Chapter 1

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# Introduction

There has been a global shift in using Artificial Intelligence (AI) to pre-screen applicants applying to positions in large companies (Holderman, 2014,p. 154). Research has also highlighted the bias affecting women and traditionally marginalized populations by being rejected during pre-screening with AI-enabled applicant tracking systems (ATS) (West et al., 2019, p.7). ATS use pre-determined criteria to determine whether an applicant is a good fit for the position. The pre-determined criteria could be keywords in a job description, experience matching previously hired employees, or other criteria (Luo et al., 2018, p.4). One of the most public descriptions is Amazon’s use of an ATS that rejected women for several years before being detected by a human observer (West et al., 2019, p.7).

In 2022, Generative AI systems became broadly available to the population by releasing ChatGPT and other similar systems. This study will conduct research which examines the use of Generative AI to create or enhance pre-employment documentation, like resumes and cover letters, versus traditional pre-employment documentation development methods on the rate at which applicants are being pre-selected for interviews. The study will conduct research which will narrow the population focus to those working in Science, Technology, Engineering, and Math (STEM) because there is a well-documented shortage of talent in these fields (Horbach et al., 2020, p.5; Nithithanatchinnapat et al., 2019, p.61). Due to the shortfall in talent to fill open positions, applicants must be fairly evaluated and not prematurely eliminated from consideration. This study will further conduct research which narrows the population of interest to traditionally marginalized populations in the STEM field because ATS, much like human manual screening, has been found to have an exaggerated effect in eliminating diverse populations from interviews (Fuller et al., 2021, p.5). Specifically, this study will conduct quasi-experimental research examining the association between interview selection rates among marginalized groups in STEM fields according to the use of Generative AI for resume creation or enhancement.

The study will be structured in five chapters. Chapter 1 will be the introduction, Chapter 2 will be the literature review, Chapter 3 will be a description of the methodology for experimentation and analysis, Chapter 4 will be an analysis of the experiment, and Chapter 5 will be the conclusion.

The Literature Review is conducted to research the gap between the available talent pool and the demand for STEM workers. It will analyze the gender and racial demographics of people graduating and available to work in STEM fields in the future. It will review the history of resume pre-screening and the impact of manual and ATS pre-screening. Chapter 2 will also review literature on the introduction of Generative AI tools available to all and the associated capability available using AI to help enhance or create pre-employment documentation. It further reviews literature on a case study where Generative AI is used to help during the pre-employment process. The case study will be analyzed from three viewpoints. The first will be the Self-Determination theoretical framework, the second will be the ethical principles governing the development and use of AI, and the third will be the theological perspective of common commands from Judeo-Christian, Muslim, and Jewish religions.

The Methodology chapter will describe the research purpose, significance, questions, and hypothesis. Additionally, it will explain the statistical analysis approach, including the dependent and independent variables associated with the survey-based data collection. It will describe the population and the methodology used to reach the population using Snowball sampling. It will describe the statistical analysis approach using the data collected. There will also be a description of methods to solicit and gain survey respondent approval. Finally, this section will describe data security measures to anonymize and protect the collected data.

# Statement of the Problem

The problem is marginalized groups have been historically excluded from interview selection in STEM fields (Casad et. al., 2021). Recently Generative AI has become widely available to consumers at little to no cost. Early studies have shown that Generative AI helped prepare employment documents, leading to greater success in interview selection rates (ResumeBuilder.com, 2023, p.1-2). There is literature documenting bias in pre-employment screening of marginalized groups in all disciplines, particularly in STEM fields (West et al., 2019, p.7). There is a gap in the literature related to the effect of Generative AI on preparing pre-employment documents for marginalized populations in STEM fields. This study conducts research that seeks to fill this gap.

# Purpose Statement

The purpose of this study is to examine differences in interview selection rates among marginalized groups in STEM fields according to the use of Generative AI for resume creation or enhancement.

According to Indeed.com, in April 2024, there were over 900,000 open STEM positions in the U.S. (Indeed.com, 2024, p.1). According to Korhonen (2023), approximately 30% fewer graduates are at all levels than the number of open STEM positions (p.1). The literature also documents through the survey of over 2400 companies worldwide where Artificial Intelligence driven Applicant Tracking Systems (ATS) are used to pre-screen resumes, of which 88% of those companies surveyed believe the ATSs are screening out qualified candidates (Fuller et al., 2021, p.22). When large segments of the population are denied opportunity, it causes instability in the foundational fabric of society. Ensuring that all people qualified for positions are fairly evaluated and considered to fill those positions is foundational to societal economic stability and prosperity.

# Significance

The focus on STEM hiring in diversity is because research has shown a gap between the number of women, Black and Hispanic workers, and those working in the AI industry (West et al., 2019, p.7). Specifically, research has shown through U.S. educational statistics that the number of women, Blacks, and Hispanic graduates in STEM is greater than those going into the field of mathematics and computer science (Kennedy, 2021, p. 1). These fields are particularly relevant because the AI development skillset is centered in this area. Research has shown that AI-enabled systems create bias in one population over another. Women and people of color are most likely to be disadvantaged by these systems. Research has shown that the companies that produce AI-enabled systems are in the West and have the lowest percentage of diverse staff in STEM fields ” (West et al., 2019, p.7). Research has shown that companies increasingly use Applicant Tracking Systems (ATS) by companies to pre-screen resumes of ’employees’ resumes before being selected for an interview. Research has also shown that with the emergence of Generative AI, there is increasing success in the use of ChatGPT to help enhance or create resumes and cover letters to contain keywords searched for by ATS (ResumeBuilder.com, 2023, p.1-2). While there has been research in the general population quantifying the benefit of using ChatGPT for resume enhancement and creation, no focus has been specifically on the diverse STEM population. West’s (2019) research states, “There is a close relationship between these workplaces with discriminatory practices and discriminatory tools (AI): a feedback loop that is shaping the AI industry and its tools. The products of the AI industry already influence the lives of millions. Addressing diversity issues is, therefore, not just in the interest of the tech industry but of everyone whose lives are affected by AI tools and services.“ (p.7).

For this reason, this study conducts research to examine the association in interview selection rates among marginalized groups in STEM fields according to the use of Generative AI for resume creation or enhancement. If an association is found using Generative AI for pre-employment documentation creation or enhancement for diverse STEM jobseekers, then jobseekers may have more successful tools for job searches. Additionally, prospective employers may fill more open STEM positions with qualified, diverse applicants.

# Background of the Problem

In 1995, fewer than 300 companies (all major corporations) used applicant tracking software systems to store, organize, and search resumes, according to Training & Development magazine. Today, some industry experts estimate that 80 percent of all companies, large and small, rely on computerized ATS as the first reader for every resume received from any source. This evolution in hiring methodology has significant implications for clients since, for many candidates, the ATS is also the last reader – 75 percent of resumes in any company database are never seen by a human recruiter or hiring manager because they do not meet the employer’s pre-established criteria for a specific position.

The most common criteria ATS uses for screening resumes includes specific years of experience within an industry or job title. Some employers use ATS selective criteria only for currently employed candidates while rejecting all unemployed candidates. Others use the system to select candidates by location (zip code or area code), and some ask the ATS to identify candidates who have worked for (or are currently working for) specific companies or competitors. (Holderman, 2014). An explainable (X-AI) framework identifies criteria for resume evaluation as: Education level, number of working years, number of awards obtained, number of relevant skills and previous work positions (Luo, 2018).

The un- or under-employment of people due to the criteria used for AI-enabled pre-screening of resumes is a worldwide problem. “In February 2020, just before COVID-19 triggered global lockdowns, employers struggled to fill positions as the economy approached “full employment .”The number of unemployed persons per job posting in the United States stood at 0.8, with 7 million positions open in the U.S.. In contrast, 5.8 million people remained unemployed, and an equal number were underemployed. There were 721,000 job vacancies in the United Kingdom during the December 2019-February 2020 period, with 1.4 million unemployed people. Similarly, there were 712,000 job vacancies in Germany in February 2020, while 2.3 million people were unemployed (Fuller et al., 2021,p.7). Given these developed countries have significant numbers of people who will be economically insecure, the countries themselves will suffer from economic growth and stability. History shows that when large segments of the population are denied opportunity, it causes instability in the foundational fabric of societies.

**AI Impact on Workforce Shortfall**

A study by Accenture and the Harvard Business School showed that there are 27 million workers unemployed because of ATS, which uses artificial intelligence. They are unemployed because the ATS has eliminated their resumes from consideration (Fuller, 2021, p.3). Additionally, of the more than 2400 companies interviewed worldwide for the Hidden Worker study, the majority understand that their ATSs are eliminating qualified workers from consideration. “They exclude from consideration viable candidates whose resumes do not match the [Applicant tracking system] criteria but who could perform at a high level with training. Most employers (88%) agree, telling us that qualified high-skills candidates are vetted out of the process because they do not match the exact criteria established by the job description. That number rose to 94% in the case of middle-skills workers.” (Fuller et al., 2021,p.3). Empirical evidence suggests that ATS can eliminate even the most highly qualified candidates. Berin & Associates, a talent management research and consulting firm in Oakland, California, tested an ATS by writing a resume for a clinical scientist position. The firm used knowledge of the job requirements to craft the resume for a theoretical ideal candidate who met 100 percent of the desired qualifications. The ATS ranked this perfect candidate as meeting just 43 percent of the qualifications, a ranking far too low to merit an interview within most companies. The candidate was rejected as not meeting the minimum educational criteria, simply because of the way advanced degrees were formatted on the resume (Levinson, 2012); (Holderman, 2014).

Ensuring that all people qualified for positions are fairly evaluated and considered to fill those positions is foundational to societal economic stability and prosperity. This study will conduct research to evaluate the varied rate of interview selection with changes in resume generation method. The two methods are traditional resume development and AI-created or enhanced resume development.

Generative AI is potentially a way to create or enhance a person’s resume to be favorably viewed by the ATS. Generative AI refers to a type of artificial intelligence that when prompted with questions about content, can create answers to the questions by generating new content. Generative AI has trained on large volumes of sentence structures, so it becomes good at predicting the next words expected in a sentence. Examples of generative AI include models like GPT-3 and GPT-4, which can generate human-like linguistic pattern matching (Chat GPT-4, 2023). Generative AI models are now a technological tool available to all that can be used to create, revise or enhance resumes. The ChatGPT-3 model was released to the public in November 2022. The recent release of this technology to all at no cost to the consumer compels a study of the impact of diverse STEM job seekers on getting pre-selected for interviews.

# Research Questions (1-2 paragraphs)

Seven research questions are being explored and described to support the study. There is one research qualifying question and six inquiry questions.

RQ1: What associations exist in interview selection rates between those who use Generative AI for resume creation or enhancement and those who do not among candidates in STEM fields?

RQ2: What association exists in interview selection rates between racial groups among candidates in STEM fields who use Generative AI for resume creation or enhancement?

RQ3: What association exists in interview selection rates between racial groups among candidates in STEM fields who do not use Generative AI for resume creation or enhancement?

RQ4: What association exists in interview selection rates between genders among candidates in STEM fields who do not use Generative AI for resume creation or enhancement?

RQ5: What association exists in interview selection rates between genders among candidates in STEM fields who use Generative AI for resume creation or enhancement?

RQ6: What differences exist in the perceived accuracy of AI-generated resume content between racial groups among candidates in STEM fields?

RQ7: What differences exist in the perceived accuracy of AI-generated resume content between genders among candidates in STEM fields?

A hypothesis tests each of these research questions.

# Hypotheses

Seven hypotheses are being tested and described to support the research study.

H01: No statistically significant association exists between interview selection rates of those who use Generative AI for resume creation or enhancement and those who do not among job seekers in STEM fields (RQ1).

Ha1: A statistically significant association exists between interview selection rates of those who use Generative AI for resume creation or enhancement and those who do not among job seekers in STEM fields (RQ1).

H02: No statistically significant association exists between interview selection rates and racial groups among candidates in STEM fields who use Generative AI for resume creation or enhancement. (RQ2).

Ha2: A statistically significant association exists between interview selection rates and racial groups among candidates in STEM fields who use Generative AI for resume creation or enhancement (RQ2).

Ha3: A statistically significant association exists between interview selection rates and racial groups among candidates in STEM fields who do not use Generative AI for resume creation or enhancement (RQ3).

Ha3: A statistically significant association exists between interview selection rates and racial groups among candidates in STEM fields who do not use Generative AI for resume creation or enhancement (RQ3).

H04: No statistically significant association exists between interview selection rates and genders among candidates in STEM fields who do not use Generative AI for resume creation or enhancement (RQ4).

Ha4: A statistically significant association exists between interview selection rates and genders among candidates in STEM fields who do not use Generative AI for resume creation or enhancement (RQ4).

H05: No statistically significant association exists between interview selection rates and genders among candidates in STEM fields who use Generative AI for resume creation or enhancement (RQ5).

Ha5: A statistically significant association exists between interview selection rates and genders among candidates in STEM fields who use Generative AI for resume creation or enhancement (RQ5).

H06: No statistically significant difference exists in the perceived accuracy of AI-generated resume content and racial groups among candidates in STEM fields? (RQ6).

Ha6: A statistically significant difference exists in the perceived accuracy of AI-generated resume content between racial groups among candidates in STEM fields? (RQ6).

H07: No statistically significant difference exists in the perceived accuracy of AI-generated resume content between genders among candidates in STEM fields (RQ7).

Ha7: A statistically significant difference exists in the perceived accuracy of AI-generated resume content between genders among candidates in STEM fields (RQ7).

Testing the hypotheses will require a rigorous research methodology and design.

# Research Methodology and Design

This quantitative, quasi-experimental design will examine interview selection rates for statistically significant associations among job seekers in STEM fields who utilize Generative AI for resume creation or enhancement and those who do not. This study will utilize chi-square analysis and ANOVA to test hypotheses for statistically significant association between groups.

A quasi-Experimental design is often used in social science research. It will be advantageous because it allows for real-world settings in which random group assignment is impractical. This Quasi-Experimental research design will compare differences in dependent variables between groups split on two independent variables from a validated quantitative instrument. The experimental design tests groups that are part of socially connected networks.

Chi-squared analysis will be used as a statistical method to determine if there is a significant association between two categorical variables. It will compare the observed frequency in each category to the frequencies one would expect to find if there were no causal associations between the variables. (Mac Farland et al., 2016, p.77-78). Since the dependent variable is the interview selection rate, Chi-squared is appropriate for examining how the interview selection rates differ across expected rates in each category (Mac Farland et al., 2016, p.77-78). The categorical independent variables are race, gender, and the accuracy of the resume. The data is organized in a matrix, referred to as a matrix representation. The interview selection rate is organized alongside the race, gender, and accuracy measures. The Chi-squared analysis assumes that the expected frequencies are sufficiently large for the Chi-squared approximation to be statistically valid. When the Chi-squared is less than 0.05, it will indicate there is a statistically significant difference between the observed and expected frequencies, indicating an association between the interview selection rate and race, gender, and use of Generative AI to create or enhance resumes or cover letters (MacFarland, 2016, p.80; Creswell, 2023, p. 268).

The Analysis of Variance (ANOVA) test compares the means of two or more independent variables to determine if at least one dependent variable mean significantly differs from the others. In this analysis, the ANOVA test is used to determine if there is a significant difference between the dependent variable and rate of interview selection, and each independent variable, race, gender, or the use of Generative AI for resume creation or enhancement. This is especially helpful when analyzing multiple independent variables, which may each have different levels or categories.(Creswell et al., 2023, p.268). The population and sampling rate are essential to the research design and methodology.

# Operational Definitions

The operational definitions for key terms are defined.

***Definition of Key Terms***

Artificial Intelligence (AI) - Artificial Intelligence (AI) refers to developing computer systems capable of performing tasks that typically require human intelligence. These tasks include but are not limited to visual perception, speech recognition, decision-making, language translation, and problem-solving (McCarthy et al., 1955, p.12-14).

Generative Artificial Intelligence (Generative AI) - Generative Artificial Intelligence (AI) refers to a subset of AI that often uses generative models to create new content, such as images, text, audio, and video. These models learn a given dataset's underlying patterns and structures and can then generate new data samples that resemble the original dataset (Vaswani et al., 2017, p5998-6008).

Gender - Gender refers to the social, cultural, and psychological attributes, roles, and behaviors a society considers appropriate for individuals based on their sex. It encompasses a range of identities, expressions, and experiences that may or may not align with the binary categorizations of male and female (West et al., 1987, p.125-151).

Race - Race is a socially constructed category used to classify people based on perceived physical or genetic characteristics, such as skin color, facial features, and hair texture. It is a fluid and contested concept that lacks biological validity but has profound social, cultural, and historical significance, shaping ’individuals’ experiences, identities, and opportunities within society (Omi et al., 2014, p.23).

STEM - STEM (Science, Technology, Engineering, and Mathematics) refers to professions that require expertise in Science, Technology, Engineering, and Mathematics. These professions involve applying scientific and technical knowledge to solve problems, innovate, and advance knowledge across various industries and sectors (National Science Board,2018, p.1).

AI Ethics Guidelines - AI Ethics Guidelines are a set of principles, standards, and recommendations that govern the development, deployment, and use of artificial intelligence (AI) technologies ethically and responsibly. These guidelines address fairness, transparency, accountability, privacy, bias, and societal impacts of AI systems, providing a framework for ensuring that AI technologies align with ethical principles and respect human rights (European Commission, 2019, p.1).

Self-determination Theory - Self-Determination Theory (SDT) is a psychological framework that explores human motivation and personality development. It proposes that individuals have innate psychological needs for autonomy, competence, and relatedness, and when these needs are satisfied, individuals experience intrinsic motivation and psychological well-being. (Deci et al., 2002, p.39)

Pre-employment screening - Pre-employment screening is the process of evaluating job ’applicants’ backgrounds, qualifications, and suitability for a particular position before they are hired (Collins, et al., 2004, p. 413-453).

Applicant Tracking Systems - Applicant Tracking Systems (ATS) are software applications organizations use to manage and streamline the recruitment and hiring process. These systems automate job posting, resume screening, candidate tracking, and communication with applicants, enabling employers to manage large volumes of job applications. (ATS Acute Market Reports, 2017, p.112).

# Scope and Delimitations

The study will address diverse STEM job seekers seeking employment within the past twelve months. LinkedIn will be used to elicit survey participants. The platform used to elicit survey respondents is worldwide, but the method of soliciting participants is socially connected networks, which begin in US. Therefore, the participants will likely represent jobseekers’ experiences in the US. The study analysis will delineate job seeker experiences using AI in pre-employment document preparation by gender and race.

# Limitations

The field of AI is accelerating very quickly. The research regarding acceptable and ethical practices in employment pre-screening may mature to eliminate the same biases in current screening systems and perceptions of using Generative AI in employment. Because Chi-Square in a nonparametric procedure, the results cannot be generalized beyond the sample. The measured results will be a snapshot in time and may not be applicable as AI-enabled systems evolve. For example, the results of the Generative AI system may change over time to reflect the evolving corpus of data used to derive results. Subsequent adoption of AI Ethics principles by ATS system developers may change post-deployment system performance. There may be population selection bias using snowball sampling. It depends on the researcher’s social networks and those known by professional networks associated with the researcher. The population will predominantly come from the United States. While this is a global problem, cultural differences will influence Generative AI’s value, as most systems are developed in the US.

# Assumptions

Assumptions in the study are that ATS is used by the companies screening resumes and jobseeker resumes. Additionally, the job market conditions have not changed over 12 months to influence criteria for interview selection. The population sampling method produces sufficient respondents in each category to appropriately analyze the results using Chi-Square and ANOVA methodology. The Self-determination theory is assumed to be valid across populations of STEM-diverse job seekers and their prospective employers. The ethical principles analyzed are assumed to be relevant to the developers and users of the AI-enabled systems used. The theological framework is assumed to be relevant to 55% of the global population, Judeo-Christian, Jewish and Islam, but not the entire population.

# Summary and Conclusion

There is a shortfall in talent in STEM fields. Additionally, there is a long tradition of diverse talent being screened out before the interview process because bias will be demonstrated through research. Additionally, as AI-enabled systems replace human reviewers, research will be conducted to examine the persistence of bias in AI-enabled systems that pre-screen resumes for interview selection. Research will examine AI Ethical guidelines as a potential source to help minimize bias in developing and using AI-enabled systems like ATS. The theoretical framework analysis will explore the level of human autonomy or regulation that should govern the use of Generative AI in preparing pre-employment documentation. Additionally, research will show theologically a framework for evaluating the Christian, Muslim and Jewish religious perspectives in prospective employee, and employer social interaction as it relates to the call for one to Love God and love their neighbor as themselves. Bias against others would be inconsistent with the outcome of this kind of AI-enabled system, should either ethics or religious doctrine be followed.

As AI has become available to the general population through Generative AI, like ChatGPT, employment candidates are turning to AI to assist in resume creation or enhancement. This has been met with acceptance by some and rejection by other hiring managers. There is an under-representation of women and minorities in several STEM fields, but no research has been done to determine if using Generative AI will improve the outcome of resume screening by an AI-enabled ATS leading to being selected for an interview. The research problem is marginalized groups have been historically excluded at a higher rate from employment participation in STEM fields.

The quasi-experimental research design and methodology will examine the research questions and hypothesis to determine the association between using Generative AI vs traditional pre-employment document creation or enhancement method relationships to the rate of selection for interviews for job seekers in STEM fields. The methodology and statistical analysis methods will address the research questions and test the hypotheses. Further research will be presented regarding the method of sampling. Additionally, the study will conduct research to present data collection, processing, and analysis methodologies. Finally, the study will conduct research to present information regarding the protection of research survey respondents through a social science research questionnaire, IRB review process, and data protection provisions. This quantitative, quasi-experimental research design will inform employment seekers about the association between using Generative AI versus traditional methods and being pre-selected for an interview.

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