable tool for hypothesis testing, allowing us to validate or refute assumptions about the independent categorical variables used in the study.

Results and Discussion

The elucidation of research findings constitutes a pivotal phase in the scientific inquiry, marking the culmination of methodological endeavors and the emergence of empirical insights. In this section, we will see the statistical outcomes and empirical revelations, unraveling the complex relationships inherent in our study. The outcomes presented herein encapsulate the meticulous application of diverse statistical methodologies we used for the research. This section will follow the discussion from the outputs of descriptive statistics to empirical statistics.

A contingency table was utilized as a tool to examine the impact of an intervention on student achievement. The outcomes were then segregated into two distinct tables to clarify how the intervention influenced the attainment of certifications.

From the tables shown below, it becomes evident that students in the control group needed to secure certifications. Despite this, most students excelled and received an 'A' grade in their final assessments. This output suggests that while the control group did not acquire certifications, their academic performance was commendable, as reflected by the 'A' grades.

Conversely, students who earned 'A' grades successfully obtained certifications within the treatment group. This positive correlation between high academic performance and certification attainment is an encouraging indicator of the effectiveness of the intervention. Furthermore, among students in the treatment group who received 'B' or 'C' grades, there were still instances of certification attainment, albeit in fewer numbers.

Certificate Not Received					
Grades	A	B	C	D	F
Control	16	6	2	3	2
Treatment	0	1	13	3	6

Certificate Received					
Grades	A	B	C	D	F
Control	0	0	0	0	0
Treatment	17	6	1	0	0

The randomized control trial, a cornerstone of empirical research, unfolds its narrative as we juxtapose the control and treatment groups. The dynamics of these groups, accentuated by the divergent instructions provided (Control vs. Treatment), unveil the varying influences on student performance. The statistical machinery of ANOVA (Analysis of Variance) weaves a narrative of treatment effects, disentangling the intricacies of group disparities and shedding light on the efficacy of distinct instructional strategies. Further, in pursuing a comprehensive understanding, the analysis expands to include covariate effects through ANCOVA (Analysis of Covariance). By incorporating the continuous variable of the final score, we discern the nuanced impact of completion status (Completed_Courses) and treatment assignments (tre_con) while controlling for the influence of this covariate.

In our study, we conducted a two-way ANOVA to examine the impact of two categorical variables, "tre_con" and "Completed_Courses," on the numerical variable "final_score." This allows us to understand the statistical significance of the main effects of each variable and their interaction effect. The output from the ANOVA depicts that the main effect of variable "tre_con" was statistically significant ($p < 0.01$), which indicates

that there is a significant impact of being in the treatment group ("tre_con1") compared to the control group ("tre_con0") on "final_score." The F-value of 7.963 suggests a substantial "final score" difference between these groups. Similarly, the main effect of the variable "Completed_Courses" was highly statistically significant ($p < 0.001$), indicating that the number of completed courses has a substantial impact on "final_score." The F-value of 45.900 indicates a strong association between the number of completed courses and "final_score."

```
                  Df Sum Sq Mean Sq F value   Pr(>F)
tre_con            1   2031    2031   7.963  0.00615 **
Completed_Courses  1  11705   11705  45.900 2.72e-09 ***
Residuals         73  18615     255
```

To further support our study, we incorporate ANCOVA in our analytical journey, allowing us to discern continuous covariates' nuanced influence on the relationship between completion status, treatment assignments, and final scores. As we navigate this terrain, the covariate of final scores unveils its role as a potential confounder, shedding light on the intricate dance between academic achievement and treatment effects. With its capacity to control covariate influences, ANCOVA enriches our understanding, offering a more nuanced perspective on the drivers of academic success within the certification program.

The outputs from the ANCOVA show that the coefficient for "Completed_Courses" is 31.569. This value suggests that for each unit increase in "Completed_Courses" (from 0 to 1), "final_score" is expected to increase by approximately 31.569 points. This effect is highly significant ($p = 2.72e-09$), indicating that the completion of courses substantially impacts "final_score." Further, the coefficient for "tre_con" is -26.089, which implies that being in the "Treatment" group compared to the "Control" group has a negative effect on "final_score." A transition from "Control" to "Treatment" is associated with an expected decrease of approximately 26.089 points in "final_score." This effect is also highly significant ($p = 9.68e-08$). This implies that the final grade has no or some limited impact on the completion of certification.

```
Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)         86.172      2.965  29.060  < 2e-16 ***
Completed_Courses   31.569      4.660   6.775 2.72e-09 ***
tre_con            -26.089      4.407  -5.920 9.68e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 15.97 on 73 degrees of freedom
Multiple R-squared:  0.4246,    Adjusted R-squared:  0.4088
F-statistic: 26.93 on 2 and 73 DF,  p-value: 1.736e-09
```

Finally, we see the association between the two categorical variables in the study to further strengthen our analysis by running a Chi-Square test. A low p-value from Pearson's Chi-Square test (close to zero) suggests that the observed association between the two categorical variables, i.e., the "tre_con" and "Completed_Courses" are unlikely to have occurred by random chance. In this case, the p-value is extremely low (2.099e-05), indicating a very strong level of significance.

```
        Pearson's Chi-squared test with Yates' continuity correction

data:  contingency_table
X-squared = 18.097, df = 1, p-value = 2.099e-05
```

Conclusion

The outcomes of this study underscore the significant potential of incorporating a certification program into the student curriculum. It becomes evident that such an integration substantially elevates the likelihood of students obtaining certifications, thereby imparting considerable value to their academic achievements. A noteworthy aspect of our findings is the limited impact of completed certifications on final grades. This observation is particularly reassuring as it suggests that students pursuing certifications need not endure additional academic stress in their quest for such credentials.

The robustness of our conclusions is grounded in a rigorous statistical approach, employing a range of methodologies, including a randomized controlled trial, contingency table analysis, ANOVA, ANCOVA, and Chi-Square tests. This comprehensive analytical framework adds depth to our investigation and enhances the reliability and validity of the study's outcomes. The nuanced insights from this research contribute to the ongoing discourse on integrating certification programs within academic settings, offering valuable considerations for educators, administrators, and policymakers.

Limitations and potential for future research

The study's findings, rooted in a specific university context, may lack generalizability to institutions with different characteristics. Future studies can enhance generalizability by examining diverse institutions and certification programs. Longitudinal research tracking students' post-graduation success will provide insights into the sustained impact of certifications. Qualitative data, such as student interviews, will offer a holistic view of students' experiences with certification programs. Addressing these aspects will contribute to a comprehensive understanding and application of certification programs in academic settings.

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