

Charting Futures: A Comprehensive Review of Guided Pathways in Undergraduate Programs for Career Selection using Machine Learning

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Submitted: 27/11/2023 Revised: 07/01/2024 Accepted: 17/01/2024

Abstract: Community college students are more likely to persist and excel in programs that exhibit a high level of conscious structuring, minimizing opportunities for unintentional deviations from the prescribed paths to completion. Additionally, success is enhanced when these programs have fewer bureaucratic obstacles, facilitating a smoother journey for students without unnecessary circumnavigation efforts. Resilience, within the realm of learning, is a complex concept encompassing an individual's ability to both generate and optimize opportunities while also responding positively to setbacks and challenges. The cultivation of students' resilience is gaining significance, supported by research demonstrating its connections to achievement, retention, engagement, and employability. Despite this recognition, there is a paucity of research investigating the specific elements of curricula that contribute to resilience and, more specifically, the distinctive role played by active learning frameworks in attaining this objective. This research presents a review that aids in comprehending the diverse facets of structure within community college career and technical programs. This paper serves as a valuable resource for practitioners engaged in program and policy design. Furthermore, it offers researchers a tool to gauge the adoption and effects of approaches characterized by a relatively higher degree of structure.

Keywords: Career congruence; Career guidance; Career Selection; Decision-making; Machine Learning;

1. Introduction:

Selecting a career represents a crucial phase in a student's life, shaping various decisions related to academic pursuits, university selection, institutional choices, company preferences, and job profiles. In contemporary times, it is common to encounter students who remain uncertain or uninformed about their career paths even after completing their graduation. Given the importance of guiding students towards successful careers in the professional and the prevalent issue of under-preparation during their earlier educational stages, it is imperative for our nation to persist in investing in interventions that secure their academic success [1]. College educators confront a threefold challenge: securing the necessary funding to initiate and test essential interventions, employing research strategies capable of revealing evidence-based best practices, and ultimately discerning the program elements that contribute to effective interventions in enhancing math and language proficiency. Addressing these challenges is crucial for fostering a supportive educational environment that propels students towards achievement in the biomedical sciences [2]. To gain a comprehensive understanding of this issue, it is crucial to explore the factors that influence students in either opting for or rejecting a career path in

professional life. Existing data shed light on these influences within specific groups. In a survey involving academic family physicians, engagement with learners, colleagues emerged as a motivating factor for faculty members to pursue education. Additionally, the perceived status of academic careers plays a role in career choices; studies indicate that technical study in various universities might hold lower ranks compared to their counterparts in research, influencing career decisions. Moreover, the support and recognition provided within academic settings may impact career preferences. Some professional researchers feel that verbal support from department chairs for their research may not translate into tangible assistance, potentially discouraging interest in academia. Mentorship also plays a pivotal role in career decisions, and the absence of appropriate role models and mentors could be a significant factor, especially contributing to the underrepresentation of student in academic medicine, particularly in leadership roles. Balancing personal and professional responsibilities is another key consideration affecting career choices. Student may perceive drawbacks such as reduced family time, a sense of diminished autonomy, and limited leisure time as deterrents to pursuing a career in academic medicine. Understanding and addressing these multifaceted factors are essential for promoting diversity and fostering interest in academic careers [3].

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2. Importance of Career Selection:

Choice of career significantly impacts every facet of our lives, encompassing the personal, social, and professional domains. It serves as a cornerstone in shaping our identity, determining our daily routines, and influencing our social status, friendships, living arrangements, and social circles [4]. The time allocated for family, friends, and self is intricately linked to our chosen career path. The financial aspects of our life, including funds for essentials like food, clothing, shelter, and entertainment, are contingent upon the earnings derived from our work or job. The level of happiness, comfort, or discomfort experienced in our workplace is closely tied to the nature of our job or profession. Opting for work aligned with our passions enables us to perform with excellence, garner encouragement, and receive rewards, thereby boosting our self-esteem [5]. In essence, our career choice serves as a linchpin that intricately weaves together the various threads of our existence. The choice of a career is a profound determinant that ripples through every dimension of our lives, leaving an indelible impact on the personal, social, and professional spheres. It assumes the role of a cornerstone, molding our identity and exerting influence over our daily routines. Beyond the individual, it extends its reach into the social fabric, shaping our social status, friendships, living arrangements, and the intricate web of our social circles. The allocation of time for family, friends, and personal pursuits becomes intricately entwined with the trajectory of our chosen career path. Financial considerations, a fundamental aspect of our existence, hinge on the earnings derived from our work or job [7]. The choices we make in our careers resonate in the funds available for essentials such as food, clothing, shelter, and the avenues for entertainment and recreation. Moreover, the quality of our work life, marked by levels of happiness, comfort, or discomfort, is intimately connected to the nature of our job or profession. Opting for a career aligned with our passions and interests transcends mere employment; it becomes a source of excellence and personal fulfillment. The alignment between one's work and personal inclinations not only fosters superior performance but also attracts encouragement and tangible rewards, creating a positive feedback loop that significantly bolsters our self-esteem [8].

3. Factors influencing Career Decision-making

- **Parental Expectations:** Many students succumb to parental desires or pressures when selecting a career, often choosing paths that align with family expectations. This decision, made early on, may lead to later regrets, especially when it diverges from the individual's true interests or aspirations.
- **Peer Influence:** The inclination to follow the crowd is prevalent, with students often choosing career paths based on the decisions of their peers. The belief that the majority's choice is the best choice can result in mediocrity, where individuals may not excel in their careers due to a lack of personal conviction [9].
- **Past Academic Performance:** Relying on past exam performance as the sole basis for career decisions is a flawed approach. In systems emphasizing rote learning and numerical outcomes, this practice may lead to misaligned career choices, as a single exam may not accurately reflect a student's true interests and capabilities.
- **Identification of Potential:** A legitimate criterion for career selection is recognizing and aligning with one's potential. Students who identify their strengths and choose a career accordingly have a higher likelihood of achieving success in their chosen field.
- **Placement Opportunities:** Job placement prospects play a pivotal role in students' career decisions. The availability of good placement options serves as a significant motivator during the career planning phase, influencing the choice of university and course [10].
- **Personality Alignment:** Some individuals base their career choices on their personality traits and characteristics. This reciprocal relationship sees individuals with effective communication skills opting for mass communication, while natural leaders may pursue management fields.
- **Financial Considerations:** Affordability is a fundamental criterion for many students in shaping their career choices. The financial aspect, often referred to as "Paisa," determines the accessibility of quality education and influences career decisions that align with one's financial capabilities.

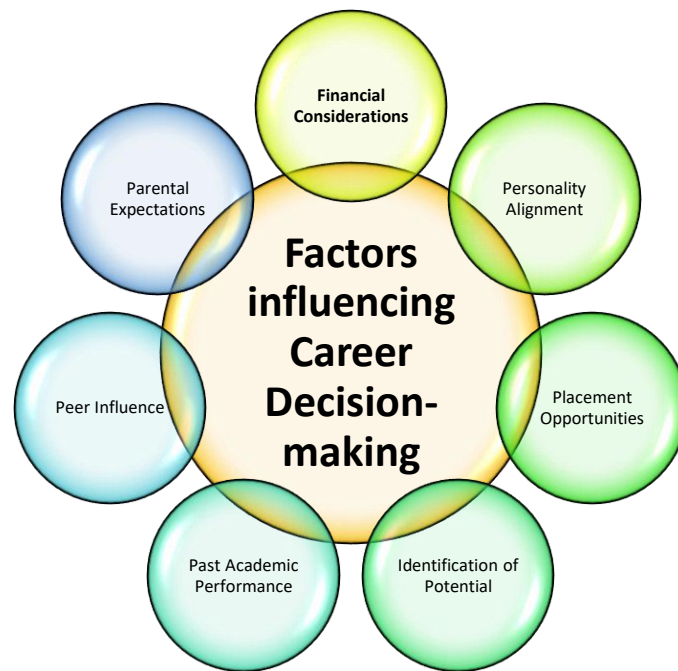


Fig 1: Factors influencing Career Decision-making

4. The Role of Undergraduate Programs:

- Follow Passions:** Envision immersing yourself in a passion project every day, a source of unparalleled energy and fulfillment. College provides a unique opportunity to integrate your specific interests into coursework, extracurricular activities, internships, or volunteer projects. By enrolling in the right program, you pave the way to continue pursuing your passion, ultimately translating it into your dream job post-graduation [11].
- Enhanced Employability:** The preference for hiring college graduates is well-established among employers. Possessing a bachelor's degree significantly enhances your marketability as a prospective employee, making it easier to craft a compelling resume. Research from the Association of American Colleges and Universities underscores employers' confidence in higher education, with 87 percent believing that a college degree justifies the investment of time and money.
- Diverse Career Opportunities:** Choosing a college program aligned with your desired career path not only provides a direct route but also offers a fail-safe. A bachelor's degree equips you to explore professional opportunities across various fields, accommodating unexpected career trajectories. Even if 46 percent of college graduates work in their field of study, those with a bachelor's degree are generally more employable compared to counterparts with high school diplomas or associate degrees [12].
- Financial Advantages:** The financial benefits of earning a bachelor's degree are undeniable. Extensive research, such as that from Georgetown University Center on Education and the Workforce, reveals that college graduates earn substantially more over their lifetime than those with lower educational qualifications. On average, adults with bachelor's degrees earn \$2.8 million, a staggering \$1.2 million more than those with only a high school diploma.
- Boost in Confidence:** College provides numerous opportunities for building confidence. Graduation marks a significant boost, but confidence gains occur throughout enrollment, spurred by positive feedback from instructors and mastering new skills. These confidence boosts become a powerful and sought-after feeling that contributes to personal and professional growth [13].
- Networking Opportunities:** Networking, crucial in today's competitive workforce, flourishes in the college environment. Surrounded by a community of motivated individuals, you benefit from valuable contacts through internships, networking events, and shared experiences. College serves as a fertile ground for forming connections that can prove beneficial throughout your career.
- Acquisition of Mentors:** College presents opportunities to establish meaningful relationships with mentors, be it advisors, instructors, or coaches. Mentees, both during and after graduation, exhibit better performance, while mentors find personal satisfaction in supporting others. Taking on both roles as a college student provides fresh perspectives and invaluable inspiration.
- Improvement in Interpersonal Skills:** Interpersonal skills, essential in today's job market, are prioritized by employers. College, with its liberal arts

coursework, hones written and verbal communication skills, contributing to the development of social intelligence. The experience acts as a powerful incubator for social and emotional development, fostering skills like self-perception and empathy [14].

- **Challenge and Growth:** College introduces achievable challenges that make life richer and more exciting. Every student, regardless of cognitive abilities, encounters significant challenges, fostering personal growth. The hurdles presented by college coursework contribute to a more fulfilling life, with students continuing to seek and overcome challenges post-graduation.
- **Development of Unique Skills:** Beyond essential skills like empathy and communication, college imparts a variety of unique skills. From music composition to video production, each skill gained becomes vital to personal and professional identity. Inspirational figures, like Tim Cook, attribute their success to the diverse education received in college, emphasizing the intersection of technology and liberal arts [15].
- **Achievement of Personal Goals:** College provides a structured environment conducive to goal-setting and achievement. The opportunity to set and attain meaningful goals, starting with earning a degree, instills a sense of pride. This achievement lays the foundation for pursuing more significant endeavors in graduate school or a successful career.
- **Preparation for Advanced Degrees:** Earning a bachelor's degree is a crucial step toward enrolling in esteemed master's programs. Graduate-level studies build upon the opportunities highlighted earlier, further enhancing long-term prospects for employment, pay, and job satisfaction. Professionals with master's degrees, on average, earn \$3.2 million in lifetime earnings, with considerable improvements in job satisfaction post-graduate education [16].

5. Role of Psychometric Test:

A psychometric test in recruitment serves as an evaluative tool designed to gauge a candidate's cognitive capabilities and personality traits. By analyzing a candidate's responses, psychometric testing can offer valuable insights into job performance, competence, and motivations. There are two primary categories of psychometric tests: ability tests and personality tests. Ability tests aim to identify a candidate's cognitive proficiency, assessing skills such as numerical, verbal, logical, and critical thinking abilities. On the other hand, personality tests focus on comprehending a candidate's behaviors and motivations [31].

These tests are instrumental in the hiring process for several reasons:

- **Insightful Predictions:** Psychometric tests provide a comprehensive and highly valid prediction of a candidate's knowledge, skills, abilities, and other attributes crucial for effective job performance [17].
- **Efficiency:** Administered online by test publishers, psychometric tests enable the swift evaluation of hundreds or even thousands of candidates with automated data compilation and reporting. This efficiency saves significant time and resources for hiring companies.
- **Bias-Free Assessment:** Psychometric tests are impartial and effective across all job levels, from entry-level positions to CEOs. Moreover, companies can customize assessments to tailor them to specific roles within the organization [32] [33].

Advantages of Psychometric Testing:

- **Job Performance Prediction:** Psychometric tests are exceptionally powerful and valid predictors of job performance, surpassing traditional selection interviews [34][35].
- **Organizational Performance:** The use of psychometric tests correlates with improved organizational performance, heightened employee retention, reduced hiring costs, lower turnover rates, decreased absenteeism, and increased employee engagement and motivation [18] [36].
- **Convenience:** Online psychometric tests can be easily distributed to candidates, minimizing the time and effort required compared to traditional selection processes like interviews and assessment centers. Reports are promptly generated, making psychometric testing ideal for pre-employment screening and high-volume recruitment [37][38].
- **Return on Investment (ROI):** The cost of hiring a subpar candidate is significantly higher than investing in psychometric testing, which has been shown to result in a more productive and revenue-generating workforce.
- **Objectivity:** Psychometric tests enhance the fairness and objectivity of the selection process, allowing candidates to be assessed based on merit through standardized tests, mitigating the subjectivity associated with traditional methods like unstructured interviews.

Types of Psychometric Tests: Psychometric tests can be categorized into cognitive ability tests (aptitude tests) and personality tests.

- **Cognitive ability:** Cognitive ability tests measure intelligence, while personality questionnaires evaluate specific traits such as leadership potential,

strengths, teamwork, competencies, values, motivations, and behaviors. Within cognitive ability tests, various aptitudes can be assessed, including numerical reasoning, verbal reasoning, logical/diagrammatic reasoning, error checking, data analysis, critical thinking, and mechanical reasoning [19].

- **Personality tests:** Personality questionnaires are versatile, measuring a range of variables to provide a comprehensive understanding of a candidate's traits. Additionally, situational judgment tests incorporate elements from both cognitive ability tests and personality questionnaires, serving as an intermediary assessment tool [20].

6. Related Work Analysis:

In [21], discusses the challenges faced by students with disabilities in their career development and school-to-work transition. The study employs Narrative Inquiry as a technique. The findings suggest that students, despite facing additional challenges, express specific career and life goals. They also share their experiences within an Open and Distance Learning (ODL) institution and discuss their perceived chances for employment.

In [22], the statement emphasizes the need for career pathways to consider the perspectives of both students and the community, with particular attention to those from marginalized groups. The technique used is an "infused model." The findings suggest that lesson plans and activities were designed to facilitate meaningful self-reflection and goal-setting. These were seamlessly integrated into the formal curriculum, contributing to the enhancement of early-stage career education.

In [23], the study aims to investigate how the alignment of career aspirations between adolescents and their parents influences the well-being of adolescents and their future intentions to pursue university education. The technique employed for this investigation is IBM SPSS v.26, suggesting a statistical analysis approach. The primary focus is on exploring the connection between parents' influence and individual motivation.

In [24], the study focuses on students' perspectives regarding their career decision-making process. The investigation involves in-depth interviews as the technique. The study explores various aspects, including the rationales behind students' career choices, their perceptions of the quantity and quality of career information within physics and related domains, and the origins of such information. The findings of this study can provide valuable insights for policymakers, school counselors, and teachers. The aim is to aid them in recognizing the factors that influence the career decision-

making processes of gifted students, with a specific focus on physics.

In [25], the objective is to develop an educational framework that comprehensively takes into account inputs from both students and parents. The technique used for this purpose is machine learning. Specifically, the Naive Bayes algorithm was employed and demonstrated a high level of effectiveness in making predictions. The algorithm achieved a Recall score of 91.2% and an F-Measure score of 90.7%, indicating superior performance in the context of the study.

In [26], the focus is on addressing the challenge of predicting student dropout to support university admissions processes and enhance the effectiveness of Massive Open Online Courses (MOOCs). The technique used is machine learning. The statement further suggests that this approach aligns with the increasing trend of meta-analytical studies in both educational and machine learning research. Additionally, there is an acknowledgment of critical examinations of the societal implications of machine learning.

In [27], the objective of the mixed-methods investigation is to identify the learning experiences that students consider significant in shaping their STEM (Science, Technology, Engineering, and Mathematics) self-efficacy and influencing their career choices. The technique used includes follow-up interviews as part of the mixed-methods approach. The combined findings from both quantitative and qualitative methods suggest that perceived innate interest may be an outcome of early experiences and family-related activities. Furthermore, students' active participation in STEM extracurriculars and career-focused activities plays a role in shaping their perspectives on their career trajectory.

In [28], the study employs Field Theory to uncover the established norms of career practices within a Computer Science department. The research aims to elucidate the mechanisms used to reinforce these norms and explore students' experiences in relation to these established norms. The technique used for data collection is semi-structured interviews. The study contributes to the understanding of norm enforcement by identifying three mechanisms: companies leveraging their departmental position for more effective recruitment, curricula being optimized to prepare students for prestigious work, and career advising assuming alignment with departmental norms.

In [29], the statement emphasizes that the selection of a career path has a significant impact on individuals' skills and abilities in diverse ways. The technique mentioned is the "Thinking-aloud protocol." Additionally, it is noted that the suggested system, which presumably relates to

career path selection, is applicable to undergraduates making choices among engineering, medicine, arts, and science degrees.

In [30], the focus is on envisioning innovative institutions as the imminent evolution in higher education. The challenge identified is the effective harnessing and integration of AI and quantum technologies to bring about a transformative shift in academic and administrative processes. The technique mentioned is "Artificial

Intelligence". The statement further highlights a crucial element in the discussion, which revolves around the acknowledgment of qualifications from institutions enriched by AI. This variable has the potential to significantly reshape the trajectory of the education sector. The article also explores the consequences of AI-driven innovations for historically Black colleges and universities.

Table I: Comparative analysis previous work done

References	Problem Statement	Technique	Findings
[21]	Students with disabilities face additional challenges in their career development and school-to-work transition.	Narrative Inquiry	The students express particular career and life goals, recount their experiences in an Open and Distance Learning (ODL) institution, and discuss their perceived chances for employment.
[22]	Career pathways need to incorporate the viewpoints of students and the community, especially those belonging to marginalized groups.	infused model	The lesson plans and activities were created to enable significant self-reflection and goal-setting, seamlessly integrating them into the formal curriculum to enhance the integration of early-stage career education.
[23]	Examining how the alignment of career aspirations between adolescents and their parents influences the well-being of adolescents and their future intentions to pursue university education	IBM SPSS v.26	This investigation aim to explore the connection between parents' influence and individual motivation.
[24]	The study also pinpointed students' viewpoints concerning their career decision-making, encompassing the rationales behind their career choices, their perceptions of the quantity and quality of career information within physics and related domains, and the origins of such information.	In-depth interviews	The results can serve as valuable insights for policymakers, school counselors, and teachers, aiding them in recognizing the factors influencing the career decision-making processes of gifted students with a focus on physics.
[25]	Develop an educational framework that comprehensively considers inputs from students and parents, utilizing intelligence to generate results that align with the diverse perspectives within the educational community.	Machine learning	The Naive Bayes algorithm demonstrated a high level of effectiveness in making predictions, achieving a Recall score of 91.2% and an F-Measure score of 90.7%, highlighting its superior performance in this context.
[26]	Addressing the challenge of predicting student dropout to support university admissions processes and enhance the effectiveness of Massive Open Online Courses (MOOCs).	Machine learning	aligns with the increasing trend of meta-analytical studies in both educational and machine learning research, along with critical examinations of the societal implications of machine learning.
[27]	The objective of this mixed-methods investigation was to identify the	follow-up	The amalgamation of quantitative and qualitative findings implies that perceived innate interest might be

	learning experiences that students deemed significant in shaping their STEM self-efficacy and influencing their career choices.	interview	an outcome of early experiences and family-related activities. Additionally, students' engagement in STEM extracurriculars and career-focused activities played a role in shaping their perspectives on their career trajectory.
[28]	This study utilizes Field Theory to uncover the established norms of career practices within a Computer Science department. The research aims to elucidate the mechanisms employed to reinforce these norms and explore students' experiences in relation to these established norms.	semi-structured interviews	This study adds to the understanding of norm enforcement by identifying three mechanisms: companies leveraging their departmental position for more effective recruitment, curricula being optimized to prepare students for prestigious work, and career advising assuming alignment with departmental norms.
[29]	The selection of a career path significantly impacts individuals' skills and abilities in diverse ways.	Thinking-aloud protocol	The suggested system is applicable to undergraduates making choices among engineering, medicine, arts, and science degrees.
[30]	Envisioning innovative institutions as the imminent evolution in higher education, the challenge lies in effectively harnessing and integrating AI and quantum technologies to bring about a transformative shift in academic and administrative processes.	Artificial Intelligence	A crucial element in this discussion revolves around the acknowledgment of qualifications from institutions enriched by AI, a variable that could significantly reshape the trajectory of the education sector. In the context of a thorough analysis of its broader societal impact, this article also explores the consequences of AI-driven innovations for historically Black colleges and universities

7. Conclusion:

In conclusion, the findings underscore the importance of conscious structuring in community college programs, as it significantly influences students' persistence and success. Programs that minimize unintentional deviations from prescribed paths to completion are more likely to foster positive outcomes. Additionally, reducing bureaucratic obstacles is crucial for facilitating a smoother journey for students, eliminating unnecessary circumnavigation efforts. Resilience, a multifaceted concept in the context of learning, plays a pivotal role in students' ability to navigate challenges and setbacks. Despite its recognized impact on achievement, retention, engagement, and employability, there remains a research gap regarding the specific curriculum elements that contribute to resilience, particularly the unique role of active learning frameworks in this process. This research contributes to the understanding of the diverse facets of structure within community college career and technical programs. It not only serves as a valuable resource for practitioners involved in program and policy design but also provides researchers with a tool to assess the adoption and effects of approaches characterized by a relatively higher degree of structure. By addressing these considerations, educators and policymakers can better tailor programs to enhance student resilience and success in community college settings.

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