

Leveraging AI-Driven Technologies to Combat Unemployment in South Africa: Building a Resilient Future

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Abstract

In South Africa, unemployment is still a major socioeconomic problem that has a substantial impact on marginalised populations and young people. The world is changing at an unprecedented pace. The practices of yesterday are becoming obsolete, and new AI-driven technologies are emerging and are having a tremendous impact on unemployment and employment. Therefore, South Africa, as a well-known player in the global economic spectrum, has to step up to make the most of the potential emerging opportunities through the adoption of AI-driven analytics and cutting-edge technologies to combat rising unemployment. In order to address unemployment in South Africa, this study suggests a comprehensive framework that makes use of artificial intelligence (AI) driven technologies. The study has shown how AI technologies could be crucial in not only addressing the current issues of unemployment but also in setting the foundation for long-term economic growth and resilience against future shocks to the labour market. This was achieved through the analysis of a case study and empirical data from a South African perspective. Hence, by using the Google Trends Index (GTI), the authors were able to establish the relationship between the use of both AI-driven technologies and unemployment or employment.

Keywords

Artificial intelligence (AI), Unemployment, Employment, Technologies

1. Introduction

Unemployment is a global phenomenon, and every government around the world always puts systems in place to continuously contain or eliminate it for the well-being of its citizens. Despite the efforts of the government, unemployment always finds ways to be present. With an unemployment rate of 32.9%, South Africa is one of the countries in the world with the highest unemployment rate (StatsSA, 2024). The unemployment rate is a result of diverse factors that have enriched South Africa's unforgettable past (Marwala, 2023). The country still struggles with historical and socioeconomic issues, including extreme inequality, energy shortages, and government ineffectiveness at some points, as well as an education system rooted in the Bantu Education System (Marwala, 2023; Mlambo et al., 2023). In the same perspective, the skill mismatches also exacerbate the country's unemployment challenge (Lekala, 2023). Conventional approaches to unemployment, which mainly involve changes in government regulations and economic restructuring, have not been able to substantially improve the situation with regard to unemployment

(Marwala, 2023). The issue of unemployment in South Africa is a crucial and solve-now problem because it mostly affects young and middle-aged people who are considered to be the light for tomorrow's hope. The future of the country is therefore only assured if the young people are transformed to be the active pillar of the current economy (Skhosana & Nel, 2023). To properly address this issue, a mindset change towards creative and all-encompassing techniques is essential in this regard. Hence, rethinking or establishing innovative systems that are align with our current transformative environment is the way forwards.

Integrating Artificial Intelligence-based technologies into our lives seems to be becoming the norm among high-tech and developed countries, such as Luxembourg, Austria, Malta, the Netherlands, Australia, Canada, Switzerland, China, Germany, Denmark, Estonia, Finland, France, the United Kingdom, Ireland, Israel, Iceland, Japan, the Korea Republic, Norway, New Zealand, Sweden, Singapore, and the United States (Dutta et al., 2022). Francis Gurry emphasises artificial intelligence (AI) as a revolutionary digital frontier that has the potential to drastically transform our lives and work environments, as described by a 2019 World Intellectual Property Organisation (WIPO) report (WIPO, 2019). The exponential growth of digital information and significant advances in computer power have made artificial intelligence and other cutting-edge technologies a transformative force (Guliyev, 2023). The advent of intelligent artificial intelligence-driven cognitive systems and advanced information technologies has fundamentally changed how people live and work. While AI has the potential to increase productivity in a number of industries, it also has the ability to automate employment and change the nature of career trajectories. AI technologies, including machine learning, computer vision, neural networks, and others, have simplified daily tasks and changed customary human behaviour. Moreover, natural language understanding (NLU) is a key component of AI developments to come, and major advances in this field have the potential to yield enormous commercial and scientific rewards. One of the main scientific obstacles in NLU is language modelling, which entails the computational representation and analysis of natural languages (Chowdhary, 2020). Natural language processing (NLP) has been profoundly impacted by the introduction of pre-trained language models like ELMo, BERT, and GPT, which represent a significant advancement in the field of deep learning (Chowdhary, 2020).

The Generative Pre-Trained Transformer 4 (GPT-4), an extensive multimodal language model created by OpenAI, is currently one of the most notable examples of technological progress (Taecharungroj, 2023). GPT-4's development and use in a range of applications have made artificial intelligence a common occurrence and sparked heated discussions about how it would affect jobs for humans. As a result, advances in artificial intelligence have sparked discussions about the future of work and brought up important issues regarding the necessity of human jobs in the workforce. Numerous studies have focused on the impact of AI and the accompanying technologies on labour markets (Acemoglu et al., 2022; David, 2017; Goos et al., 2009; Oschinski & Wyonch, 2017). The question of how automation affects employment is not a new one; it has its roots in past discussions of the rise and fall of labour automation (Jenkins & Sherman, 1979). Significant job displacement has mostly not occurred despite prior concerns (Whitley & Wilson, 1982). However, the situation now is very different, as supercomputers can now handle a wider range of activities beyond the first impact of digitisation because of the combination of AI with improved data access and processing capabilities (Brynjolfsson & McAfee, 2014). "Future strategic advantage will hinge on the capacity to harness AI technologies, such as machine learning, computer vision, and autonomous systems, blending them with human labour to form effective human-machine collaborations." (Rahwan et al., 2019).

Conversely, the relationship between AI and unemployment is well understood in economic theory and is frequently understood as a direct "pass-through" effect on labour productivity (Acemoglu et al., 2022). As mentioned by experts, AI raises productivity and possible future wealth (Guliyev, 2023; Stevenson, 2018). AI is comparable to other technological advancements that have historically increased productivity, sparked economic growth, and decreased unemployment rates in this regard. It is acknowledged that AI may cause brief increases in structural unemployment, but these usually subside when the labour market stabilises. Because there is an absence of systematic data capturing AI utilisation, the literature examining the relationship between unemployment and AI primarily uses descriptive and comparative research rather than arguing for a definitive econometric model to capture this relationship. In order to improve unemployment modelling efforts, unorthodox data sources like Google Trends have been investigated. Enhancing unemployment prediction models has been demonstrated to be a potential use for the Google Trends Index (GTI), which tracks Google search queries (Mihaela, 2020; Nagao et al., 2019; Simionescu & Cifuentes-Faura, 2022). Using this methodology as a foundation, this study examines the relationship between AI and unemployment rates by utilising GTIs related to AI from a South African perspective. This study stands out for being one of the first to use the GTI estimation technique and AI experts' views to examine the effect of AI on unemployment and for undertaking a comprehensive examination across the country.

1.2 Problem statement

South Africa is battling with the rise in unemployment, especially among youth, which is considered the future of the country. At the current status quo, the South African youth is still far from being the backbone of tomorrow's development, and that may put the country on a path that jeopardises its promised future. Hence, the authors believe that South African unemployment could be reduced or eliminated with the deployment of artificial intelligence and its cutting-edge technologies-driven practices, which are assumed to be the catalyst for this transformative world.

1.3 Significance of the study

The significance of this paper is to strive and demonstrate that the rising unemployment rate could be combatted with the use of artificial intelligence and its related advanced technologies because this approach has already been considered elsewhere, and the authors believe that it is time to face off the emerging technologies to make it work for us instead of avoiding it to preserve the few job opportunities available.

2. Related literature review

Research on the impact of artificial intelligence and its related cutting-edge technologies on labour markets has significantly increased in the last few years (Ernst et al., 2019; Martens & Tolan, 2018). Throughout this corpus of work, AI-driven practices are frequently seen in the larger perspective of automation (Wang & Siau, 2019). Academics typically take one of two stances. Some claim that AI and its related advanced technologies have a “replacement effect,” meaning that AI directly replaces occupations. Others propose the “displacement effect,” which refers to a change in the kinds of occupations that are accessible as opposed to a complete replacement (Guliyev, 2023).

The “replacement effect” literature lists a number of ways that AI-based cutting-edge technologies might negatively affect employment. This encompasses the possibility of elevated joblessness as a result of employment replacement. According to an early study conducted in the field of emerging technologies, AI may someday replace most of the labour force, which would exacerbate the problem of unemployment (Leontief, 1983). Subsequently, about 50% of technology specialists think that robots could replace humans in routine work (Khogali & Mekid, 2023). This suggests that traditional jobs—aside from those needing a high level of skill—are in jeopardy in the age of artificial intelligence and other advanced technologies. As ordinary tasks are replaced or are being replaced by technology, there will be an increase in high-tech unemployment, as predicted by Guliyev (2023). Within 20 years, almost 47% of the more than 700 occupational roles could be automated, according to estimates from (Frey & Osborne, 2017; Kelly, 2022). AI has the potential to replace workers in 55% of occupations, regardless of gender (David, 2017; Shen & Zhang, 2024). Furthermore, robots mostly impact low-skilled jobs (Graetz & Michaels, 2018). Studies conducted in the field of AI-driven technologies found a correlation between strong automation potential and a higher likelihood of job change or unemployment (Felten et al., 2018; Frank & Alina, 2019).

Using a task-based study, a group of scholars investigated how robot integration could affect US labour markets (Acemoglu & Restrepo, 2020). They found that a 0.2% drop in the employment-to-population ratio and a 0.37% drop in salaries are correlated with an increase in robot density. They also emphasised how workers with lesser levels of education are more negatively impacted by automation, which has an impact on their hourly wages and job security—looking at the employment trends of jobs that were previously considered to be very vulnerable to automation in 2012 and evaluated if there was a decline in these positions throughout the next seven years (Shen & Zhang, 2024). According to their findings, compared to other professions, these particular job categories either saw a slower pace of employment growth or, in some cases, a modest reduction in the number of workers. In a follow-up study, the investigation was on how the development of artificial intelligence is expected to drastically change the occupational skills environment, pointing out that regional innovation is essential in mitigating this impact (Ma et al., 2022). They also noted that the impact of AI on middle-skill occupations tends to decline as innovation increases in tandem with industrial evolution and technical breakthroughs. Furthermore, in environments marked by technological advancement and innovation, high-skilled sector employment follows a U-shaped trajectory.

From this perspective, artificial intelligence, along with its related cutting-edge technology practices, is seen as benefiting the labour market by lowering unemployment rates, creating new jobs, and ultimately providing positive dividends for employment rates. Although experts contend that artificial intelligence will likely have an impact on the labour market in the near future, mainly because of enhanced production efficiency, in the long run, more jobs and employment opportunities should be created as a result of the eventual expansion of production capabilities. The recipient of the Nobel Prize in Economics claims that the advancement of AI technology is reproducible (Boden,

1987). He predicts a net gain in employment availability in the future—jobs that may change in nature but will be more plentiful than those that were accessible in the past, notwithstanding any difficulties that may arise during the transition period. The McKinsey Global Institute Research’s 2016 findings, which predict a need for 250,000 data scientists by 2024, support the idea that there will soon be a boom in the demand for data science specialists. Simultaneously, Graf and Mohamed (2024) investigated how robot integration affected the German labour market and found that although it changed the way jobs were distributed among different industries, it did not lower overall employment levels. A related study claimed that the adoption of artificial intelligence did not immediately increase unemployment rates by including AI in an economic development model that considered constraints on overall demand (Saba & Ngepah, 2024). To further enhance this discussion, Acemoglu and Restrepo (2018) explored the relationship between automation, artificial intelligence, and employment, revealing a number of interesting findings. They contend that automation and artificial intelligence increase productivity, a process that is further supported by the accumulation of more capital. With the help of more trained individuals, this capital inflow makes it possible to upgrade present responsibilities, which creates new job prospects. According to (Abulibdeh et al., 2024), universities are essential for developing professional skills and good character qualities that can help graduates reduce the likelihood that artificial intelligence will replace them. According to Webb (2019), jobs that are particularly vulnerable to automation technologies have seen declines in employment and pay. On the other hand, data from France demonstrated that automation positively affects employment at the industry and firm levels (Philippe et al., 2020). In contrast to businesses that refrained from investing in robots and saw job losses throughout the same timeframe, an examination of a set of industrial enterprises in Spain showed that the introduction of robots resulted in a net job growth of 10% (Koch et al., 2021). The authors did point out that, generally speaking, automation neither greatly increases nor decreases the total number of jobs. Using an “AI Occupational Impact” metric, Felten et al. (2018) found that while AI marginally increases earnings, it has no effect on employment levels. In a similar vein, Acemoglu and Restrepo (2020) found no conclusive link between exposure to AI and changes in employment or income levels based on their analysis of online job listings.

Although academic circles have examined the relationship between artificial intelligence and unemployment from a variety of perspectives, there is a striking absence of empirical research on the subject. This study seeks to fill the most important holes in the body of current literature. It first tackles the deficiency of empirical studies that concentrate on the relationship between unemployment and artificial intelligence. Developing an empirical econometric model moves beyond theoretical conversations about the potential consequences of AI in the future. Second, it addresses the problem of inadequately large datasets that have been encountered by earlier research. In order to achieve this, this study makes use of a large dataset that spans 14 years (2010–2024) and includes panel data from the whole country (South Africa). To further strengthen the validity and reliability of the model’s conclusions, the Google Trends Index (GTI) is used in the current research as a stand-in measure for AI use in order to address the problem at hand.

3. Methods/tools

The econometric method utilised to investigate the relationship between unemployment and AI is described in this section. The number of people who actively seek employment but are unable to do so within a given time frame—a month, quarter, or year—is known as the unemployment rate. This measure shows how the labour market is doing right now. It records the number of unemployed individuals seeking employment at a specific moment in time. When analysing unemployment, the dynamic lag effect is important to consider since it recognises that policies and economic conditions may impact the labour market over time. On the other hand, the assumption is that if there is no proven relationship between AI and unemployment, AI may be the country’s potential driver for employment rates.

A quantitative research approach is used for data collection and analysis. This approach is used to quantify the relationships between variables of AI and Unemployment for an objective evaluation. This is to find patterns and correlations which will attest to whether the deployment of the AI ecosystem in South Africa would yield more job opportunities to combat unemployment and increase employment rates across industries. Hence, a Likert scale was used in the development of the questionnaire since it is a useful tool for gauging attitudes, views, and perceptions. With a range of choices from “strongly disagree” to “strongly agree,” the Likert scale enables respondents to indicate how much they agree or disagree with a series of assertions about AI and unemployment (Jebb et al., 2021). A purposeful sampling method is used in the study. Using this method, respondents who satisfy particular requirements pertinent to the study’s goal are chosen. In this instance, the availability and relevancy of the respondents on the social media site LinkedIn allowed for their identification before the questionnaire was distributed. The sample is guaranteed to be representative of the chosen South African population segment by purposeful sampling. In this instance, the LinkedIn platform was used to administer questionnaires for the purpose of collecting data. The LinkedIn platform

was selected because of its professional network, which makes it easier to reach relevant and particular audiences who are experts in artificial intelligence and its related cutting-edge technologies, and LinkedIn has been used by various scholars globally for similar purposes (Akilimalissiga & Sukdeo, 2023a). The questionnaire was created with the goal of collecting data as quickly and effectively as possible, making use of social media's extensive audience to increase the response rate. The survey was created and disseminated using Google Forms, which is a flexible tool that makes data management and response distribution and collection simple. We received a total of 51 responses out of 100 targeted experts in the field of AI development. Despite being modest, the sample size is adequate for preliminary exploratory analysis with descriptive statistic techniques. Small samples are easier to obtain ethical committee permission for, yield faster findings, and can be conducted inside a single centre without the complications of multicenter investigations. According to (Indrayan & Mishra, 2021), small samples are easier to obtain ethical committee permission for, yield faster findings, and can be conducted inside a single centre without the complications of multicenter investigations. To arrive at more reliable conclusions, they might need to use similar statistical analytic techniques. Regardless of sample size, no single study is regarded as conclusive. Nonetheless, it is simple to carry out a large number of minor studies in diverse contexts. A more solid and trustworthy conclusion can be reached through a meta-analysis if the findings of various studies are comparable.

The identified respondents' availability and willingness to take part in the study were taken into consideration while collecting the data. Also, the study was undertaken with ethical standards to guarantee respondent anonymity and confidentiality. Participation was optional, and informed consent was obtained from all individuals prior to their involvement in filling out the study questionnaires. In other words, participants gave their consent after being informed of the study's objective, the type of data being gathered, and how it would be used. Security precautions were taken to safeguard the information gathered, making sure that it was kept safe and only available to authorised researchers.

In the same perspective, this study also uses the Google Trends Index (GTI) to investigate the potential relationship between AI and unemployment in South Africa from 2010 to 2024. The GTI tracks the volume of relevant search inquiries over time, acting as a proxy for public interest and worry over AI. We extract the graphical representation of the data to see whether changes in AI-related searches could explain the changes in unemployment rates by comparing this data with Statistics South Africa (Stats SA) unemployment statistics. Our research sheds light on the possible effects of AI on the labour market in South Africa by identifying trends and patterns that could educate stakeholders and policymakers about the socioeconomic effects of AI developments.

4. Empirical findings

An empirical investigation was necessary to come up with significant insights to understand the relationship between unemployment and artificial intelligence through the formulated questionnaire. The first part of the analysis was based on five vital statements that made up the questionnaire, and 59 responses were received from participants. The results of the first statement are summarised in the below.

4.1 Statement 1: Artificial Intelligence (AI) has the potential to reduce the unemployment rate in South Africa

When surveying whether "AI has the potential to reduce the unemployment rate in South Africa", a large proportion of the experts in the industry are still unsure (neutral point) of the consequences of the adoption of AI-driven practices. However, the general movement made up of 29 (roughly 50%) respondents (16 agreed and 13 strongly agreed) is a clear indication that, despite the AI space being extremely new to the South African environment, there is a potential lurking in terms of combating the rising unemployment rate that is rising quarter to quarter. One of the key points that some experts are still sceptical about is the divergent impact that AI can have on the labour market. Also, one should be objective in highlighting that the infrastructure to accommodate AI platforms is still far from being functional. Therefore, that may be a concern to take into account at this point in time for countries in the South (Figure 1).

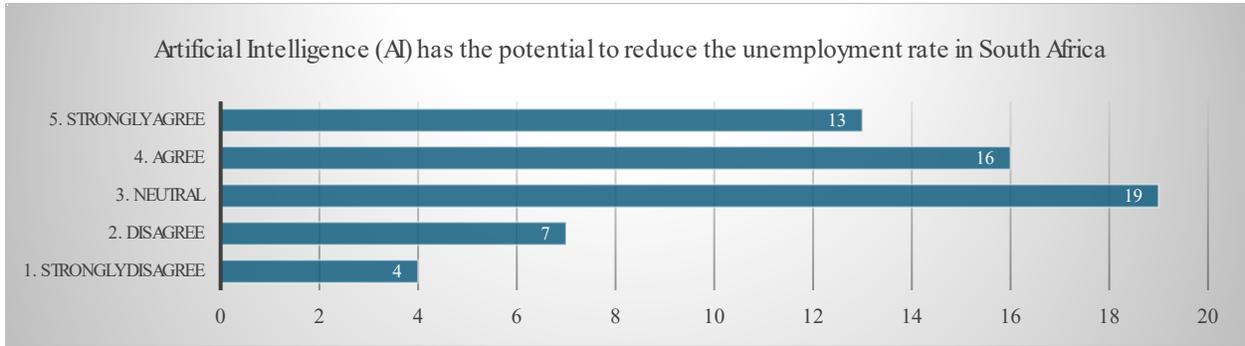


Figure 1. Artificial Intelligence and unemployment rate in South Africa

4.2 Statement 2: AI generates job opportunities that never existed before

It was also critical to investigate whether AI generates job opportunities that never existed before. The experts in the field of AI generally (strongly) agreed with a percentage of roughly 81% that AI has the ability and significant potential to generate non-existent job profiles or opportunities. This means that AI-driven technologies could be at the forefront of job creation to combat the unemployment that the population is suffering from. Additionally, the hope of having AI in the picture is significant in potentially addressing the issue of unemployment in a manner that describes the technology of the current era (Akilimalissiga & Sukdeo, 2023b). The other issue that needs to be considered with the new job opportunities generated by AI is the availability of employees' skills to match the new job opportunities (Abulibdeh et al., 2024). (Figure 2).

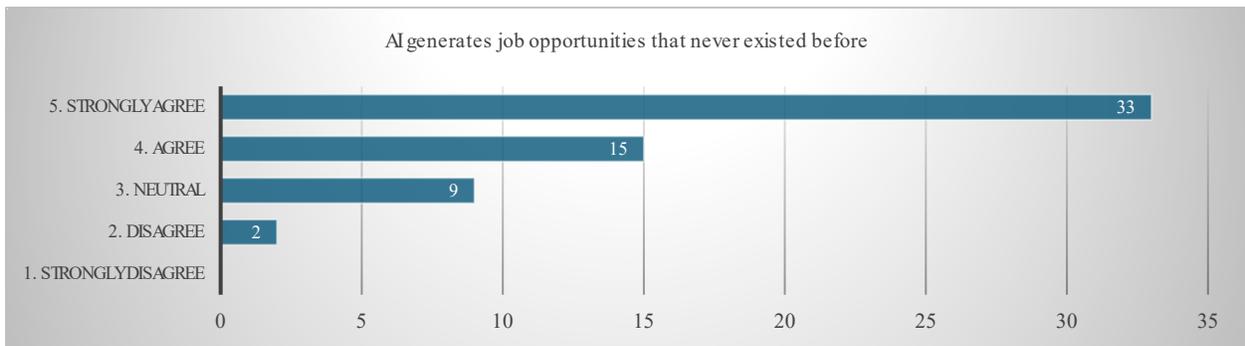


Figure 2. AI and new job opportunities

4.3 Statement 3: AI can create more jobs to combat unemployment in South Africa

Statements 2 and 3 are interlinked in terms of AI job creation. However, statement 2 specifically looked at whether the amount of job opportunities created by the implementation of AI would be enough to combat or reduce the unemployment rate, especially among the youth population. The response trends show that there is hope that AI will generate more job opportunities that will be sufficient to reduce the unemployment rate significantly in South Africa. This is interesting in that the country would be able to leverage the advantages of AI-related practices to provide sustainability in job creation and an economic growth perspective (Figure 3).

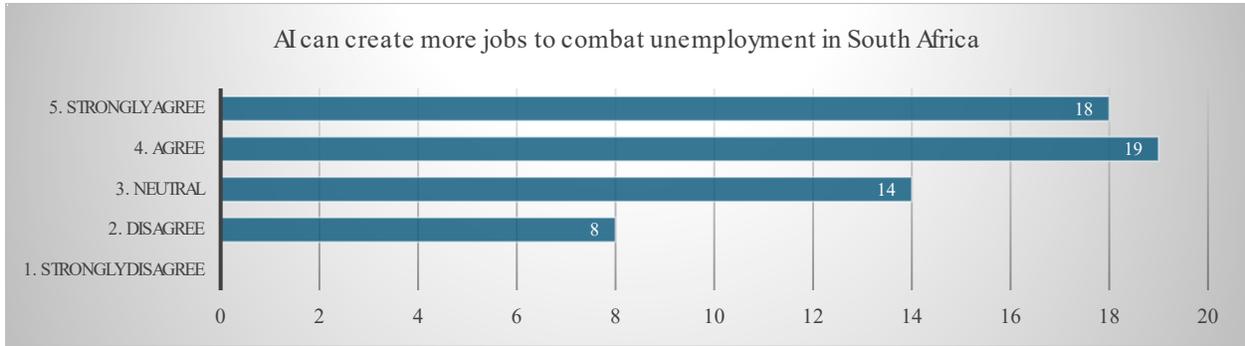


Figure 3. AI can create more jobs to combat unemployment in South Africa

4.4 Statement 4: Rethinking the education system in line with AI is essential for job creation

As the implementation of AI-based practices becomes paramount, rethinking the educational foundation in line with AI sounds critical to creating a balance between the new education system and AI-based technologies in order to provide sustainable job creation and skills development. This status is supported by more than 80% of the experts in the AI industry in South Africa. This implies that clear partnerships should be established between the learning institutions and the industry to rethink the kind of learning and training programmes that are aligned with the development of new technologies to create a match between the new job opportunities and the skillset in demand (Figure 4).

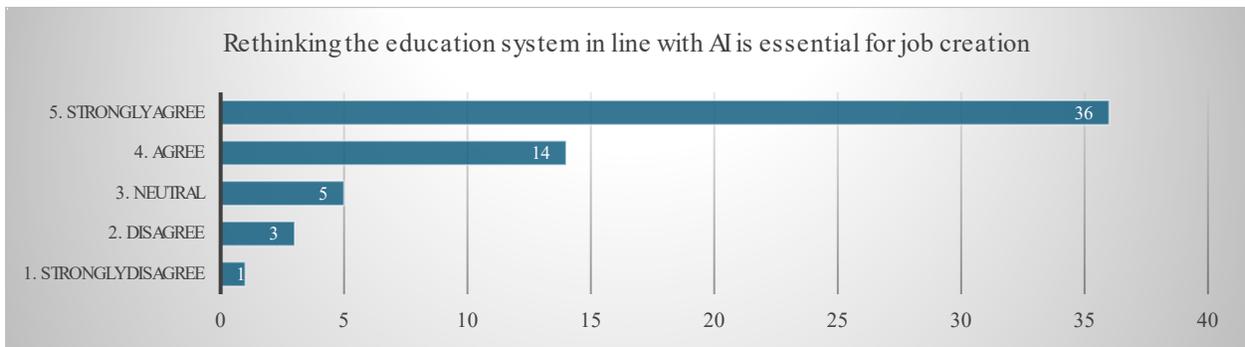


Figure 4. Rethinking the education system in line with AI is essential for job creation

4.5 Statement 5: Improving skills development in line with AI is essential for job creation

The main idea behind this statement was to establish a link between skills development and the implementation of AI in a South African context. It is clear that AI-powered practices are beneficial to the country's industry only if the workforce on the ground is equipped with skills that are in line with smart technologies. The outcomes of this statement revealed that close to the entire number of experts considered partaking in this survey strongly or simply agreed that improving skills development in line with AI-based practices is essential for job creation. This is also a good ground to highlight that learning institutions are to be at the forefront to play an enabling role in this regard (Figure 5).

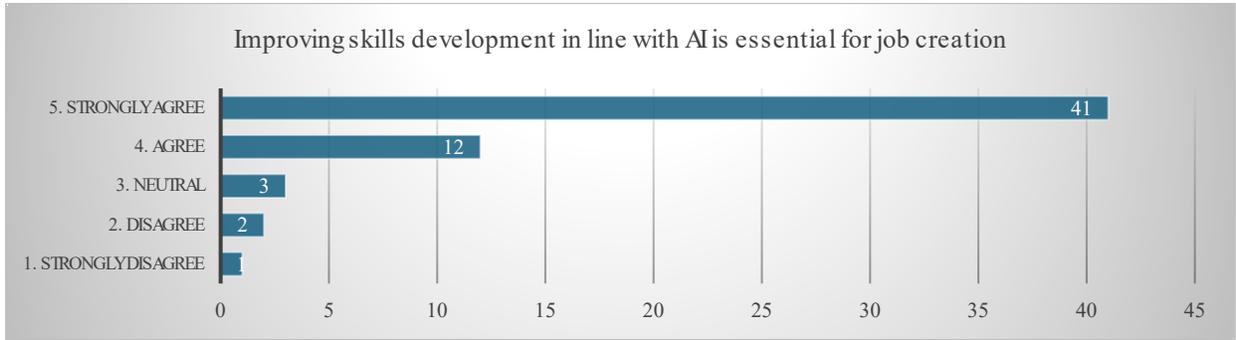


Figure 5. Improving skills development in line with AI is essential for job creation

4.6 Google Trends Index (GTI)

The relationship between AI and unemployment sounds complex, depending on the parameters considered. In this study, the authors measured the relationship between AI and employment. If there is a relationship between the two, it implies that there is no relationship between AI and unemployment. Hence, the analysis of the GIT shows there is no clear correlation between AI and employment from 2010 to 2021. However, from 2022, the analysis displays a comparative increase in AI-based practices and Employment awareness till 2024. In other words, AI seems to drive up job opportunities, which have the potential to reduce the unemployment rate in South Africa, and this is evident between the years 2022 and 2024 (current year) (Figure 6).

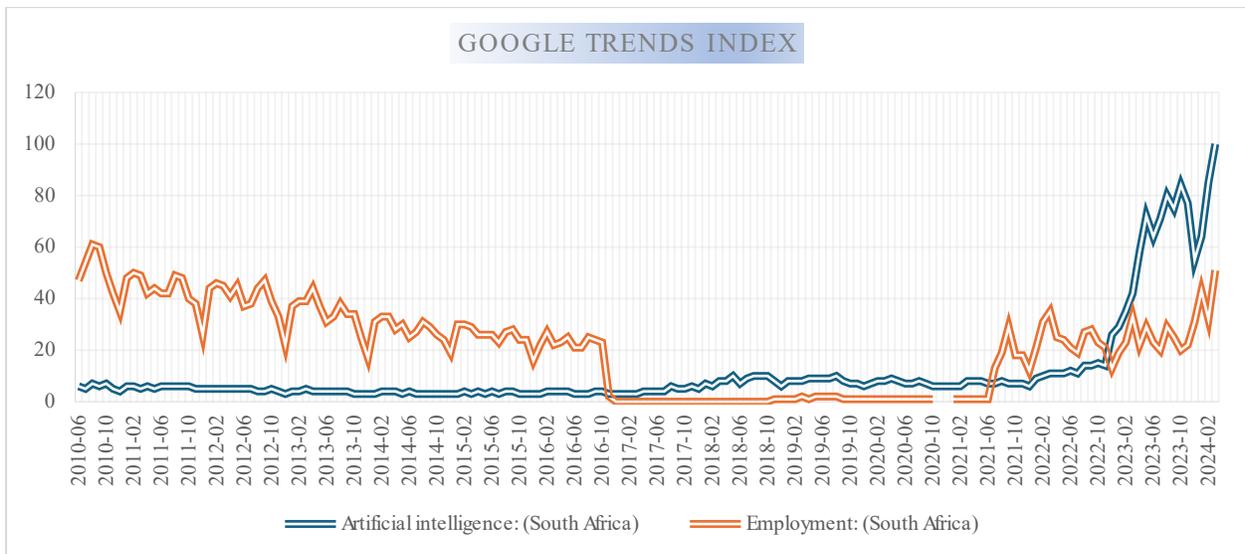


Figure 6. Google Trends Index

5. Discussion on the findings

The study explored the opportunities and challenges of using AI to reduce unemployment in South Africa. Although many experts are indifferent, a sizable percentage (50%) think AI might assist in lowering unemployment by generating new job opportunities, underscoring concerns about South Africa's infrastructure and preparedness for AI integration. This cautious optimism stems from the conviction that, despite AI's potential to spur innovation and economic growth, the organisational and technological frameworks required to facilitate widespread adoption are still underdeveloped (Marwala, 2023; Mlambo et al., 2023). The analysis supports Google Trends data, which indicates a recent change in the perception of AI's involvement in job creation by showing a notable increase in public interest in AI-related employment only after 2022. This implies that even if more people are becoming aware of AI, the country as a whole is still in the early phases of utilising AI's potential to lower the unemployment rate.

The vast majority of the experts surveyed (81%) overwhelmingly concurred that AI has the potential to generate whole new categories of roles in fields such as machine learning, data science, and AI ethics (Boden, 1987). This viewpoint is consistent with statistics from the Google Trends Index (GTI), which indicates an increase in AI knowledge and employment prospects, especially after 2022. The survey's findings highlight the fact that AI is already creating jobs in innovative industries, even if these new positions frequently call for specialised knowledge that many members of the present workforce do not possess. This changing dynamic draws attention to an important point: although AI has the potential to generate jobs, its ability to lower the total unemployment rate will rely on how well-equipped the workforce is to fill these new positions. The general public appears to be growing increasingly aware of AI's ability to create jobs, as evidenced by the rise in searches linked to the technology. However, in order to stop the skills gap from growing, real efforts must be made to reskill and upskill the workforce.

The urgent need to reorient education and skill development to match the demands of an AI-driven economy is a recurrent subject in the research. Over 80% of experts concurred that in order to guarantee that the workforce of the future can fully benefit from AI-driven employment prospects, educational systems must give priority to AI-related skills like programming, data analysis, and AI literacy (Abulibdeh et al., 2024). Public awareness of AI has grown, especially since 2022, which shows how important AI is becoming, but it also emphasises how urgent educational change is (Acemoglu & Restrepo, 2020). Without focused reskilling and upskilling initiatives, South Africa runs the risk of experiencing a severe skills shortage that could obstruct AI's ability to significantly lower unemployment. In conclusion, the research shows cautious optimism regarding AI's potential to create jobs, but it also emphasises that in order to fully realise this potential, industry, policy, and education must work together to build the infrastructure and skills needed to support the future of work in an AI-driven environment.

6. Conclusion

A Complex Yet Promising Relationship

AI and unemployment in South Africa have a complex relationship. Both the Google Trends Index and the expert analysis indicate that although AI is generating new job prospects and increasing public awareness, its effects on unemployment are still nuanced and dependent on a number of factors. There was no discernible correlation between AI and employment between 2010 and 2021; however, starting in 2022, AI's contribution to job creation has significantly increased. This implies that the benefits of AI for the labour market are just now becoming apparent. However, South Africa must address infrastructure issues, rethink its educational system, and make investments in skill development if AI is to dramatically lower unemployment. By doing this, the country will be better able to integrate AI technology's promise to generate long-term employment opportunities and stimulate economic growth. The results show cautious optimism: AI has the potential to spur job growth, but achieving this promise would necessitate concerted efforts from the fields of industry, education, and policy creation.

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