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Designing an AI-Driven Career Guidance Framework in South African Higher Education: A User-Centric Approach

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Abstract. The integration of Artificial Intelligence (AI) into career guidance systems presents a valuable opportunity to address the structural, informational, and psychological barriers that hinder effective decision-making for university students. This study outlines the development and implementation of a user-centred, AI-driven career guidance framework tailored for South African higher education institutions. Grounded in behavioural theory, particularly Social Cognitive Career Theory (SCCT), the framework was crafted using a qualitative research approach that incorporated insights from students' focus group discussions and semi-structured interviews with lecturers. Findings show that students value personalised, context-sensitive guidance features, particularly those that link academic achievements to job market trends. Educators emphasised the need for system transparency, data security, and fair access to build trust and promote adoption. Results indicate AI-powered tools can boost students' confidence and career self-efficacy when integrated into academic support frameworks. The study highlights key contextual factors influencing career decision-making, such as the availability of reliable information, self-efficacy, the perceived usefulness of AI tools, and the digital readiness of institutions. The framework integrates machine learning profiling, personalised recommendations, and feedback loops, addresses inequalities, aligns education with labour-market needs, and helps students make career decisions. The evaluation findings show that stakeholders essentially embrace AI-powered guidance tools, though ongoing concerns include data privacy, confidence in the recommendations, and ensuring equal access. This paper offers a practical and theoretically informed model for career development

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interventions in developing contexts, serving as a blueprint for inclusive, scalable, and adaptable AI solutions in higher education.

Keywords: Artificial Intelligence; Career Guidance Framework; User-Centred Design; Career Guidance

1. Introduction

Career choice remains a critical challenge for students in South Africa, shaped by socioeconomic inequalities and limited guidance structures. Many first-year students enter higher education without a clear understanding of their career trajectories or alignment with labour market demands, often resulting in disengagement, poor performance, and mental health concerns, particularly at historically disadvantaged institutions (Farao & du Plessis, 2024; Levin et al., 2020). Globally, policymakers recognise that mismatches between education and employment undermine workforce sustainability (Amitha Peiris & Gan, 2013; Cappelli, 2015).

In South Africa, this concern is underscored by Department of Higher Education and Training (DHET) data indicating that more than half of workers experienced education-job mismatches in 2019, with 21.6% overqualified and 29.5% underqualified (DHET, 2021). These realities highlight the urgent need to better align post-school education and training with labour market requirements (Brown et al., 2019). Although Artificial Intelligence (AI) has transformed career guidance internationally through data-driven, personalised, and accessible services (Bankins et al., 2024; Bahalkar et al., 2024), South African realities complicate its implementation. Local challenges such as insufficient institutional funding, multilingual contexts, and digital access disparities constrain the scalability and inclusivity of career guidance technologies.

Moreover, while Social Cognitive Career Theory (SCCT) provides a strong conceptual foundation for understanding how self-efficacy, outcome expectations, and interests shape career decisions (Lent & Hackett, 1994), interventions informed by SCCT often fail to address students' cultural identities, socioeconomic contexts, and long-term aspirations (Zhang, 2024; Dabula & Makura, 2013). Although SCCT-based programmes have enhanced decision-making self-efficacy among South African students (Buthelezi et al., 2009; Pillay, 2020), they remain fragmented and lack sustainable, technology-enhanced integration.

This research aims to fill existing gaps by creating an AI-based framework for career selection, specifically designed for South Africa's higher education landscape. The framework combines career-choice theories, AI technologies, and contextual elements to facilitate informed decision-making, ensuring that its application is ethical, transparent, and socially aware. It highlights AI's potential to improve decision-making by delivering career suggestions that extend beyond simple user preferences, offering real-time, personalised insights. Furthermore, the research examines how AI-driven career recommendation systems can assist students in identifying career paths, emphasising practical application, efficiency,

and impact, particularly within the study's context. Specifically, it combines student perspectives, stakeholder input, and labour-market alignment to deliver personalised and scalable guidance that extends beyond generic user preferences to provide real-time, contextually relevant recommendations.

The core research question guiding this study is: How can a user-centred, AI-driven career guidance framework be designed and implemented to integrate career choice theories, emerging technologies, and South African realities to better support undergraduate students? This paper is part of a study currently under examination for a Doctoral thesis in Information Technology at Nelson Mandela University, titled: Designing an Artificial Intelligence-Based Career Choice Framework for Undergraduate University Students; thus, more details are in the complete thesis. The paper is structured as follows: a literature review, a methodology section, a summary of key findings, a discussion, and a conclusion.

2. Literature review

2.1 Career Guidance in South African Higher Education

Universities are instrumental in generating knowledge and fostering societal skills. These educational institutions play a crucial role in shaping students' career trajectories by offering pertinent qualifications (Samuel et al., 2019). Numerous institutions have introduced bridging programmes (Shyle, 2020). Social narratives shape cultural contexts and exploring them in career counselling helps individuals address their concerns (Arulmani, 2024). University career support services offer limited counselling and workshops (Maree & Magere, 2023).

Technological advancements often overlook rural communities (Bhumichitr et al., 2017), leaving students without adequate guidance (Gati & Kulcsár, 2021). Resource limitations challenge career services. In South Africa, career support is restricted by its physical presence (Chiramba & Ndofirepi, 2023; Khurumova & Pinto, 2024), and unfortunately, in-person counselling primarily emphasises testing (Jackson, 2015). Therefore, AI platforms are needed to leverage analytics to deliver career advice (Chaohua & Zaifeng, 2024), thus improving accessibility in regions that are typically underserved (Ocen et al., 2025). Notably, AI in career guidance is transforming counselling into data-driven frameworks for individual needs.

Universities struggle with ineffective data flow between records and support systems. National strategies promote digital learning, yet career services lack digital capabilities. The absence of platforms linking academic and labour market data hinders career support (Ahmadian Yazdi et al., 2024). As AI technologies progress, their integration could help address challenges such as unemployment and skills mismatches. South Africa's higher education system is grappling with issues of unequal access and a youth unemployment rate approaching 60% for those aged 15-24 (DHET, 2021). Limited resources hinder the availability of career guidance for marginalised communities (Mabidi, 2024; Murniarti, 2019). Mavuso et al. (2023) highlighted the importance of a user-centred AI framework that considers personality and socio-economic factors to provide students in rural areas with customised guidance.

Understanding factors influencing students' career choices is vital for educators to provide guidance (Subramanian & Ramachandran, 2019). This helps institutions support career planning (Goga et al., 2015). Higher education institutions must provide career selection resources in disadvantaged contexts (Mudhovozi & Chireshe, 2012). Students rely on parents and advisors while considering passions and job prospects (Bloxom et al., 2008; Alimam et al., 2014). Without guidance, students struggle to align interests with abilities (Donald et al., 2018).

Given the constraints of limited resources, developing automated systems for career guidance is crucial (Razak et al., 2014). Leveraging technology in career support addresses the challenges posed by job displacement (Dassah, 2021; Ardeleanu & Stanescu, 2016). Consequently, AI frameworks must be adapted to local contexts, and AI applications should account for linguistic diversity to ensure equitable access (Sokhulu et al., 2025; Twetwa-Dube et al., 2025). The DHET underscores the significance of guidance tailored to local markets (DHET, 2019).

2.2 AI in Career Guidance: Global and Local Developments

The overwhelming influx of information from digital platforms, external sources, and personal experiences has woven a complex network of influences affecting individuals (Patel et al., 2017). This intricacy makes decision-making challenging, especially in major life decisions such as choosing a career path (Hatane et al., 2020). Adequate support is crucial for making well-informed career choices; however, the lack of sufficient professional guidance has led many students to pursue careers that do not align with their abilities, interests, or personalities (Jackson & Wilton, 2017; Shaikym et al., 2023).

Advancements in technology within modern universities have promoted the integration of computing into their existing physical spaces (Nie et al., 2020). The application of recommender systems in career decision-making is becoming more pertinent, as making informed career choices requires individuals to have the skills and abilities to understand themselves (Madadipouya & Chelliah, 2017; Nie et al., 2020).

AI integration can enhance career services' effectiveness. Transparency and monitoring help reduce bias and protect data. Digital equity remains a concern, as rural students often lack internet access (Batisai et al., 2022). Mobile-friendly and offline solutions with equitable access policies are essential. AI frameworks align career paths with student interests (Li & Li, 2025). Ethical governance requires transparency and human oversight in AI-driven career guidance (Binns, 2018). AI implementation raises privacy and bias concerns (Luckin et al., 2016), particularly in South Africa's context of digital inequality.

2.3 User-Centric Design Principles in AI Systems

The effectiveness of AI-based career guidance systems depends on their user-friendliness and on their acceptance among students, counsellors, and educators. User-centric design (UCD) involves users throughout development to ensure systems are intuitive and culturally appropriate (Norman, 1986). Systems created

with user involvement inspire greater trust and effectiveness (Shneiderman, 1987). Engaging end-users ensures that technological solutions are accessible and relevant to users' needs (Kahraman, 2010; Robert et al., 2020). Human-centred AI emphasises transparency, fairness, ethics and user control in algorithmic systems (Schmager et al., 2025; Shneiderman, 2020). For career guidance, students should consider the functionality of AI tools when making career decisions (Floridi et al., 2018). While user-centred design builds trust (Hollanek, 2023), many systems remain difficult to use, poorly localised, and contain biased training data (Nizamani et al., 2025).

Career services in South African universities are under-resourced and unequal. Many lack the capacity for personalised guidance, especially for disadvantaged students (Maringe & Chiramba, 2022). Studies have shown that AI-driven technologies can provide personalised learning experiences by adapting to students' abilities and requirements (Ampo et al., 2025). Furthermore, AI can expand career services while still offering a tailored approach, helping students align with suitable career paths and identify opportunities and skill gaps (Bankins et al., 2024). Tools like chatbots provide continuous support (Goyal et al., 2023). Personalised guidance improves retention rates (Fraske, 2022). In resource-limited settings, AI can enhance access if systems are inclusive.

2.4 Theoretical Underpinnings

Career development theories help analyse career paths and achievements by assisting individuals in recognising their values, weaknesses, strengths, and desired direction (Ackerman & Beier, 2003; Hui & Tsang, 2012), as well as in identifying common career stages (McAdams & Cox, 2010). Imbalanced psychological growth affects career progression, though theories rarely show how development can be misdirected (Watanabe-Muraoka et al., 2001). Psychological assessments determine students' inclinations (Alimam et al., 2014).

Social Cognitive theory identifies mediators of career behaviour through learning experiences (Dabula & Makura, 2013). The Social Cognitive Career Theory (SCCT) states that decision-making depends on career self-efficacy, outcomes, and interests (Lent & Hackett, 1994). In South Africa, SCCT workshops enhance self-efficacy, though gains decrease without support (Miles & Naidoo, 2017). SCCT helps develop interventions through students' belief systems (Maulana et al., 2025). Career decision-making self-efficacy involves confidence in selecting paths (Lam & Santos, 2018). Studies show a correlation between career decision-making confidence and professional development, including vocational identity and preferences (Bandura, 2006; Marcionetti & Rossier, 2017; Priyashantha et al., 2023). Career decision difficulties affect the quality of choice and satisfaction, thereby impacting job attainment (Maduwanthi & Priyashantha, 2020).

In higher education, AI-driven learning experiences impact new graduates' confidence in their AI abilities and their dedication to their careers by enhancing AI literacy, skills, and motivations. This, in turn, increases both intrinsic and extrinsic motivation to acquire AI expertise for future career advantages (Wang et al., 2021). Design science research (DSR) generates knowledge by creating and

assessing innovative solutions to practical issues, offering a deeper insight into the effectiveness and rationale behind these solutions (Abbasi et al., 2024).

3. Methodology

As part of the researcher's doctoral dissertation, this investigation required ethical clearance in accordance with institutional research ethics protocols. The researcher adhered to Nelson Mandela University's Ethics policy by submitting the research proposal to the Research Ethics Committee (Human) (RECH), which subsequently approved it. All study participants were recruited and enrolled through ethical means and provided their consent to participate in the research.

3.1 Research Design

The research employed various data collection techniques, emphasising the qualitative aspect through focus group discussions and interviews. The study used DSR as its primary framework, chosen for developing and verifying theory-driven artefacts in real-world contexts. DSR provided a methodical approach to constructing and evaluating an AI-driven career-choice framework for higher education institutions. The design process included six essential phases: 1) problem identification, 2) objectives of the solution, 3) design and development, 4) demonstration, 5) evaluation, and 6) communication.

To establish a robust theoretical foundation, the framework integrates components from SCCT — self-efficacy, outcome expectations, and contextual influences — to ensure that AI-driven recommendations align with the psychological and sociocultural factors that shape students' career choices.

3.2 Participants

A purposeful non-probability sampling method recruited participants who could contribute to the framework's design and evaluation. This approach aimed to gain insights from stakeholders with experience in career guidance, rather than statistical generalisability. Participants from the Faculty of Engineering, Built Environment, and Information Technology (FBEIT) were selected to provide domain knowledge for DSR artefacts. The study included First-Time Entrants and Final-Year students to capture diverse perspectives on career decision-making.

Qualitative data were gathered through students, lecturers and support staff. Focus group participants were recruited through class presentations, with communication via WhatsApp groups managed by class representatives. Lecturers were contacted through Department Heads, while the Work-Integrated Learning manager connected with unit personnel. Academic Advisors were engaged through Student Development and Support. All discussions used a participatory design approach to develop the framework. Only results from undergraduate students' focus groups and semi-structured interviews with lecturers are presented.

3.3 Data Collection

A purposive non-probability sampling method was used to recruit individuals who could offer valuable perspectives on career advising procedures within the

institution. Data gathering transpired in three consecutive steps according to the DSR process:

Exploratory Phase (Needs Assessment):

- *Participants*: Undergraduate Students (n = 27) comprising 4 Groups. Group 1 comprised 7 participants; Group 2 – 7 participants; Group 3 – 8 participants; Group 4 – 5 participants; Lecturers (n = 8) and WIL Coordinators (n = 5).
- *Method:* Focus group discussions with students and semi-structured interviews with staff members.
- *Objective:* Identify obstacles in career decision-making, key influencing factors, technology adoption among students, career selection motivations, institutional role, and technology integration in career decisions.

Framework Design Phase:

- *Participants*: Undergraduate Students, Lecturers, Academic Advisors, and WIL Coordinators.
- *Method:* Focus group discussions with students, semi-structured interviews with staff members, and a participatory design workshop.
- *Objective:* Co-develop framework components, validate design requirements, and integrate best practices in AI ethics and fairness.

Evaluation Phase:

- *Participants:* Expert panel (n = 3), including an AI specialist, an HCI researcher and a guidance counsellor.
- *Method*: Experts utilise evaluation rubrics to evaluate the usability, explainability, and scalability of the AI-driven framework.
- *Objective:* Validate the prototype and refine technical specifications for institutional deployment.

Discussions took place in lecture rooms, with Microsoft Teams utilised as needed. For focus groups, the researcher met participants after class, while assistants managed concurrent sessions elsewhere. Interviews were conducted in offices or the boardroom. Focus groups, expert reviews, and interviews gathered insights into student needs, constraints, and career guidance practices. To ensure methodological rigour, the study focused on credibility, transferability, dependability, and confirmability.

Credibility was enhanced through triangulating data from focus groups, interviews, and expert evaluations during DSR phases. Transferability was addressed by providing detailed context, though results are specific to FBEIT and South African higher education. Dependability was achieved through audit trails and systematic data management using ATLAS.ti for consistent coding. Confirmability was strengthened by reflexive journaling, recording analytical decisions and assumptions to reduce bias and increase transparency.

3.4 Data Analysis

The data analysis was conducted iteratively, integrating thematic analysis of the qualitative data to ensure a comprehensive interpretation of the results.

Qualitative Analysis:

- Interviews and focus group recordings were transcribed and coded in ATLAS.ti.
- Through thematic analysis, recurring patterns were identified, including themes like student self-efficacy, resource accessibility, and technology preparedness.
- Insights from experts were mapped against SCCT constructs and DSR phases, linking psychological theory to artefact design.

4. Findings

This section outlines the main findings of the study, categorised by participant group. Data were collected from focus group discussions with undergraduate students and semi-structured interviews with lecturers, Work-Integrated Learning (WIL) coordinators, and academic advisors. Although many stakeholders were engaged, this paper presents only feedback from students and lecturers. The results are organised around the essential elements of the proposed AI-based career choice framework: Student Background, Teaching and Learning Delivery, Emerging Technologies, AI-Driven Policies & Career Choice Theories, Curriculum Design, and Stakeholder Engagement.

4.1 Focus Group Discussions with Undergraduate Students

- *Awareness of Career Guidance Tools*
  Students were often unaware of career guidance services and relied on informal networks. Participants suggested institutions should offer comprehensive career guidance through workshops, fairs, and mentorship programmes to help students understand IT career paths.

  Participant 2 from Group 4 mentioned, "*Hosting events connecting employers, alumni, and students to explore careers*." Institutions can provide information on employment options and help IT students understand professional pathways after graduation. Participant 4 from Group 1 mentioned, "*As everything is going digital, I want to advance myself, knowing very well about technology"*. Students are inspired by advanced technologies like AI, machine learning, and cybersecurity. Universities should provide guidance, mentorship, and career path tools, helping students recognise the value of their education and maintain motivation.

- *Digital Literacy Gap*
  While students actively use technology for communication and social purposes, most lacked familiarity with educational AI systems:
  Through technology usage, participants gain practical experience that boosts their skills and confidence in their chosen field, inspiring some students to consider entrepreneurial ventures. Participant 4 from Group 4

expressed, "*With the rise of technology use, almost everything is done online. I saw it as a skill I can utilise to create my own opportunities.*" For students, the prospect of launching their own enterprises makes earning an IT qualification more enticing.

Furthermore, some individuals stress the value of acquiring hands-on experience and practical skills to thoroughly investigate various career opportunities. Participant 1 from Group 2 said, "*Gaining knowledge about global technologies and enhancing one's existing abilities is a valuable approach*". Experiential learning builds analytical thinking through AI simulations and projects that reflect industry needs, aligning academic skills with jobs.

- *Difficulties with career decision-making*
  Participants discussed challenges related to career choice uncertainty and online information overload, though some students were confident in their current career path. For instance, Participant 1 from Group 1 said, "*I chose IT because of my love for electronic devices and because the world is evolving and new technology is introduced every day, so I can keep up with the world*.". For certain individuals, a deep-seated interest in technology, sparked by genuine passion and curiosity, often takes root during childhood. For example, Participant 7 in Group 1 stated, "*I developed a strong passion for technology during my high school years, gained hands-on experience in the field identifying my interest in IT*." Their enthusiasm drives students to seek knowledge, comprehend concepts, and create, which should inspire them to put in effort in their chosen course.

- *Career Selection Determinants*
  Participants identified key factors for career selection, including working conditions, income, flexible hours, and personal values. Participant 3 from Group 4 noted, "*After graduating, my most determining factor in choosing the type of job I will pursue is income, as I will still be trying to find my feet in the working space.*" Students view the IT sector as a lucrative field offering immediate jobs and long-term financial growth. Participant 6 from Group 1 expressed, "*The most important factor would be to make more money in order to provide for my family*." Participant 1 from Group 4 emphasised that "*the income*" will be the primary consideration.

  Furthermore, participants indicated a preference for flexible schedules, which include the possibility of working remotely or having variable hours. Participant 4 from Group 1 mentioned, "*Flexible working hours because you can work hybrid, that is, work in an office and work from home.*" The same sentiments of convenience were used as motivating factors. Participant 7 from Group 2 stated, "*For me, flexible working hours would be a huge factor as I would be able to work anytime, I want.*" Maintaining a work-life balance helps prevent exhaustion and sustains job commitment, while a supportive workplace enhances mental health and mitigates burnout. Participant 4 from Group 2 emphasised, "*My most important factor is going to be peer respect so that I can work freely and avoid having depression while*

working." Concerns about mental health and emotional well-being are increasingly prevalent in workplaces, especially affecting younger employees.

- *Institutional-Based Initiatives*
  Students recommended ways to boost interest among first-year IT students, emphasising the institution's role in promoting successful outcomes. For effective teaching and learning, Participant 5 from Group 4 suggested, "*The institution can provide electronics related to the course that will encourage students; hence, they will be seeing some devices for the first time, for example, smartwatches and virtual Google.*"

  Participants suggested incorporating practical learning experiences and interaction with IT experts to make the course engaging and motivate students toward IT careers. Participant 5 from Group 4 suggested, "*Bring in IT professionals to share their experiences, offering real-world perspectives and motivation*." Students value industry connections for practical knowledge. Institutions should enhance career guidance through workshops, fairs, and mentorship to explore IT careers. Participant 2 from Group 4 mentioned, "*Hosting events gathering employers, alumni, and students together to explore career opportunities and industry trends*."

From the student engagements during the focus group sessions, several themes emerged, closely linked to factors mentioned in the literature. The key factors affecting students' decision-making, as indicated in Figure 1, include: Enthusiasm, Information overload, Indecision, Technology proficiency, Usefulness of technology, Self-efficacy, Self-awareness and Mentorship availability.

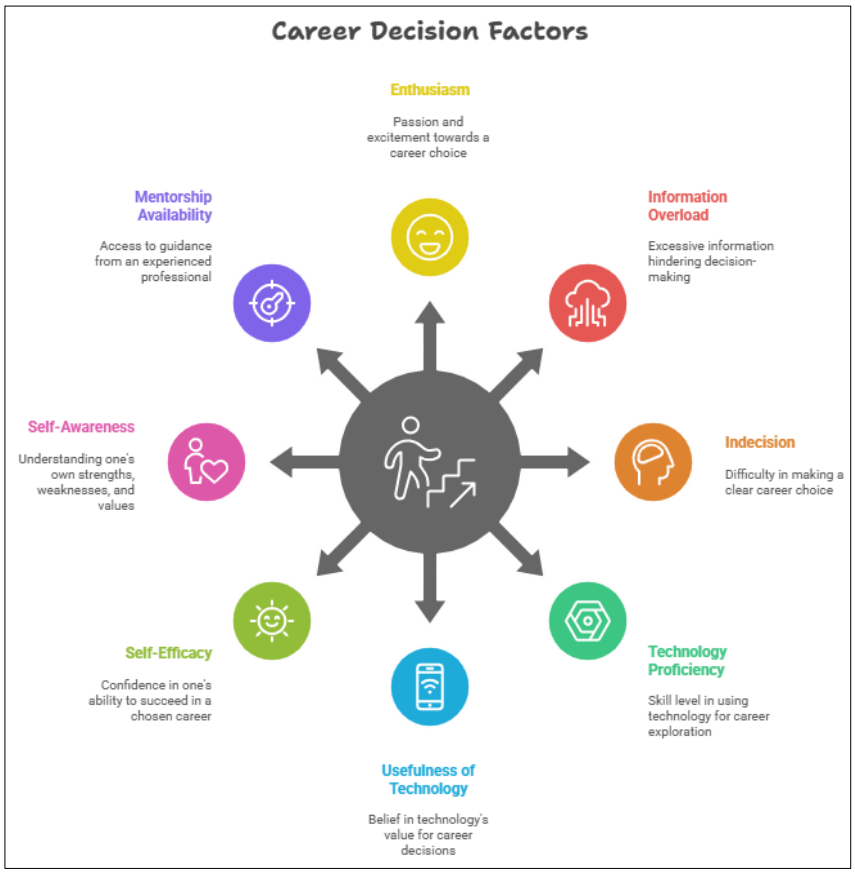

Figure 1: Factors Affecting Career Selection

Research showed students favour technology-based career tools that are navigable, personalised, and aligned with market trends and personal profiles, particularly where resources are limited. This revealed gaps in institutional support, digital readiness, and AI literacy. Students prefer career-advising systems that integrate behavioural and cognitive aspects, thereby supporting the theoretical basis of the AI-driven job-selection framework.

4.2 Semi-Structured Interviews with Lecturers

Some of the identified themes include Personalised Career Guidance, Accessibility and Usability, Lack of Awareness about Career Options, Emerging Technological Tools, Career Awareness, Student Preparedness and Career Reality Gaps, Curriculum and Industry Alignment.

- *Personalised Career Guidance*

To achieve the best results in career recommendations, Lecturers 6 and 7 suggested a hybrid approach to career guidance that combines online and face-to-face counselling. As Lecturer 6 stated, "*A combination of online and face-to-face approaches might yield the best results.*" Integrating AI into counselling offers benefits, as artificial intelligence is believed to enhance human counsellors by providing data-driven insights for tailored support.

Educators also emphasised the importance of AI systems continually adapting their suggestions based on students' evolving academic performance and individual preferences. Lecturer 5 mentioned, "*AI tools can assess students based on their marks and suggest careers based on their strengths*" Automated systems that assess students' abilities and preferences can improve career counselling by providing effective guidance on career trajectories. In support, Lecturer 7 mentioned, "*AI tools can suggest careers and certifications based on students' strengths and job market demands*." This aligns with a recommendation from a WIL coordinator to use simulation to enhance essential processes likely to occur in the workplace.

- *Accessibility and Usability*

Education experts emphasise audience-specific programmes. Career systems need hardware and software. Students need accessible guidance across platforms. Lecturer 1 mentioned, "*Technology can help a lot... our students are tech-savvy and would be freer interacting with an app than a counsellor*." The availability of technology as a key driver in fully utilising career-related initiatives, Lecturer 4 echoed, "*Almost each of them have a gadget, a handset or something... They can get the information they require through these tools*." In addition, Lecturer 8 highlighted the shortcomings of course materials on the university's website, stating, "*The documents are lengthy and overwhelming... an interactive tool would be better*." The instructor's remark is consistent with an academic advisor's insight that students should be provided with innovative, relatable, and engaging solutions. A more intuitive user interface can help promote widespread adoption.

- *Lack of Awareness about Career Options*

Educators observe that students struggle with fundamental ideas. To address this, institutions should encourage self-directed learning and career exploration. As noted by Lecturer 8, "*Students have knowledge on their phones but need more encouragement to explore courses*." Career exploration in curricula may encourage student research. Limited faculty involvement in student support reduces guidance, yet instructors remain focused on developing industry-required skills. Lecturer 2 stated, "*We have the responsibility to make students love their field.*" Another Participant, Lecturer 7, emphasised that "*Lecturers should take a leading role in explaining programmes to students*." Lecturer 3 acknowledges: "*We should integrate career-related discussions in teaching*."

- *Industry Collaboration for Real-World Relevance*

Instructors emphasised the need for industry professionals' insights to align recommender systems with job market requirements. All participants affirmed the value of industry partnerships. Lecturer 8 emphasised, "*Universities should work closely with industry partners to ensure that their programmes are up-to-date and relevant to current professional practices. However, in other cases, there may be a gap between what is taught in universities and the skills and knowledge required in the workforce"*. To ensure institutions receive swift updates and insights from the business sector, industry experts need to engage and participate consistently.
Lecturer 4 noted, "*AI tools can track industry needs and inform students accordingly.*" Regional job market analysis provides location-specific insights into employment

demands. Lecturers cite uneven guidance resources as a challenge, creating career literacy gaps among students with varying levels of engagement.

- *Emerging Technological Tools and Career Awareness*

Technologies transform career exploration through new evaluation methods and connections. Digital literacy gaps limit access. Simulated environments help students understand careers, though expectations differ from realities. Lecturer 5 mentioned, "*There are too many misconceptions from the students about the streams selected*". This points to a shortfall in sufficient guidance and thorough research in the specified field. For instance, Lecturer 4 mentioned that he was "*shocked to learn from one of his tourism students that they assumed that a career in tourism only entails glamorous travel*." Educators must provide students with realistic workplace expectations. A gap exists between student expectations and career realities. Lecturers bridge theory with practice to prepare students.

Table 1 illustrates the researcher's process for analysing all the findings presented in the study. This method enabled the identification of the primary themes and views emphasised by participants and literature, which ultimately aided in the formulation of the framework components.

Table 1: Analysis Process

Analysis Process	Description
Thematic Extraction	Identify recurring themes
Thematic Classification	Arrange themes into categories
Thematic Mapping	Associate items with framework elements
Component Definition	Establish framework components
Validation and Refinement	Evaluate themes and incorporate feedback
Framework Integration	Merge elements into the framework

5. Framework Description

Figure 3 depicts the process of designing the framework. The steps taken ensured that the AI-based framework developed would serve as a responsive, data-driven, and ethically sound solution, facilitating early, informed, and personalised career guidance. It aims to close institutional gaps, improve student decision-making, and align academic pathways with real-world career prospects.

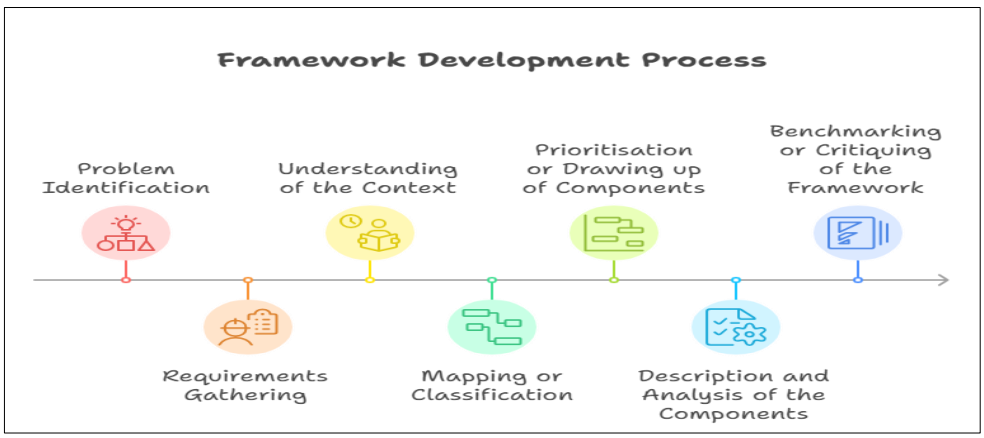

Figure 2: Framework Development Process

The AI-based framework for career selection was crafted by merging empirical studies, stakeholder feedback, and scholarly work on career development theories and recommendation systems. Anchored in Design Science Research and Social Cognitive Career Theory, this framework is both evidence-driven and focused on human needs. It seeks to address the challenges faced by undergraduate students in South African higher education institutions. Table 2 provides a detailed breakdown of each framework component and its purpose.

Table 2: Framework Components

Framework Component	Description
AI-Driven Policies & Career Choice Theories	This element combines career development theories with algorithms to generate recommendations, incorporating ethical and educational guidelines. These foundations ensure appropriate, sound career advice aligned with academic goals, improving AI transparency.
Curriculum Design	Curriculum design integrates career guidance with academic content by incorporating career exploration into learning objectives and assessments, making career development central to education while connecting academic knowledge to future careers.
Emerging Technologies	This involves incorporating AI, machine learning, NLP, mobile platforms, and cloud computing into the framework. These technologies enable data-driven, personalized career guidance through intelligent decisions, adaptive interfaces, and enhanced systems. Selecting these technologies ethically promotes equity and responsiveness.
Stakeholders	Participants include students, teachers, parents, school leaders, counsellors, policymakers, and innovators, demonstrating cross-disciplinary scope. Their engagement ensures cultural relevance while providing input for designing interventions and maintaining shared ownership.
Student Background	This element considers the learner's key characteristics, including academic performance, language skills, family income, and technology access. This profile helps the AI system provide relevant recommendations, reducing bias and ensuring supportive guidance.
Teaching & Learning Delivery	This component examines career advisory delivery through conventional and technology-enhanced methods. The AI architecture aligns instruction with learners' capabilities across formats, particularly in under-resourced settings. Delivery must enhance digital literacy and maintain career relevance.

The framework consists of six elements: Teaching & Learning Delivery, Emerging Technologies, Student Background, AI-Driven Policies & Career Choice Theories, Stakeholders, and Curriculum Design, as shown in Table 1. Figure 4 depicts the revised AI-Based Career Choice Framework, highlighting specific variables

within each component, selected for their relevance to the focus of this paper, as indicated by the findings presented.

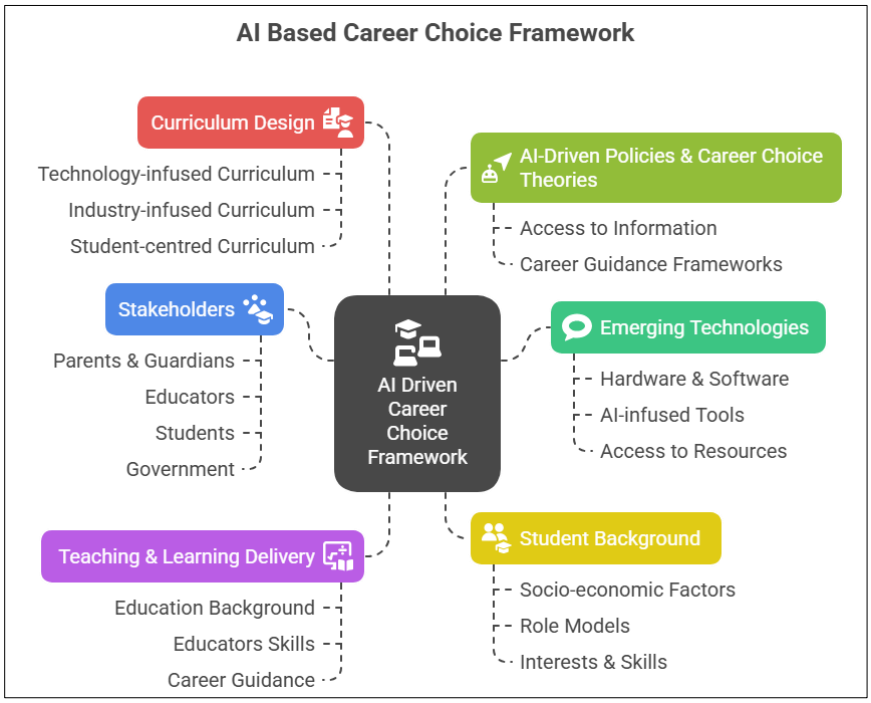

Figure 3: AI-Driven Career Choice Framework

5.1 Evaluation of Framework

Three experts from IT, career development, and technology-enhanced education evaluated the AI-Based Career Choice Framework. The experts included an IT Professor, a Computer Science Professor, and a Deputy Director of Student Affairs, selected for their interdisciplinary research experience. The AI specialist praised the framework's theoretical and ethical aspects, while the career expert confirmed its SCCT alignment. The technology expert noted its focus on learner profiles. All experts agreed that the framework suits resource-limited institutions. Table 3 offers a comprehensive overview of the expert feedback, clearly linking their insights to the framework's elements and illustrating how these viewpoints contribute to practical improvements that boost the framework's effectiveness and strength.

Table 3: Expert Feedback

Expert Feedback	Framework Component	Practical Adjustment in Framework
Emphasise the importance of student self-efficacy and expectations of outcomes, particularly for students who are not adequately prepared.	Student Background	Incorporate SCCT elements of self-efficacy and outcome expectations into student profiles to enhance personalised recommendations.
Concern about system effectiveness in resource-limited schools.	Teaching & Learning Delivery	Create streamlined versions of the system that operate efficiently with limited bandwidth and minimal computing power.
Recommendation for flexible advisor dashboards and multilingual support.	Stakeholders	Develop adaptable interfaces with language localisation for institutions.
Call for Explainable AI (XAI) to clarify algorithm outputs.	Emerging Technologies	Add an XAI layer that visually explains how career recommendations are generated.
Caution about historical data bias disadvantaging underrepresented students.	AI-Driven Policies & Career Choice Theories	Before using historical data, detect bias and evaluate fairness.
Proposal for an ethical audit framework to monitor fairness, integrity, and bias.	AI-Driven Policies & Career Choice Theories	Conduct automated and manual audits to monitor ethical data usage.
Noted that conventional psychometric tools miss identity-career expectation interactions.	Curriculum Design	Incorporate reflective practices like journaling and values exercises into career pathway development.
Suggested reflective prompts and feedback loops for deeper student engagement.	Teaching & Learning Delivery	Create modules for students to assess career fit and get personalised feedback.
Emphasis on culturally relevant content and pathways to reflect diverse student identities.	Curriculum Design	Create content and recommendation pathways that are culturally tailored to the South African environment.
Encouraged cross-university workflow flexibility.	Stakeholders	Ensure framework compatibility with institutional processes and IT systems.

6. Discussion

This study's findings are discussed by integrating insights from focus groups with undergraduate students and interviews with lecturers, with the aim of exploring the effective design and implementation of AI-driven career guidance systems in South African higher education. By merging the viewpoints of these two participant groups, the study provides a thorough understanding of the practical, pedagogical, and contextual factors that shape career decision-making and technology adoption.

Student focus groups have consistently highlighted a substantial need for tailored career guidance tools. Participants expressed appreciation for recommendations that considered their academic records, personality traits, interests, and future aspirations. This observation aligns with prior research that emphasises the critical role of personalised support in career development by taking into account the diverse factors that shape career choices (Natividad et al., 2019). Many students reported feeling uncertain about their career direction, attributing this to overwhelming information and insufficient personalised guidance. This scenario highlights the impact of intrinsic motivation, curiosity, and early exposure on career interests, consistent with Social Cognitive Career Theory (SCCT). This theory stresses the importance of self-efficacy and outcome expectations in career choices (Lent et al., 1994).

Lecturers have highlighted several institutional challenges, including fragmented support systems, poor data integration, and an overreliance on manual advising methods. These observations align with the findings of Kamal et al. (2024) and Goga et al. (2015), who noted that the lack of intelligent infrastructure hampers the effectiveness of academic guidance systems. Lecturers have identified AI's potential to boost efficiency and relevance, but they have also voiced concerns about whether institutions are adequately prepared.

They noted that while there is enthusiasm for AI, there is a noticeable lack of infrastructure and training necessary for its effective integration into teaching or advising. This issue is indicative of broader challenges within South African HEIs, where digital inequalities persist (Mateko et al., 2025). To address these challenges, the AI framework should account for resource constraints by offering scalable, cost-effective solutions and cloud-based systems compatible with environments with limited bandwidth.

Although many institutions collect valuable academic and demographic data, they often fail to leverage this information for predictive or advisory purposes. The research emphasises significant disparities in digital access and readiness between students in rural and urban areas. Students from less privileged backgrounds reported difficulties using digital platforms, consistent with previous research highlighting structural disadvantages in education systems reliant on digital media (Murad et al., 2018; Saeed et al., 2021). Students stated that they often relied on informal networks like friends and family for guidance rather than institutional resources.

This lack of organised guidance creates uncertainty in student choices. These observations reveal a gap in institutional communication of career resources. The findings align with those of Watson and Struwig (2024), who suggest that African higher education institutions need to rethink student support systems in the digital era. Likewise, DHET (2019) emphasises the importance of institutional career guidance frameworks for the digital economy.

While some studies praise AI for its ability to scale (Lin et al., 2018), this research presents a critical viewpoint: AI solutions might further disadvantage vulnerable student groups if they are not tailored for low-bandwidth environments and

inclusive interfaces. The data reveal that students are cautiously optimistic about AI's role in career decision-making, provided the system is transparent, user-friendly, and ethically designed. This perspective is consistent with the Technology Acceptance Model (Davis, 1989), which emphasises that perceived usefulness and trust are vital for adoption. Dutta et al. (2022) and Srinivasan et al. (2022) reach similar conclusions, underscoring the importance of trust and ease of use for the adoption of educational AI systems.

This study introduced an AI framework to assist undergraduates in career choices, integrating theoretical, pedagogical, technological, and contextual aspects. By anchoring AI recommendations in vocational development theories, the framework ensures appropriate guidance. Incorporating these principles into algorithmic design addresses concerns about bias in AI education research (Holmes et al., 2021). The findings suggest career exploration should be integrated into the curriculum rather than offered as an additional service.

Linking career outcomes connects academic knowledge with employability, supporting literature on curriculum alignment (Sophia & Onen, 2024). This is relevant in South Africa, where students often enter higher education with limited career exposure. The framework emphasises machine learning, natural language processing, and cloud platforms for personalisation while highlighting that Mobile-first, low-data designs address equity concerns in bandwidth-constrained areas (Czerniewicz, 2018) and align with calls for equitable AI adoption in education.

Engaging stakeholders ensures cultural relevance and system credibility, aligning with socio-technical perspectives in HCI (Bannon, 2011). Considering academic performance, socioeconomic status, and access to technology enhances inclusivity and prevents inequalities (Tinto, 2017). Delivery balances AI scalability with human interaction through a blended model. These components show AI in higher education as a socio-technical intervention, demonstrating how career support can be data-driven, pedagogically informed, and equitable (Holmes et al., 2021).

The implications of these findings are twofold. First, they highlight AI-driven systems' potential to close the guidance gap by combining student background data, institutional analytics, and labour market trends for tailored recommendations. Second, they emphasise creating ethical and inclusive AI tools that address socio-economic inequalities and accessibility issues in South African higher education (DHET, 2019). These insights contribute to the knowledge base by situating AI-driven career guidance within Human-Computer Interaction (HCI) and Social Cognitive Career Theory (SCCT), highlighting adaptive interfaces, transparency, and cultural relevance in promoting student success. The study advances the discussion on context-sensitive AI design for education, advocating a model that aligns technological innovation with human development and institutional effectiveness.

The study reveals that both students and lecturers perceive an urgent need for a more individualised, context-aware strategy for career guidance in South African higher education. Students expressed frustration with the limited availability of accessible, relevant advisory resources. At the same time, lecturers and academic advisors highlighted the inadequacies of institutional systems that fail to incorporate data-driven insights into decision-making. These findings underscore a notable gap between the career support structures provided by institutions and the evolving expectations of digital-native students, who seek adaptive, interactive systems similar to those in commercial AI platforms.

South African universities must reevaluate strategies for career guidance and technology integration using evidence-based methods. AI-driven career guidance systems require institutional alignment and digital infrastructure to be effective; therefore, a policy framework from Higher Education and Training is needed for AI integration into student support. Universities should incorporate AI career guidance into digital transformation strategies, aligning with teaching systems. These systems need regular labour market updates through industry collaborations. Additionally, AI career advice should be integrated into curricular activities, with career modules in first-year programmes to help students use AI recommendations.

7. Conclusion

This study contributes to addressing career guidance issues for undergraduate students. The study shows that combining AI-driven systems with user-centric design principles offers a scalable, context-aware solution to enhance career decision-making in higher education. The findings emphasise the need for institutions to prioritise enhancing digital literacy, ensuring ethical integration of AI, and promoting collaboration among diverse stakeholders to achieve fair implementation.

The framework particularly recommends initiating pilot programs on campuses with limited resources, where AI-driven guidance can have the greatest impact. The study also highlights the potential of a user-centred, AI-driven framework to advance career decision-making in South Africa's higher education sector. By combining career theories with ethical AI practices, this framework addresses socioeconomic and digital inequalities, reduces career mismatches, and improves student outcomes, while also offering a scalable solution for environments with limited resources. This research accentuates the potential of combining SCCT with DSR to create a framework that is both theoretically sound and practically useful for AI-driven career guidance in South Africa's higher education landscape.

By tackling significant local issues such as resource disparities, demographic variety, and changing labour market needs, this approach positions AI as a scalable and supportive tool for inclusive career development, rather than a substitute for human judgement. The study emphasises the need to focus on student self-efficacy, ethical transparency, and stakeholder collaboration to ensure AI systems are attuned to contextual realities.

The importance of this research lies in its illustration of how emerging technologies such as machine learning, natural language processing, and mobile systems can be ethically applied to improve personalised guidance without widening digital divides. Although a complete prototype was not created, the framework provides a structured model for universities aiming to incorporate AI into existing career services.

By promoting a blended approach that merges AI's analytical strengths with human-centred mentoring, the framework ensures that technological progress complements, rather than replaces, interpersonal interaction. Additionally, one limitation of the study is that the evaluation phase relied solely on feedback from three expert reviewers. Although their insights were valuable, this narrow focus may not encompass the wide range of perspectives necessary for a thorough evaluation of the AI-based career choice framework.

Looking ahead, the framework offers a strategic basis for South African institutions to rethink career development through responsible AI adoption. It encourages further exploration into explainable AI (XAI), adaptive career modelling, and institutional readiness, allowing policymakers, educators, and technologists to collaboratively develop equitable and sustainable guidance ecosystems. Ultimately, this study underscores that the future of career development in higher education relies not only on technological innovation but also on its ethical and contextual integration within human learning systems.

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