Sep 14th, 12:00 PM - 12:30 PM

A Customized Artificial Intelligence Based Career Choice Recommender System for a Rural University

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Research Paper

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ABSTRACT

Rapid technological developments have enabled users to be supported and guided in decision-making. An example of this is the ability of tertiary students to use technology to explore different career options and make informed decisions about their future. Notwithstanding the increasing use of technology in general, the technology for career guidance and personalized career recommendations in South Africa is still limited. There are some limiting factors such as the ever-looming challenge of limited access to technology, language barriers and cultural differences that are prevalent in rural areas. With this premise, this study collected quantitative data from students at an Eastern Cape University in South Africa, in which the students participated on how they use artificial intelligence tools and technologies in their career choice process. The study highlighted the need for bespoke, locally developed job assessment systems that are more effective and culturally appropriate for a South African university student, particularly in rural areas. Participants would prefer to be engaged, be part of and propose their suggestions on the developed career choice, as current ones do not exactly refer to their context. Tailor made and customized career guidance solutions with Artificial Intelligence (AI) capabilities have more chances of adoption and usage by targeted users.

Keywords

Artificial Intelligence, Decision-Making, Career Exploration, Career Assessment Tools, Undergraduate Students.

INTRODUCTION

Career decisions are some of the most complex decisions a person makes and, unfortunately, young people are unprepared to make one of the most important decisions in life. Regrettably, in the absence of proper alignment and professional background information, individuals are likely to make wrong decisions (Nie, 2020). Fortunately, students have expressed their active interest in career and self-development, especially due to the significant changes in education and technology (Marcionetti & Rossier, 2017). One of the keyways that technology has transformed career discovery is through the availability of online career assessment tools (Prasanna & Haritha, 2019). These tools are designed to help students identify skills, interests, and values and link them to possible career paths (Nie, 2020; Prasanna & Haritha, 2019). The career concept and the choice of career are linked but emphasize different facets. Research on careers in general is extremely diverse as it is a broad concept. Accordingly, the aspects of career choice are very diverse due to the contextual factors that influence them in different areas and phases of human life (Levina, 2020). Studies on career choices are consistent with the fact that individual career choices are among the most important decisions made by individuals, as such choices have a profound impact on people's well-being and livelihood (Levina, 2020; Todorescu, Greculescu & Popescu-Mitroi, 2015; Korir, 2012). The ideal time to explore career options depends on individual needs, particularly the motivating factors behind the choice itself (Meddour, 2016; Shumba & Naong, 2012).

Due to the current information overload through digital media, external bodies and individual knowledge, there is an overwhelming influence (Patel, Kakuste & Eirinaki, 2017). Every decision to be made gets harder and lifelong decisions like choosing a career don't get any easier. Appropriate support is required when choosing a career. However, due to a lack of appropriate guidance from professionals, many students experience a mismatch in professional skills, interests, and personality (Jackson & Wilton, 2017; Verma, Sood & Kalra, 2017). To the extent that artificial intelligence (AI) tools and other new career choice support tools are available, it is evident that most of these are being developed without actual user involvement. This article therefore sets out the importance of developing tailored AI solutions that reach a wider audience, especially in rural areas, and the importance of integrating cultural and contextual factors into the design of personalized career recommendation systems. There is a need to cater to the needs of the diverse communities in South Africa. The rest of the work is structured as follows: in the following section, the literature review is presented, followed by the methodology. The preceding sections cover the results, discussion of findings, recommendations and the conclusion.

LITERATURE REVIEW

Career exploration

A significant number of students are highly motivated and ambitious about their education, and everything related to it, but without adequate support, they are likely to be challenged to develop meaningful plans to achieve their career goals (Verma et al, 2017). The most pervasive challenge faced by individuals is the concession to choose a career they genuinely care about, without constraints or compromises. Additionally, some may face challenges in choosing a career because they are unsure and unable to choose a career path with confidence. In general, prospective graduates go through a dreadful phase when it comes to choosing a course, and career (Shumba & Naong, 2012). The role of universities is to ensure a smooth transition for their new students (Dabula & Makura, 2013). Once the underlying causes of indecisiveness are identified, career counselors and work psychologists can develop individualized approaches and interventions (Levina, 2020). Dabula and Makura (2013) point out that the vagueness, confusion, and stress experienced by students has an impact on their transition phase, where confusion can impair their ability to make positive, informed decisions.

Career Indecision

Dabula and Makura (2013) report that if student skills are not developed and nurtured in adolescence, there is a high propensity for career indecision, resulting in unsatisfactory job searches and intractable careers. A lack of career guidance is likely to result in mismatches in interests, skills, personality, academic achievement, and ability (Afolabi, Ojelabi, Amusan & Adefarati, 2017). Therefore, it is crucial to build an automated system that guides students in making career choices, as careers advisors are likely to face numerous challenges, such as: a lack of resources, time, training and support in helping students with career planning (Razak, 2014). Technology-enabled career choice support is becoming increasingly popular and has a positive impact on student decision-making processes. In contrast, the continuous process of career guidance has led to the so-called lifelong guidance, which has emerged through the process of continuous learning. Lifelong learning is a necessity for today's careers due to the challenges of outplacement and the lack of job opportunities (Ardeleanu & Stanescu, 2016). Some students choose their career paths based on the unfilled courses at universities, which is also the most common challenge students face is professional indecision (Levina, 2020). Bolat and Odac (2017) found that South Africa's graduation rate is among the lowest in the world at around 15% of any South African university. A 2013 report by the Council for Higher Education (CHE) found that only one in four students graduate within the shortest reported time (Murray, 2014). This is due to the high dropout rate, lack of interest and difficulties in mastering the content at school.

Career Development

Theories of career development are used to investigate professional pathways, behavior, and performance. These theories are an important stage in determining an individual's underlying values, limitations, strengths, and preferred direction (Shumba & Naong, 2012). When it comes to schooling, counseling, and other essential interventions, a career development theory can help identify common professional stages (Levina, 2020). There are several career development theories, each focusing on a distinct perspective on what the original developers considered to be vital and key to professional development.

In adolescence, identity formation takes place, which is also primarily linked to professional identification. According to Erikson's theory, consistent engagement in school activities and appropriate career exploration help shape a student's professional identity (Nie, 2020). Similarly, self-perception theory posits that key motivations and personal goals can be inferred from an individual's behavior (Nie, 2020). Their educational and career choices and commitment to career choices are mostly related to people with whom they have close ties, such as peers or parents (Hirschi, Niles, & Akos, 2011). This can lead to negative or positive effects on professional development tasks in later adolescents. There is much data made available to students that can be used effectively to determine several key student characteristics and interests.

Super's career development theory emphasizes the importance of self-concept development, which Super says self-concept changes and progresses over time because of experience (Super, 1980). Supers Work changed the notion that career choice is a static event at a given point in time, to a dynamic process where career development is viewed as an ever-evolving process of life. This is because of the proposed factors influencing career development, such as personality development, own values, skills or needs, and social learning experiences. The theory posits that people go through five stages during the career development process, including: growth, exploration, establishment, maintenance, and withdrawal (Levina, 2020).

Technology Tools

Due to the current information overload through digital media, external bodies and individual knowledge, there is an overwhelming influence of influences (Patel et al, 2017). Every decision to be made gets harder and lifelong decisions like choosing a career don't get any easier. Appropriate support is required when choosing a career. However, due to a lack of appropriate guidance from professionals, many students experienced a mismatch in professional skills, interests, and personality (Jackson & Wilton, 2017; Verma et al., 2017). A great wealth of data is available in the education sector and institutions can be transformed by information and communication technologies (ICT) through proper adaptation and collection of the available data (Tulasi, 2013). If the currently available data could be analysed, it would lead to the fear that doing so would yield various benefits on a larger scale, however several institutions fail to effectively use the vast amount of data at their disposal (Job, 2018). Therefore, it is imperative that after analyzing all the data generated by the different educational information systems, weaknesses within the institutional processes are identified and more attention and resources are devoted to them (Tulasi, 2013). The approach of using data and evidence in decision-making has transformed many areas and data-driven decisions have been shown to increase and increase output and productivity (Yukselturk, Ozekes & Trel, 2014). The same approach can be applied to currently available student unstructured big data, using data mining techniques to analyze previously scattered data, thereby achieving academic effectiveness within institutions (Daniel, 2014).

Online job evaluation tools offer students several advantages. Firstly, they are convenient and accessible as they can be accessed from anywhere with an internet connection. Additionally, they provide personalized feedback and recommendations based on individual responses, helping students find career paths that match their individual strengths and interests (Prasanna & Haritha, 2019). Recommender systems are software tools that support users in decision making by providing suggestions on different cases (Subramanian & Ramachandran, 2019; Meza, Simo & Monguet, 2017). They use users, items, and a scoring matrix to formulate a consolidated ecosystem known as a domain, which can be used to formulate a user's interest (Khan, Ibrahim, & Ghani, 2017). Widespread and predominant in e-commerce, recommendation engine tools and techniques have been used in various sectors such as government, education, healthcare, and agriculture over the past decade (Meza, Simo & Monguet, 2017; Dwivedi & Roshni, 2017). In education, recommendation systems should be able to recommend suitable career paths to students based on various factors considered as factors in career choice (Bhumichitr, 2017).
Most studies on career choice and recommendation systems focus on electives (Dwivedi & Roshni, 2017; Bhumichitr, 2017; JothiLakshmi, & Thangaraj, 2018). The focus on the factors contributing to career choice was academic performance or preference, and students' personality, interests, and abilities.

Using recommendation systems when choosing a career can help students to clearly identify the main reasons for their chosen career path. There are several underlying factors that play a crucial role in influencing the choice, for example, according to Holtschlaga, Masudab, Reichec and Moralesa (2020) some students choose careers preferred by their parents, others choose careers that will bring them high income, while others will follow their passion regardless of the success of that career. Subramanian and Ramachandran (2019) considered factors related to students' school outcomes, students' academic interests, and their home and school activities as key factors in support of career recommendation. Notably, a person's adaptability and sense of identity are considered insufficient to succeed in a career. However, measures aimed at the pursuit of personal work goals and career experiences help in the realization of career guides and goals (Kiziltepe, 2015).

Customized Career Recommender Systems

One of the goals of using ICT-based career guidance resources and services, such as personalised career recommender systems is to help young people and adults to make informed and prudent educational, occupational, training and employment related decisions (Vuorinen et al., 2011).

One of the key challenges faced is the gap in skills between the quality of university graduates and the required skills of the private sector. This gap can be reduced by helping students choose their path of career based on their skills, personality type and knowledge of their educational background (Qamhieh et al., 2020). Providing students with professional guidance is essential to help them choose a future career path and this takes into consideration several factors such as personal and cultural values, personal profile, parental education and expectations, and academic performance (Qamhieh et al., 2020). Consequently, a need arises for lifelong learning tools that could support people in changing careers, (re)skilling or (re)entering the labor market after a period of unemployment. This trend is visible over the last decade through increased public interest in platforms supporting online learning, such as Coursera for lifelong learning or Khan Academy3 for school education (Ilkou et al., 2021).

According to Duarte (2017) relationships and culture are the core tools of meaning-making for an individual's experience; understanding work means identifying how social, political, and economic forces influence the distribution of resources and affordances on a macro level. Artificial intelligence can help people find the right career based on their abilities, interests, and personality traits, and can be a useful tool in career selection. AI can assist in providing people with personalized recommendations and insights that help them make informed career decisions.

The implementation of personalized recommender systems is dependent on several factors such as personal profile of target users, gender, personality type, environmental and cultural background. According to Qamhieh et al., (2020) there are numerous ways AI can be applied in career selection:

Personalized career recommendations: AI algorithms can analyse data from resumes, online profiles, and other sources to propose a suitable career path based on individuals' abilities, experiences, and interests. This can help individuals make better career decisions.
Personality assessment: AI algorithms can analyse a person's personality traits and recommend career paths that are consistent with his/her strengths and interests.
Career path prediction: AI can analyse an individual's career patterns and employment trends to predict the practicality of certain career paths and assist individuals prepare for future job prospects.
Skill assessment: AI can analyse a person's skills and competencies based on their previous work experience, education, and other aspects to offer recommendations on career paths that fit their skills.
Job matching: AI can analyse job postings and candidate profiles to match job seekers with appropriate job opportunities based on their skills, experience, and qualifications.

The idea of career development is in many respects a concept of modern times, considering that careers were selected, modified, adapted, and even completely modified, based on many factors that did not include the intervention of career development practitioners (Otwine et al., 2022). Work history indicates that in earlier times people went to work instead of a career. In this context, it was argued that work is just a matter of earning money, while a career is a series of related opportunities and activities that provide the

experiences necessary for the development of the future and that involves going beyond the minimum contractual work obligations (Pillay, 2020).

METHODOLOGY

This study is conducted based on a selected philosophy that a study essentially adheres to that assists the researcher in conducting research (Creswell & Poth, 2018). The study is guided by epistemological assumptions whereby the study is concerned with how knowledge can be formulated, attained, and communicated (Cassell, et al., 2018). Methodological approaches chosen are channeled by the epistemological foundations as the main objective of this study is the design of a conceptual framework. As a result of seeking to gain more knowledge and understanding of the problem domain and its solution this will be achieved through the building and application of the designed artifact, whereby in this study, a framework was formulated to assist in the development of a customized AI based career choice recommender system.

The study collected data through mixed methods, including qualitative data acquired through document review and quantitative data from 120 students at an Eastern Cape University in South Africa through an online questionnaire that was distributed. The survey questionnaire was created using Linkert scale, respondents were asked closed ended questions regarding their utilization of online career assessment systems. The link of the Google Form questionnaire was shared through various WhatsApp groups through the assistance of lecturers. Participants anonymously completed the questionnaire, and all questions were answered by respondents. The questionnaire aimed to primarily examine how AI technology can be utilized in the career choice decision making process to facilitate a positive developmental experience for students during their career choice decision making process. Quantitative data was analyzed with SPSS and qualitative data was analyzed through thematic analysis. The authors also applied own understanding in proposing the key requirements of how the AI could be customized.

FINDINGS

The following section outlines the findings from the collected data. A total of 120 respondents participated in the study.

The respondents made up of 50% females and 42.9% male and the rest of the respondents selected the prefer not to say option. 67.5% of respondents are first years, 17.5% are second years, 7.5% are third year students and 7.5% are fourth year students.

Figure. 1 shows the number of respondents who have been exposed to computers prior to joining the university. Almost half of the respondents were not exposed to computers, 48.3% responded with no, 27.5% occasionally had access to computers and only 24.2% have been exposed to computers in high school. This high number of participants with no previous exposure and access to computers is an indication of a high likelihood of e-learning challenges the learners will face. Additionally, the limited exposure to the plethora of information available online that can assist with career exploration options will result in students only selecting career streams they know from their family and community members.

Figure 1
Previous Exposure to Computers

Were you previously exposed to computers in high school?
120 responses
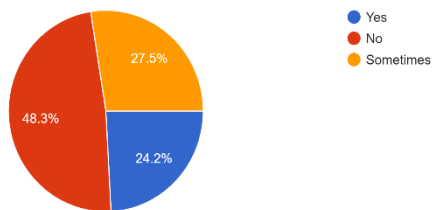
Respondents were asked if the current course they are registered for is their first choice more than 50% responded that they were currently registered for a course that is not their first choice, and 45.8% said they are doing their selected first choice as shown on Figure 2. Almost half of the respondents are doing a course they do not like, this is likely to be a contributing factor to high failure rate, demotivated learners and high dropout rate which are challenges the country is already struggling with.

Figure 2
Registered Course Preference

Is the current course you are registered for your first choice?
120 responses
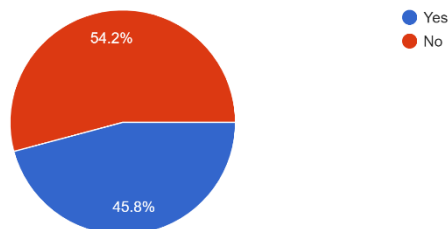
Respondents were also asked if they were familiar with and had any knowledge of technology before joining the university. 51.7% responded positively that they had some form of knowledge about technology, with 20.8% who had no prior knowledge about technology before joining the university.

Figure 3 shows results from respondents when they were asked: Have you used an online career assessment/guidance/recommendation system such as: Level Up Assessments, FundiConnect Career Quiz or 16 Personalities Test before? 49.2% stated that they have previously used an online career assessment system before, and 31.7% had not used any online career guidance system before. This is a slightly positive outcome that shows that respondents are keen on getting assistance and recommendations regarding their selected career paths.

Figure 3
Online Career Recommender Systems Utilised
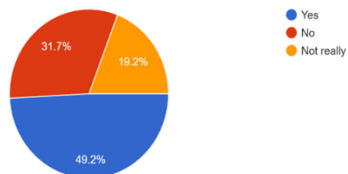
A follow-up question regarding the level of difficulty when using any online career assessment system was asked, and 29.2% found the systems not difficult, followed by 27.5% who found them slightly difficult and only 4.2% found the systems greatly difficult. There is an indication that the currently available online career recommendation systems are too user friendly especially for non-proficient computer users.

Additionally, the ability to navigate through the online platforms was asked, 47.5% agree and strongly agree that they can navigate the online career assessments websites with ease with 29.1% respondents disagreeing with the statement. Contrary to the previous question above regarding difficulty experienced with online career assessment systems where respondents mentioned that they find the systems difficult. However, a slightly high 47.5% can navigate through the systems.

Respondents were asked if the information available online helped them in any way to make a better career decision, 85% responded positively and agreed that the information on the internet assisted in providing more information that made their career selection process easier. 6.7% of the learners did not get any information online to assist with decision making. This is a positive indication that the respondents are keen on acquiring more information and understand the value the internet brings.

Figure 4 demonstrates the preparedness of respondents with regards to their career development. 70.9% of students agreed that they have a plan created for their development in the selected field, and only 7.5% do not have any plan in place in terms of career development. This highly positive outcome indicates that learners are planning and mindful of their future after university.

**Figure 4**
Career Development Plan

Contrary to the positive upkeep on developmental plans, respondents were asked if there is a possibility or likelihood that they are likely to change their current course. Figure 5 shows that approximately 39.2% are neutral, that is, they are uncertain whether they may change or not change their current course. 20.8% of the students agreed to the statement that they are likely to change the current course. 40% of the respondents stated that they are not likely to change their current course. These respondents demonstrate some form of contentment and confidence that they selected a career path that they are happy with. This response is closely linked to the question of whether the current course enrolled for was their first choice, whereby 54.2% stated that they were not registered for their most preferred course.

Figure 5
Contentment with Current Course Selected
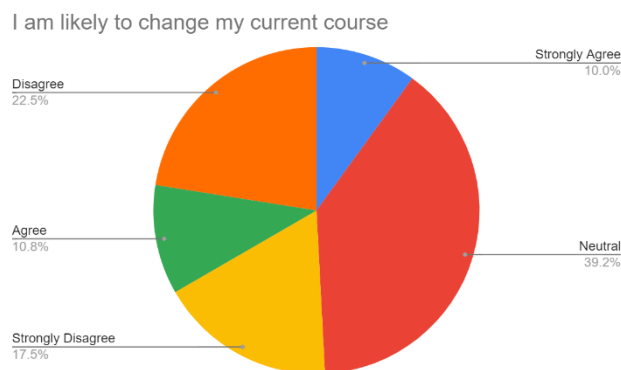
As demonstrated on Figure 6, the development of an effective customized recommendation system includes: having a good understanding of the participants background, culture, family, interest etc. In addition, for a system to be in a better position to recommend, it is important to know what the learners are currently doing in terms of their studies and what are their future. In addition, it is important to expose the learners to various types of technology tools, this experimental approach will provide valuable insights on what is the level of interest and skillset the learners have. To customize, one should be able to understand the various factors that have an impact on the decision-making process, these factors will be used to determine the input for the recommendation engine to come up with recommendations.

Figure 6
Components of a Customized AI Career Choice Recommender System
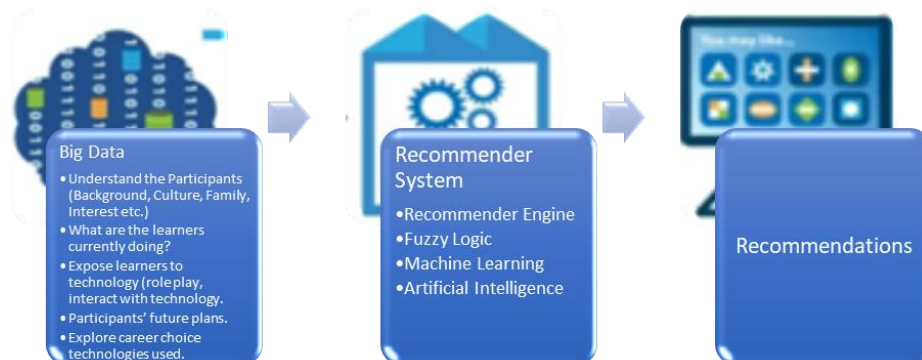
DISCUSSION OF FINDINGS

Results gathered from the study give several insights on students' perception of their selected streams. 97.5% of the respondents attended their high school in a public school, with only 2.5% attended private high school. These figures correlate to the 60% of respondents who stated that they spent most of their childhood years in rural areas with only 19.2% were brought up in urban areas. This is an indication that most students enrolled at Buffalo City Campus have a rural upbringing. The above results are linked to the results that demonstrate that almost half of the respondents were not exposed to computers, 48.3% responded with no, 27.5% occasionally had access to computers and only 24.2% have been exposed to computers in high school. Since many of the students attended public schools in the rural areas, their level of computer literacy is low. Resource availability or scarcity is undoubtedly the key factor that separates one institution of higher learning to another (Jothilakshmi & Thangaraj, 2018). In addition, the inequalities within institutions of higher learning indisputably exist and unfortunately it can be mirrored through students within those institutions (Goga et al., 2015). Hence with career decisions, students from previously disadvantaged schools face added challenges when it comes to career choice, these include lack of career information, lack of finances, inadequate career guidance services and poor academic performance (Shumba & Naong, 2012). The lack of access to computer technology because of their socio-economic circumstances unfortunately leads to limited exposure of career options available. In addition, as stated by Shumba and Naong (2012) students from disadvantaged communities face even greater challenges in choosing appropriate programmes, as they tend to avoid careers that seemly have longer training duration which their finances will be unable to support. This exacerbates the inappropriate selection of careers due to external circumstances. There are attempts by the government to try and assist students with career development. For instance, Career Development Services (CDS) is a national initiative to bring free quality career information, advice, and counselling services to South Africans of all walks of life. CDS was established in 2010 following a decision by the Cabinet of the Republic of South Africa which sought to

ensure that South African's of 'all ages have access to quality and differentiated career information, advice, and counselling services throughout their lives'. This initiative offers a variety of graduate recruitment and career development services to help students plan their careers and make the transition from school to the workforce after graduation.

The respondents demonstrated positive traits in their interest and knowledge of the availability of career assessment systems available online, as well as formulating career development plans. Similarly, to a study by Verma et al., (2017) where the authors discovered that a considerable number of students are highly motivated and ambitious in terms of their education, and everything pertaining to it, however without adequate support they are likely to be faced with challenges when developing comprehensible plans to achieve their career goals. Almost 50% mentioned of the students they are confident of their selected career stream and are unlikely to change the course they are currently enrolled for. Hirschi et al., (2011) echoes that career development among adolescents is influenced by their social-cognitive personality dispositions which are linked to factors such as emotional stability and internal control beliefs leading to issues in career decidedness. External entities and attachments such as parents and peers have a great influence in shaping, understanding, and committing to certain career choices. The students also mentioned the importance of career guidance received and the accessibility to online career assessments assisted in the career selection process. As assented by numerous studies that to eliminate the global career uncertainty among students most studies have opted for recommender systems' assistance (Levin et al., 2020; Meza et al., 2017; Subramanian & Ramachandran, 2019).

RECOMMENDATIONS

The data collected is in this study will assist in designing an AI based career choice recommender system for university students, in a rural South African university. As articulated in literature, there are various contributing components that have an impact in the student's decision-making process, and these should be considered in attempting to recommend the most ideal career path for the student. The incorporation of big data and analytics in higher education can bring about transformative attributes by altering current processes in teaching and learning, administration and academic work through hidden patterns that exists (Job, 2018).

Linked to the study's findings, it is vital that the components that play a major role in formulating a well customized career choice recommender system are considered. Figure 6 demonstrates the key components that are required for developing a rural based customized recommender system. When all the big data has been collected, then incorporated with various artificial intelligence-based algorithms, the datasets will be modeled into valuable and meaningful details which will result in a recommendation being made. The ability to employ processes to systematically extract relevant knowledge through various techniques from both structured and unstructured data is of great importance as this allows the big data to be used in the recommender system (Job, 2018; Daniel, 2014).

CONCLUSION

The study revealed a number of factors or elements to consider when choosing a particular career path for students. Many studies have shown that some students choose certain careers because of the situations and responsibilities they will face, while others are still unsure about the chosen career. The use of a career referral system is crucial to solving the problems faced by both students and colleges. The use of recommendation systems in education is increasing due to the dominance of technology. The educational recommendation system has been widely used, and various scientific problems have been solved,

professional recommendations have gained popularity, and many studies have summed up its importance. The results of the study suggest that the inequalities within universities are undeniable and, unfortunately, can also affect the students of these institutions. Therefore, students from previously disadvantaged schools face additional career choices when it comes to career choices. These include lack of career information, lack of finance, inadequate career guidance services and poor school performance. Due to the various unique components, it is important that a co-design approach is used to develop a highly effective, customized AI-based career choice recommendation system. The limitations of this study include the decision components from the learner's perspective and no other key people who are closely associated with a learner, such as their parents or friends who are able to provide more insight into the learner's upbringing and personality traits.

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