MIAMI, FL,USA

APRIL 15-17, 2025

2025 WEI INTERNATIONAL ACADEMIC CONFERENCE PROCEEDINGS

EDUCATION & HUMANITIES

BY THE WEI

ISSN 2167-3179 (ONLINE) USA

TABLE OF CONTENT

Integrating ChatGPT to Enhance ESL Writing Skills in Pakistani Higher Education: An Empirical Study

Abrar Ajmal, Dr
abrar.ajmal@mul.edu.pk
English Language Center, Minhaj University, Lahore, Pakistan

Abstract

This study investigates into the untapped potential of ChatGPT, an advanced artificial intelligence language model developed by OpenAI, to revolutionize English as a Second Language (ESL) writing skills among university students in Pakistan. By integrating ChatGPT into ESL writing courses, this research addresses common educational challenges such as limited individual feedback and varied student proficiency levels. Employing a quasi-experimental design, the study involves 120 students from three Pakistani universities, divided into control and experimental groups. The experimental group utilizes ChatGPT for drafting and revising essays, while the control group follows traditional instruction methods. Pre-test and post-test assessments, alongside surveys and interviews, are conducted to measure improvements in writing proficiency and gather qualitative insights. The findings are expected to significantly enhance grammar, coherence, and overall writing quality among the experimental group.

Additionally, positive feedback on the usability and effectiveness of ChatGPT is anticipated, underscoring its role in not just enhancing writing skills, but also in increasing learning engagement. This research contributes to understanding AI's educational potential, particularly within Pakistani ESL. It suggests avenues for future studies to validate and expand upon these initial findings.

Keywords: Artificial Intelligence (AI) in Education, ESL Writing Skills, AI-Assisted Learning, Educational Technology Integration

A retrospection into South Africa's Mathematics enrolments: why the number of high school Mathematics learners decline across the FET phase

Fitzgerald Abakah
Northern Cape Department of Education, Kimberley, South Africa
Albert Antwi[1]
Department of Mathematical Sciences, Sol Plaatje University, 24-26 Scanlan St, New Park, Kimberley, 8301, South Africa.

Abstract

The number of students offering mathematics in South African schools is below expectations, despite the global advocacy for students to study mathematics. Despite this concern, many students in the FET (Grades 10-12) phase discontinue the subject, therefore the students' attrition rates in mathematics in South African schools are evident. This worrisome trend and the global concern of students' attrition rates at various levels of mathematics education has necessitated the need for this study to identify some of the causes to assist schools and key stakeholders to take actions to slow down the trend. Using the Participation-Identification Model as the theoretical framework, data was collected using questionnaires from which content analysis was undertaken. The fixed-effects beta regression modelling framework was also used to model dropout rates. It was uncovered that, drop-out rates significantly differ across the FET phase and within the quintile categories of schools. It was observed that there is a significant difference in the dropout rates between the elite and poor schools. This observation supports the assertion that school, as well as parental support and participation, as mediated by their socioeconomic status, affect dropout rates. Evidence from the content analysis indicate that the negative attitude of students towards mathematics and how they are guided to learn mathematics, highlighting their learning difficulties, were the noticeable reasons behind their dropouts. Therefore, it is advocated that teachers must be guided to implement appropriate instructional approaches in mathematics classrooms in South African schools to stimulate student interest.

Keywords: Students' Attitude, Student's drop-out, Mathematics Advocacy, Students' attrition; beta regression.

1. Introduction

South Africa is still not addressing the root causes behind the decline in the number of mathematics students or the decrease in the pass rate of those who choose the subject. Less than 30% of all matric learners take mathematics and only half of them pass their exams" (Small, 2022, P.1). Amelink (2012) and Simegn *et al.* (2017) assert that if students develop a phobia for mathematics, it will negatively affect their involvement and performance, not only in mathematics, but in other related subjects and careers in science and technology. This is because mathematics serves as keys to the doors of other related subjects since it is part of the fundamental knowledge required for learning other science and commerce subjects (Dahiya, 2014).

South Africa's mathematics troubles have also been recorded in the junior grades, although the situation with the high school phase, inevitably, negatively affects studies at the tertiary levels, universities and TVET colleges (DoBE, 2018). At the tertiary level, the high failure rate of students in mathematics prevents their enrolment in mathematics-related courses, such as Engineering, Actuarial Science, Accounting, Economics, Mathematics, and Statistics (DoBE, 2018). Sometimes, even if these students do register for such courses, there is a significant dropout rate as they quit from these mathematics-related courses later.

Tertiary records indicate that there is a high student attrition rate from engineering courses, in the third year of study, particularly in civil engineering, mechanical engineering, aerospace or aeronautical engineering, electrical engineering, and electronic engineering, among others. TVET college students in South Africa are also not spared from the consequences of the failure in mathematics; a lot of these students are unable to complete engineering courses, from N1-N6 levels. The failure and drop-out rates, in addition, are recorded from N3-N6 levels (DoBE, 2018; NCDoE, 2021). The narrations above reveal that South Africa's mathematics struggles cut across all levels of her educational

[1] Corresponding author: albert.aantwi@outlook.com. ORCID: 0000-0002-3571-4850.

hierarchy. Attrition and failure rates of considerable students at the university level have raised questions about 'what' and 'how' mathematics is taught in high schools, forcing lecturers, authorities, and researchers to have serious reservations about the teaching and learning of the subject, in South Africa, at the pre-tertiary levels (DoBE, 2018).

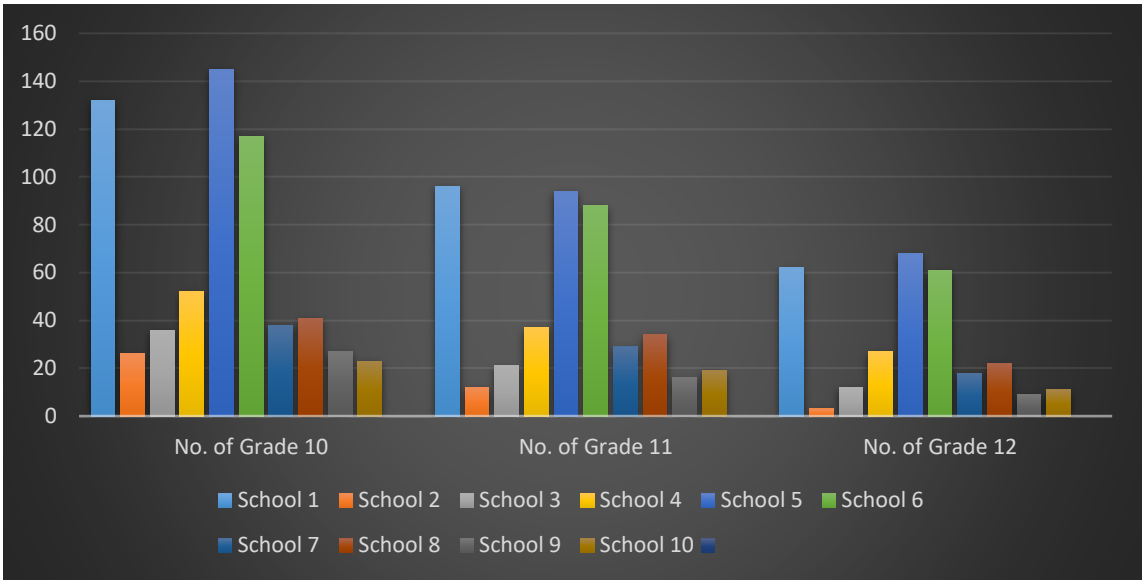


Figure 1: Trend of mathematics learners [2]across the FET phase (NCDoE, 2021).

Figure 1 above indicates a randomly selected ten schools in an education district of the Northern Cape Department of Education (NCDoE). For each school, the number of mathematics learners in Grade 12 were targeted and how many these group of learners were in Grade 11 and Grade 10 were recorded. To ensure anonymity, the name of the education district and the ten schools have not been provided. It can be seen from Figure 1 that for each of the ten randomly selected schools, the number of math learners decreases during the FET phase. For some schools, not even half of the learners who started Mathematics in Grade 10, continued with the subject to Grade 12. It can be safely assumed that some of those students who discontinued mathematics opted for mathematical literacy, as they may have developed a negative attitude towards mathematics (DoBE, 2018).

Mathematics has relevance in academia, hence, there is a global advocacy for students to study mathematics. In South Africa, the number of mathematics students is below expectations, despite global advocacy and the strong relationship of the subject to South Africa's critical skills careers, such as accounting, engineering, architecture, among others, which are holistically dependent on mathematics (Small, 2022; Volmink, 2020)

Even though the number of students taking mathematics in South Africa is- below expectations, many of them discontinue with the subject in the FET phase as indicated in Table 1. Student attrition rates at various levels of study and from subjects with high impact are a concern globally and South Africa is not isolated. Unfortunately, even the few learners, about 50% who study Mathematics up to grade 12 end up not passing the subject, even at a 30% pass mark. The need for policy makers, parents, schools, and all-important players to find ways to mitigate the growing and persistent dropout rates has necessitated this study to identify some of the underlying causes. Therefore, the study investigates the underlying reason(s) for the discontinuation of mathematics as a subject by learners in FET grades through content and statistical analysis to answer the main question 'Why *do the dropout rate of high school mathematics learners decline in the FET phase?'*

2. Literature review

[2] Mathematics is a compulsory subject from Grade R to Grade 9 in South Africa, however, at the Further Education and Training phase (FET), that is, from Grades 10- 12, learners have the option to either study Mathematics, Mathematical Literacy or Technical Mathematics; in this study, the focus is on mathematics learners at the FET Phase.

Factors affecting learners to drop-out of subjects such as mathematics at high school level are multi-facet. Although some of these factors emanate from socioeconomic classifications of schools and the role that parents play in their children's school, others may come from the schools themselves because of the quality of teachers they have and the support that teachers provide to students.

Socio-economic factors, ethnicity, sex, prior school achievement, peer pressure, motivation and truancy may result in students harbouring negative attitudes towards mathematics (Kuru Cetin & Taskin, 2016; Tang & Tran, 2023). Amelink (2012) and Simegn et al. (2017) posit that students' negative attitudes toward mathematics impact their participation and achievement in the subject. Furthermore, parental socioeconomic status influences their children's participation and mathematics performance (Gülhan, 2023; Kuru Cetin & Taskin, 2016).

It should be noted that South African schools are demarcated into quintiles (1- 5) according to the level of socioeconomic status of the communities in which the schools are located. Quintile 1 schools are the poorest whilst quintile 5 schools are the richest. Quintile 1 to 3 schools are considered poor school or disadvantaged due to the socioeconomic status of the communities they operate in, while Quintile 4 to 5 are considered the affluent schools. Unlike parents from affluence schools, parents from disadvantaged schools can be prevented from participating in their children's school activities due to barriers such as poverty, lack of financial resources, lack of access to information, and lack of awareness (Ahmed et al., 2024). Some of these parents also do not see the need to participate in their children's school activities because they believe that is solely the work of the teachers. However, parental support and participation in school activities have been shown to influence student performance in mathematics (Tang & Tran, 2023; Fan & Williams, 2010), thus the lack thereof may contribute to student disinterest and lack of extrinsic motivation, which has dire consequences on student performance and dropout rate in disadvantaged schools.

The link between parental support, their participation in their children's school activities and the performance of the children is well documented in literature. For example, (Hernández-Padilla et al., 2023) observed that the learning experiences of students in mathematics are significantly influenced by the support they receive from their parents and the participation of their parents in their school activities is mediated by their parents' socioeconomic status. The lack of parental support and participation is a general course of concern for educators in schools serving disadvantaged communities (McDowall & Schaughency, 2017). Teachers in such schools perceive parental involvement to be less encouraging and less rewarding in advancing children's learning (Luxomo & Motala, 2012).

In a study aimed at investigating the effect of parental participation on self-esteem, anxiety, attitudes, and achievements of high school students in mathematics Tang & Tran (2023) observed a positive impact of parental involvement and mathematics expectations achievement of students. However, the study also revealed a negative impact of attitudes of students toward mathematics while parental expectations had positive impact on attitudes of students toward mathematics. The weakened student anxiety in mathematics due to parental support and participation can extrinsically motivate them, thus reducing dropout rates. Likewise, when parental support and participation is lacking, students anxiety may increase leading to lack of extrinsic motivation and increase in dropout rates from mathematics become the inevitable consequence.

Characteristics of schools, such as support from teachers and curriculum knowledge of teachers, play a key role in student's interest in subjects which may play a significant role in subject drop-out rates- such as in mathematics. Supportive teacher behaviours such as emotional, social, and academic have been found to be associated with higher levels of intrinsic motivation among. For example, Katz et al. (2009) found that students' adaptive motivation for homework is influenced by psychological support from teachers regardless of the expressed level of needs of students. Dietrich et al., (2015) in their study titled "Teacher support and its influence on students' intrinsic value and effort: Dimensional comparison effects across subjects" also found a positive impact of teacher support on the intrinsic value development and efforts of students. These observations and many others, including Reeve & Jang (2006), lend support to the influence of teacher support on student motivation. Since intrinsic motivation leads to positive student attitude and performance of subjects, schools that make efforts to encourage teachers to motivate students are expected to have lower dropout rates compared to schools that do not.

Many studies have established the competence of the teacher as one of the fundamental factors affecting the performance of students (Pournara et al., 2015; Shepherd, 2013).Using quasi-experimental study, Pournara et al. (2015) compared the performance of teachers who participated in a year-long professional development course mathematics content with those who did not participate and found a statistically significant improvement in the

performance of students who were taught by teachers who had participated in the developmental course. Shepherd (2013) also observed that when teacher unobservable are accounted, the performance of leaners across the various quintiles within South African schools is positively influenced the subject content knowledge of teachers. Since no two schools may have the same internal characteristics as evidenced by teacher support and curriculum knowledge of teachers, among others such as governance style, there are differences among student's attitude, motivation, and anxiety towards mathematics learning which can subsequently lead to dropout rates as students' progress across the different grades, therefore, it is believed that the school as a whole can contribute to the decrease in student numbers across the various grades in South African schools.

3. Methodology

3.1 Theoretical framework

In this study, the Participation-Identification Model, was implemented as the theoretical framework. This model was applied in this study to identify learners who participated in Mathematics as a subject and still maintained their participation and learners who participated in Mathematics as a subject and withdraw their participation to study Mathematical literacy. When considering the reasons for the continuous participation of the learners and / or withdrawal of their participation from mathematics as a subject, we considered the dimensions of behaviour (participation) and emotional (identification) of the learners (Onwuka, Oladele, Zuoyu, 2019).

3.2 Ethical considerations

Ethical procedures as required in education research were followed. For instance, informed consent- permission of learners and their parents/guardian, school governing body of the school which served as the research field, and the district directorate of education were obtained in witting; voluntary participation- all individuals who participated in this study did so willingly; and confidentiality- participants identities were not revealed to any third party.

3.3 Research design

This is a case study conducted at a district directorate of the Northern Cape Department of Education in South Africa. This is because the researchers sought to make a deep investigation of South Africa's mathematical practices, for example how teaching and learning is conducted, the teaching and learning environment, and promotional requirements, so that relevant information could be collected on the reasons why the number of high school math learners declines in high school grades. The researchers assume that if the root causes for this decline are known, then relevant interventions can be conducted to address them accordingly.

3.4 Participants

Ten schools under a District Department of Education in the Northern Cape Province were randomly selected for this study (see Figure 1). Learners who had stopped studying mathematics and had moved to other subjects were aimed at serving as participants in this study. They were asked to respond to a questionnaire administered to them by the researchers. In all, 100 participants were selected for this study. They included learners who had stopped learning mathematics in grades 10 (n= 48), 11 (n = 36) and 12 (n= 16). Participants were thoroughly informed about the purpose of conducting the study before receiving the questionnaire and were expected to return completed questionnaires after 3 days. As indicated earlier, participation was not mandatory and gender, ethnicity, social and race affiliations were not inclusion criteria.

3.5 Beta regression for modelling drop-out rates

Since parental support and participation affect the performance of students in mathematics, it is not fare-fetched to believe that the quintile or the socioeconomic status of a could significantly affect dropout rates in mathematics and there is also a reason to believe that the dropout rates in the disadvantaged schools are significantly higher than the rates in the affluent schools. Difficulties levels in mathematics curriculum and lack of proper foundation in grade 10 content could also be the reason between the differentiation among the drop-out rates among the different grades. Different schools may also have peculiar factors such as lack of adequate or experienced math teachers, which may

also contribute to the dropout rates in schools. Therefore, the researchers seek to find answers to the following questions:

1. Does the socioeconomic classification (quintile) of a school have a significant impact on the dropout rate of its mathematics students across the grades?
2. Are there significant differences between dropout rates of mathematics students within the quintiles?
3. Does a school influence the drop-out rate of its mathematics students?

To answer the questions above, we use the beta regression framework. Beta regression is appropriate to model responses within the (0,1) interval (Geissinger et al., 2022). Our dropout rates range from 0.171 to 0.75 which makes the beta regression framework a good choice. Given independent random variables $y_1, y_2 \ldots, y_n$ where $y_t,\ t = 1, 2, \ldots, n$ a parameterization version of the beta density is given by

$$f\left(y_t;\mu_t,\ \phi\right) = \frac{\Gamma\left(\phi\right)}{\Gamma\left(\mu\phi\right)\Gamma\left(\left(1-\mu\right)\phi\right)} y_t^{(\mu\phi-1)(1-y)^{(1-\mu)\phi-1}}, 0 < y_t < 1, 0 < \mu < 1 \text{ and } \phi > 0. \quad (1)$$

where μ_t is the mean, ϕ is an unknown precision parameter. The mean and variance of the density are defined by $E\left(y\right) = \mu$ and $var\left(y\right) = \frac{\mu\left(1\ -\ \mu\right)}{1\ +\ \phi}$ respectively. Given the covariates (independent variables) $x_{t1}, x_{t2}, \ldots . x_{tk}$ which are assumed to be fixed and known, the beta regression model is formulated as

$$g\left(\mu_t\right) = \eta_t = \beta_0 + \beta_1 x_{t1} + \ldots . + \beta_k x_{tk} \quad (2)$$

The link function $g\left(\cdot\right)$ should be chosen such that it is strictly monotonic and twice differentiable which maps (0, 1) into the real number space. There are several forms which $g\left(\cdot\right)$ can assume but a more useful case employed in this study is the logit link because of its easy conversion into odds ratios and due to its interpretability. Since we have dropout rates across three grades for the schools, the effects of schools need to be blocked, thus we have a case of repeated measure, which suggests the use of a repeated beta regression model. The covariates(independent) variables used include the quintiles, the grades and the school's index. The school index is specifically used as a blocking variable.

The designed questionnaire enabled the researcher to gather relevant information to comprehensively answer the research question, and, as mentioned, the questionnaire was answered by participants in the research fields.

4. Discussion of research findings

4.1 Content Analysis

The items of this questionnaire were divided into two parts, Part A: the grade level at which the participants discontinued learning mathematics and what motivated their decision to do so; Part B: any other comments/remarks. The questionnaires were administered to the 100 participants, however, there was a return rate of 82% as 18 participants did not return their completed questionnaires. Relevant data was extracted from the 82 questionnaires and tabulated (see Table 2), then some questionnaires were taken at random and a scan of the actual responses of these participants was presented. These actual responses / quotations served as evidence from which discussions of the analysis of the questionnaire were based.

Table 1: Summary of information extracted from the 82 questionnaires returned.

PARAMETERS	Respondents of grade levels learning discontinued mathematics			Respondents who stopped learning mathematics willingly	Respondents who diverted to mathematical literacy	Respondents who did not enjoy learning mathematics tics	Respondents who knew the value and usefulness of mathematics	Respondents who did not have confidence in learning mathematics	Respondents who had other comments/remarks
Number of participants	G10 **38**	G11 **29**	G12 **15**	78	80	82	62	82	74
Percentage of participants	G10 **46 %**	G11 **35%**	G12 **18%**	95%	98%	100%	76%	100%	90%

As shown in Table 2, 38 (46%) of the respondents discontinued learning mathematics in grade 10; 29(35%) of them discontinued learning mathematics in grade 11, while 15(18%) of them discontinued learning mathematics in grade 12. This shows that the highest rate of dropout was recorded in Grade 10. These results, concur with the assertion by NCDoE, (2021) that the decline in the number of mathematics learners is across all high school grades. Also, illustrated in Table 2, 78(95%) of the respondents willingly stopped learning mathematics and 80(98%) of the respondents diverted from mathematics to mathematical literacy. This supports the assertion by Volmink, (2020, p.2) that "the decrease in candidate numbers in mathematics and the concomitant increase in the number of learners offering mathematical literacy remain a matter of concern". The actual responses from the respondents attesting to the results are presented in Appendix 1.

Furthermore, Table 1 informs that 82 (100%) of respondents indicated that they did not enjoy learning Mathematics, which contributed to their decision to abandon the subject. Actual responses from respondents attesting to this result are presented for the readers' examination Figure 2. Lastly, 74 (90%) of the respondents had additional comments/remarks as seen in Appendix 2. Also, 62 (76%) of the respondents knew the value and usefulness of mathematics. Actual responses from the respondents attesting to this are presented for the readers to read. Furthermore, 82 (100%) of the respondents did not have confidence in learning mathematics, as seen in Appendix 3.

The qualitative analysis revealed that students' negative attitudes towards mathematics and how learners are guided to learn mathematics are the two main factors that explain the decline of students in mathematics classes across the FET phases. In terms of negative attitudes towards mathematics, the National Numeracy report (2022, p.3). argues that *negative attitudes towards maths are damaging, leading to disengagement, increased anxiety and a lack of confidence, and a reluctance to try to improve skills*. The acceptable level of performance of learners in mathematics is the highest objective of every teacher; however, the attitude of learners has proven to be a major challenge, making an appreciable number of mathematics learners obtaining the required pass percentage a difficult venture (Di Martino & Zan, 2010; Goldin *et al.,* 2016; Mullis *et al.,* 2020). Students' negative attitude towards mathematics influences their performance (Makondo & Makondo). This was established in this study as indicated by excerpts from the students' responses below.

Response 1: No, because mathematics was difficult for me and difficult to pass.

Response 2: No, because it was never easy for me to pass or improve my mathematics level.

Response 3: I changed mathematics because it was very difficult for me to pass.

These responses testified that the negative attitude participants harboured toward mathematics contributed to their underperformance in mathematics (Makondo & Makondo). According to Di Martino & Zan (2010), attitudes emerge from teachers' practices and students' experiences. These authors claim that teachers interpret the negative attitude of students as a common construct that is indispensably attributed to students' failure in mathematics instead of students' behaviour. The negative attitudes of the students originate, first, from their bad experiences with mathematics (they never conceptually understood fundamental mathematics in their earlier grades). This is demonstrated in this study, as 82 (100%) of the respondents indicated that they did not enjoy learning the subject, as shown in the following excerpts from their responses.

Response 4: No, I found mathematics subject difficult, and I could not understand everything that was done in class;

Response 5: No- because mathematics was very hard, and I didn't understand...

Response 6: -I changed mathematics because I could not understand anything, I tried all my best and I did not like the subject.

The lack of fundamental knowledge and understanding of mathematical concepts of the respondents as established in this study is in support of the findings from Khanum (2006), that learners who lack good educational foundation will inevitably encounter difficulties in the next grade. This was what participants experienced, making them to develop negative attitudes for mathematics, which resulted in them dropping the subject. The lack of fundamental knowledge and understanding of the participants led them to develop a lack of confidence in learning high school mathematics, as established in this study: 82 (100%) of the respondents did not have confidence in learning mathematics. This is seen in the following excerpts.

Response 7: No, I did not enjoy the subject, that is why I did not have confidence in learning mathematics.

Response 8: "No, because it was never easy for me to pass or improve my mathematics level"; Response 9: "No, because my confidence in mathematics it was low…"

These responses highlight that the participant developed low confidence in learning mathematics from the lower grades, which contributed to his decision to drop the subject. Many respondents indicated that they knew the value and usefulness of mathematics in academia and in our daily life. This can be confirmed as indicated below.

Response 10: yes, I do know the value and usefulness of mathematics.

Response 11: yes, I know because mathematics has opportunities.

Response 12: yes, as in many tertiary institutions they require mathematics than mathematical literacy.

However, the bad memories of mathematics that students had experienced in previous grades made them develop negative attitudes towards the subject, despite being fully aware of the value of mathematics. Their bad memories have caused them to develop anxiety for the subject, as the mention of mathematics made them uncomfortable; hence, they chose to abandon it (National Numeracy, 2022; Goldin *et al.,* 2016).

According to Mullis *et al.,* (2020) students' attitudes towards mathematics can be measured through these three components - their enjoyment of mathematics, their value of mathematics, and confidence in mathematics. The analysis of the responses to the questionnaire in this study established that more than 70% of the participants did not enjoy mathematics and were not confident in mathematics; this indicates that they harbour negative attitudes towards mathematics. Among the three descriptors of students' attitudes towards mathematics as identified by Mullis *et al.,* (2020), students' lack of enjoyment and lack of confidence in learning mathematics were the prevalent factors.

This study established that 62 (76%) of respondents knew the value and usefulness of mathematics; however, they could not continue learning the subject as they had encountered several learning difficulties, which had contributed to their decision to abandon mathematics. The 20 (24%) of the respondents who did not know the value and usefulness of mathematics also dropped the subject, as this contributed in them developing negative attitudes for the subject (Mullis *et al.,* 2020). Dahiya, (2014) advises that teachers must educate students on the value of mathematics and its usefulness as without this it would be difficult to encourage students to learn mathematics. Students perceive mathematics as complex, and without them knowing its value and relevance in our daily life, it might put a lot of doubts about the subject in their minds; this creates a lot of negative attitudes towards the subject (Dahiya, 2014). Furthermore, Dahiya, (2014) avers that there is the need to create public awareness of the value and usefulness of mathematics.

How learners are guided to learn mathematics is particularly important *teaching mathematics well is a complex endeavour, and there are no easy recipes for helping all students learn or for helping all teachers become effective, as stated by* NCTM (2014). Mathematics is perceived as a difficult-to-teach and difficult-to-learn subject in schools in South Africa (Abakah, 2019). Poor achievement of math learners has raised concerns about how teaching and learning of the subject occur in schools in South Africa; this has led to multifaceted concerns among math teachers and researchers. In most schools, one notices how ineffectively mathematics is taught to learners in classrooms, with many teachers, still glued to the traditional ways of teaching (DoBE, 2018). The following excerpt from the student response attests to the findings of the study.

> *Response 13 - No, because my confidence in mathematics it was low and did not have any understanding with the teacher who teach that subject.*

In responses 7, 8 and 9 the participants confirmed that they did not enjoy mathematics at school as they did not have confidence in the subject, (see also scans 10, 11 and 12 in Appendix 1). From these remarks, the researchers conclude that, with more than 70% of the respondents having indicated that they did not enjoy learning mathematics and lacked confidence in learning mathematics, the ineffectiveness of mathematics was taught to them. This is in concord with the findings of Gulnaz and Fatima, (2019), as they assert that most students' dislike for mathematics start to develop from the earlier grades, owing to how they were taught the subject. An effective teacher well versed in content knowledge and appropriate pedagogy knows how to build the confidence of students in the subject, knows how to build the desire of students to like and enjoy learning the subject, and makes students see the reasons for studying mathematics (DoBE, 2018; Yadav, 2019, Dahiya, 2014; NCTM, 2014). Therefore, the study findings that most of the respondents lacked confidence and did not enjoy learning mathematics pointed to the pedagogical deficiencies in some of the mathematics classrooms in South Africa, compounded by the lack of qualified mathematics teachers. This confirms that teachers do not adequately guide learners to learn mathematics well (DoBE, 2018; Yadav, 2019, Dahiya, 2014; NCTM, 2014).

Furthermore, the researchers in this study posit that South Africa's educational practices, in general, do not help students learn mathematics effectively. From our experiences as mathematics educators in South Africa, the common practice of the Department of Basic Education (DoBE) has been to score 'progress' or 'condone learners' to push learners to the next grade, without substantial knowledge and understanding of the previous grade. "Condonation" refers to a relaxation of promotion requirements of one subject only applicable if a candidate requires a maximum of 2%, either to obtain a pass at 30% or 40%. 'Progression', on the other hand, means moving a learner to the next higher grade despite not meeting the minimum promotional requirements (DoBE, 2021; Stott, Dreyer & Venter, 2015). From grades 10-12, the DoBE also employs the practice of progression (moving students to the next grade despite them not having attained the minimum promotional requirements). There is also what is termed the 'inclusive basket', where schools look at their previous student scores for the previous three years per grade, per subject to make an informed decision about how current student marks can be condoned (to push them to the next grade) (DoBE, 2021; Stott, Dreyer, & Venter, 2015). DoBE also implements the 'age cohort' as a promotion condition; where a learner is promoted to the next grade if he has spent 4 years in a phase irrespective of whether he has passed (DoBE, 2021; Stott, Dreyer & Venter, 2015). As researchers, we attempted to comprehend the rationale for this age cohort practice but to no avail; we asked ourselves the question - *Does education have any age barrier?* These promotional practices implemented in South African schools have done more harm than good, as over the years these practices have lowered student performance and education standards (Stott, Dreyer & Venter, 2015).

The researchers believe that these promotional practices are not good for the cultivation of student knowledge, especially in mathematics, since they do not ensure that students develop the required prior knowledge before being promoted to a higher grade. NCTM, (2014) advocates for lessons to be structured based on students' prior knowledge and experiences. Mabonga, (2021, p. 2-6) maintain that prior knowledge of students is essential for the following reasons: it lays a foundation or foundation for learning new ideas; it makes learners confident during the teaching and learning process; it helps in designing and modifying pedagogical practices; it makes learning meaningful; it builds learners' comprehension; it facilitates integration of new knowledge; and helps a teacher correct students' misconceptions. This implies that students lacking prior knowledge due to the country's promotion practices, is one of the main contributing factors responsible for learners developing several severe learning difficulties in mathematics, resulting in them dropping the subject.

In summary, how learners are taught mathematics, the lack of qualified mathematics teachers and South Africa's promotional practices do not help learners learn mathematics well; thus, they make learners mathematically incapacitated and helpless (Brijlall, 2015). This study has established that these are some of the factors for the number of high school mathematics learners declining across the FET phase.

4.2 Statistical analysis of dropout rates across grades and quintiles

The use of the beta regression model to make inferences requires checking the following assumption to assess the adequacy and fitness of the model.

(a) normality of the residuals,
(b) homogeneity of the variance of residuals and
(c) independence of each the residuals.

To test for residual normality, the Shapiro wilk test (SWT) was used. A plot of the residuals versus the predicted values and the residual versus the order of the observations were used to assess assumptions (a) and (b), respectively. The accuracy of the models was also assessed using the mean square error, root mean square error, and absolute percentage errors. The results of the analysis are summarised in the tables and figures below.

Table 2: Model Fitness and Diagnostic Test

Evaluation metric	**Value**
MAE	0.037
RMSE	0.0464
MAPE	10.478
P-value for SWT	0.2215

The MAPE value is expressed as percentages.

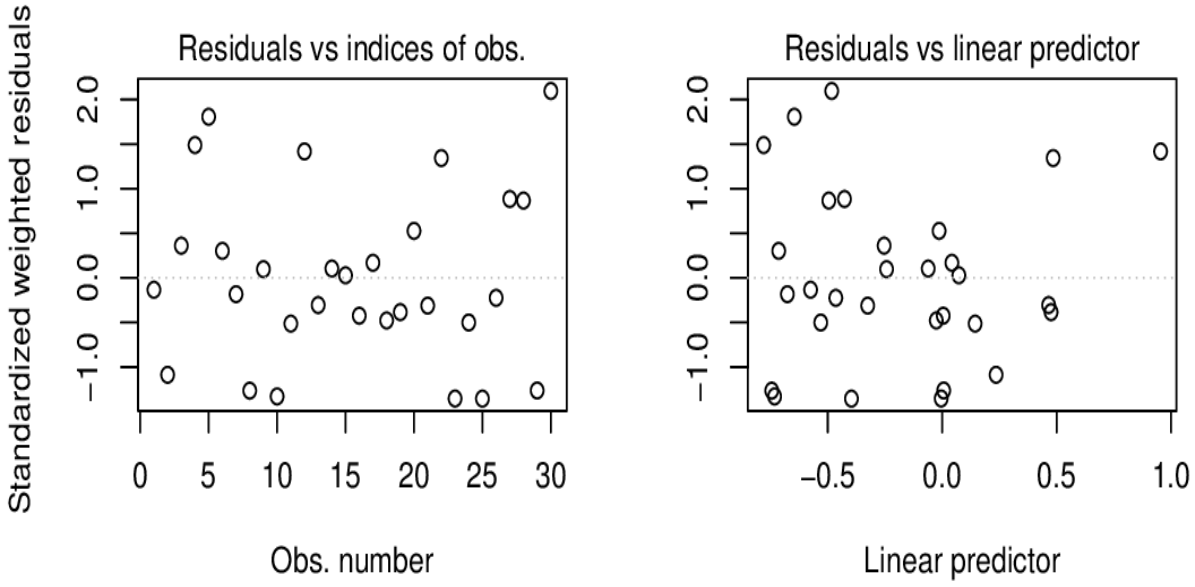


Figure 2: Plot of standardized residual versus observed order and predicted values

For a good fit, the *p-value* of the Shapiro wilk test should be greater than 1% or 5% and the plot of the residuals versus the predicted values and the residual versus the order of the observations should not indicate any patterns. In addition, the MAE, RMSE and MAPE should be relatively smaller. Indications from Table 2 and Figure 2 suggest a good fitted and accurate model since the MAE, RMSE and MAPE values are relatively smaller, the *p-values* of the Shapiro wilk test is greater than 5%, and there are no observable patterns in the plots of the residuals versus the predicted values and versus the order of the observations. Therefore, valid inferences can be made from the estimated models. The estimated differences in mean drop-out rates for the quintiles and grades and the school variable are reported in Table 3.

Table 3: Estimated variable and differences in dropout rates.

Variables	**Estimate**	**Pr(>|z|)**
School Index	0.4728	<0.0001*
Grade10-11 and Grade11-12	0.0880	0.0016*
Quintile 1 and Quintile 2	0.1588	<0.0001*
Quintile 1 and Quintile 3	0.2149	<0.0001*
Quintile 1 and Quintile 4	0.3237	<0.0001*
Quintile 1 and Quintile 5	0.2537	<0.0001*
Quintile 2 and Quintile 3	0.0561	0.5010
Quintile 2 and Quintile 4	0.1648	0.0001*
Quintile 2 and Quintile 5	0.0949	0.0473*
Quintile 3 and Quintile 4	0.1088	0.0455*
Quintile 3 and Quintile 5	0.0388	0.8065
Quintile 4 and Quintile 5	-0.0700	0.2523

**Indicates the variable is significant at 5%.*

It can be observed that the differences in the dropout rate between grade 10 to 11 and grade 12 to is about 9% significantly higher. This could be due to factors such as difficulty in the curriculum content of grade 11 compared to

grade 12 or lack of adequate foundation in grade 10 which makes the student lose interest and drop out, as confirmed by the findings of the qualitative analysis in this study.

Within the poor schools (quintile 1-3), the differences in the drop-out rate between quintiles 2 and 3 is not significant but they are significant between quintile 1 and 2 and quintile 1 and 3. This could be explained by the fact that the socioeconomic statuses of the quintile 2 and 3 schools are not much different from each other but much better than the quintile 1 schools. Thus, socioeconomic barriers that affect parental support and participation in the school activities of students from quintile 1 schools are much severe compared to the barriers for parents from quintile 2 and 3 schools. Consequently, parents of students from quintile 2 and 3 schools are in a better position to support and participate in the learning process of their children, which may lead to sustained interest and confidence in mathematics, which may significantly reduce the dropout rates.

Furthermore, observations from Table 3 indicate that except for quintiles 3 and 4, the differences between dropout rates of the poor schools (quintiles 2-3) and the elite schools (quintile 4 and 5) are significant. The elite schools are mostly located in communities where the parents of the students are mostly the middle, working or the affluent class. Such parents are usually informed about the need to support and be actively involved in their children's school. In addition, parents usually have the resources to support and participate in their children's school activities. Since they pay school fees, they also take keen interest in the children's studies to safeguard their performance. Unlike the poor schools, the children in the elite schools may have their parents or other prominent community members as their role models, which in turn may extrinsically motivate them in taking keen interest in the study of mathematics and the other school subjects, thus keeping the dropout rates low in comparison to the poor schools. Although quintile 3 schools are categorized into the poor schools, they sit at the top of the poor group. Some of the parents of the students within this quintile may be involved in lucrative formal and informal activities, and since they do not pay school fees, they may have an advantage in terms of resources to support and participate in the learning processes of their children; thus, the insignificant difference in the dropout rates within the quintile 3 and 4 schools is not surprising.

Among the elite groups since most parents have the necessary socio-economic means to support their children and they are also well informed about the role of parental support and participation in school activities, it comes as no surprise that the differences in the drop-out rates are not significant. The existence of the differences (although not significant) however may be due to other factors that may be school-specific, such as experienced teachers who are able to motivate and sustain interest of students throughout the lessons. This is because a school index as a variable considered in the modelling process as indicated in Table 3 is found to be a significant contributor of dropout rates because its *p-value* is less than 5%. This observation supports Finn & Voelkl (1993) claim that school factors influence student participation.

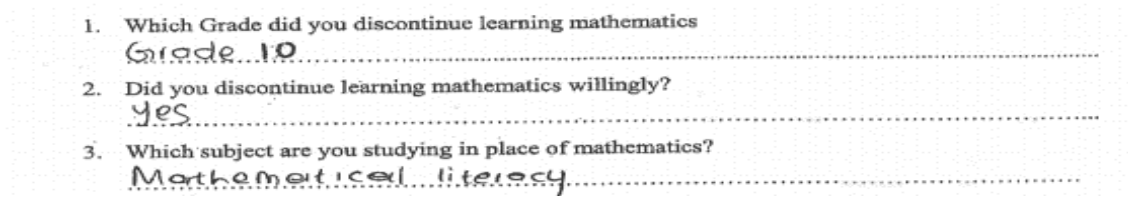
5 Conclusion and Recommendation

This study established that the negative attitudes of students toward mathematics and how learners are guided to learn mathematics were the main reasons why the number of high school mathematics learners always declines throughout the FET phase. This study determined that students are faced with learning difficulties in mathematics and that was the main reason they develop negative attitudes toward the subject, which in turn discouraged them from continuing learning the subject. Students' negative attitude towards mathematics can be corrected; therefore, the researchers recommend that teachers must be guided to implement appropriate instructional approaches in mathematics classrooms in schools in South Africa. This study has established that ineffective instructional approaches that have been employed in mathematics classrooms contribute to students' attrition and underperformance in mathematics. The statistical analysis conducted in this study informs that dropout rates differ significantly across the FET phase and within the quintile categories of the schools. We noted that there is a significant difference in dropout rates between elite schools (quintile 4 and 5) and some poor schools (quintile 1 and 2). These statistical findings highlight that: (1) the school as a variable influences students' participation; (2) parents' socioeconomic standing influence their support and participation impacting students' dropout rates. In conclusion, the researchers, recommend that teachers must be guided to implement appropriate instructional approaches in mathematics classrooms in schools in South Africa. Furthermore, it is recommended that relentless efforts should be made by schools in quintiles 1-3 to educate parents on the need to actively participate in their children's school activities and to encourage them to support their children by supervising their school activities when they are at home. The government should also assist and empower the school governing boards which comprise community members to actively engage with parents to find out how they can support them in playing active roles in their children's school activities.

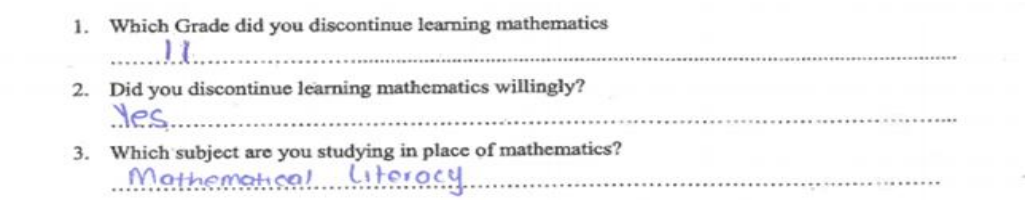
Appendix

Appendix 1: Excerpts of the actual responses to Questions 1 to 3.

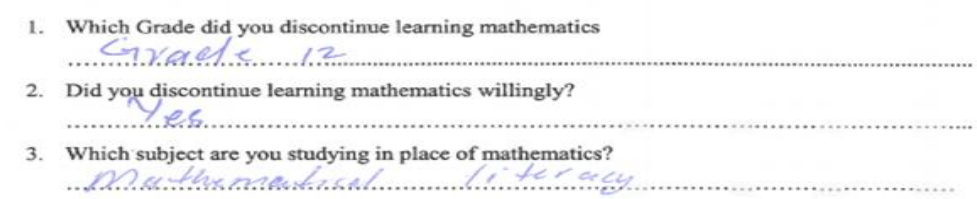
Scan 1: Actual responses of a respondent who left mathematics at Grade 10


1. Which Grade did you discontinue learning mathematics
Grade 10
2. Did you discontinue learning mathematics willingly?
yes
3. Which subject are you studying in place of mathematics?
Mathematical literacy

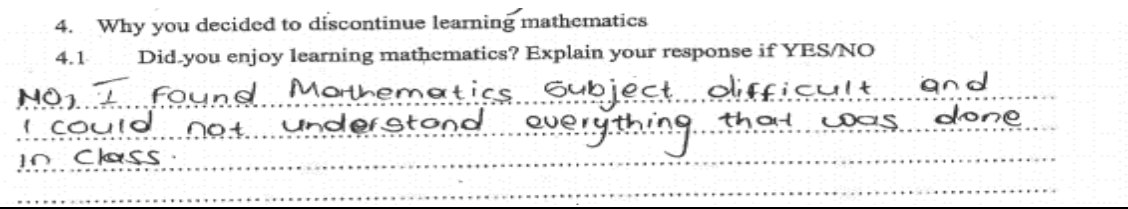
Scan 2: Actual responses of a respondent who exited mathematics at grade 11.


1. Which Grade did you discontinue learning mathematics
11
2. Did you discontinue learning mathematics willingly?
Yes
3. Which subject are you studying in place of mathematics?
Mathematical Literacy

Scan 3: Actual responses of a respondent who left mathematics at Grade 12

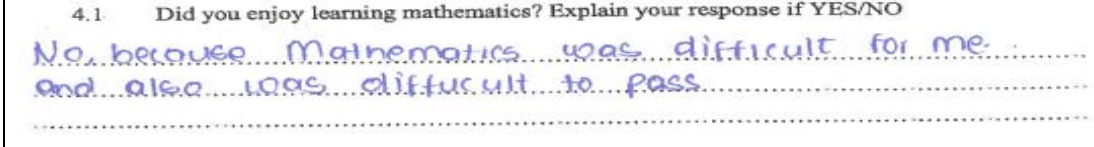

1. Which Grade did you discontinue learning mathematics
Grade 12
2. Did you discontinue learning mathematics willingly?
Yes
3. Which subject are you studying in place of mathematics?
Mathematical literacy

Scan 4: Actual responses of a respondent who left mathematics at Grade 10

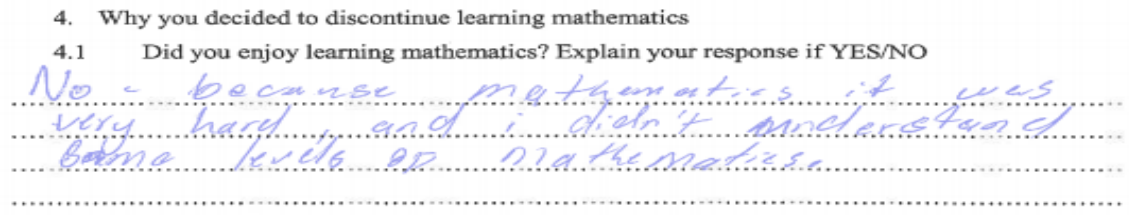

4. Why you decided to discontinue learning mathematics
4.1 Did you enjoy learning mathematics? Explain your response if YES/NO
NO, I found Mathematics subject difficult and I could not understand everything that was done in class.

Appendix 2: Excerpts of the actual responses to question 4.

Scan 5: Actual responses of a respondent who exited mathematics at grade 11.


4.1 Did you enjoy learning mathematics? Explain your response if YES/NO
No, because Mathematics was difficult for me and also was difficult to pass.

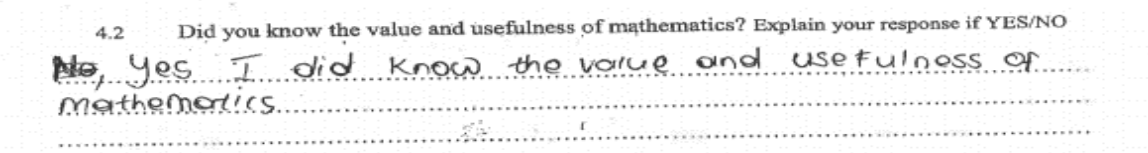
Scan 6: Actual responses of a respondent who left mathematics at Grade 12


4. Why you decided to discontinue learning mathematics

4.1 Did you enjoy learning mathematics? Explain your response if YES/NO

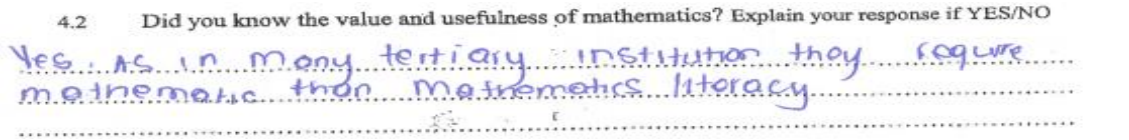
No - because mathematics it was very hard, and i didn't understand some levels of mathematics.

Scan 7: Actual responses of a respondent who left mathematics at Grade 10


4.2 Did you know the value and usefulness of mathematics? Explain your response if YES/NO

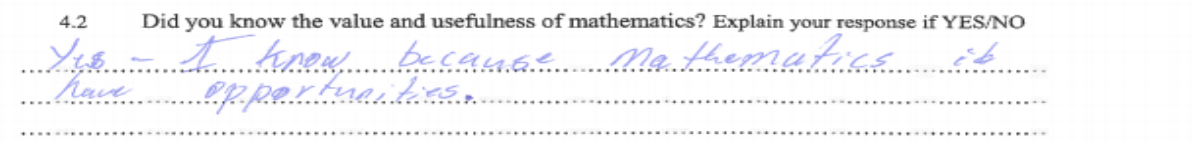
~~No~~, Yes I did know the value and usefulness of mathematics

Scan 8: Actual responses of a respondent who exited mathematics at grade 11.


4.2 Did you know the value and usefulness of mathematics? Explain your response if YES/NO

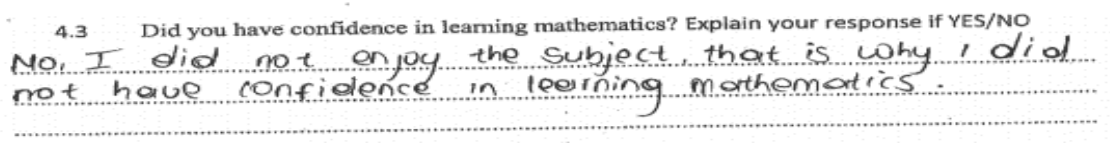
Yes. As in many tertiary institution they require mathematic than mathematics literacy

Scan 9: Actual responses of a respondent who left mathematics at Grade 12


4.2 Did you know the value and usefulness of mathematics? Explain your response if YES/NO

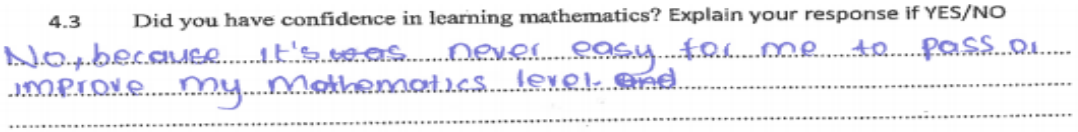
Yes - I know because mathematics is have opportunities.

Scan 10: Actual responses of a respondent who left mathematics at Grade 10


4.3 Did you have confidence in learning mathematics? Explain your response if YES/NO

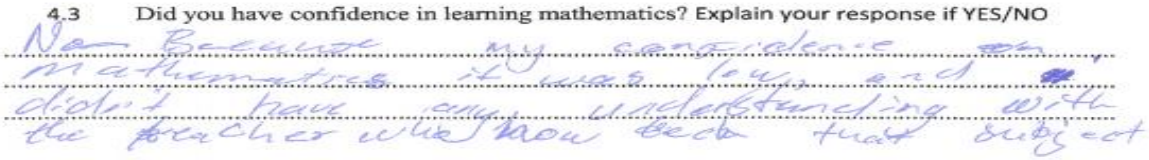
No, I did not enjoy the subject, that is why I did not have confidence in learning mathematics.

Scan 11: Actual responses of a respondent who exited mathematics at grade 11.


4.3 Did you have confidence in learning mathematics? Explain your response if YES/NO

No, because it's was never easy for me to pass or improve my Mathematics level. and

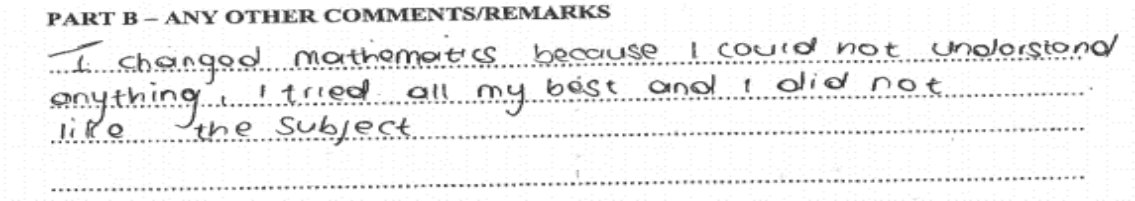
Scan 12: Actual responses of a respondent who left mathematics at Grade 12


4.3 Did you have confidence in learning mathematics? Explain your response if YES/NO

No Because my confidence on mathematics I was low, and I didn't have any understanding with the teacher who know beda that subject

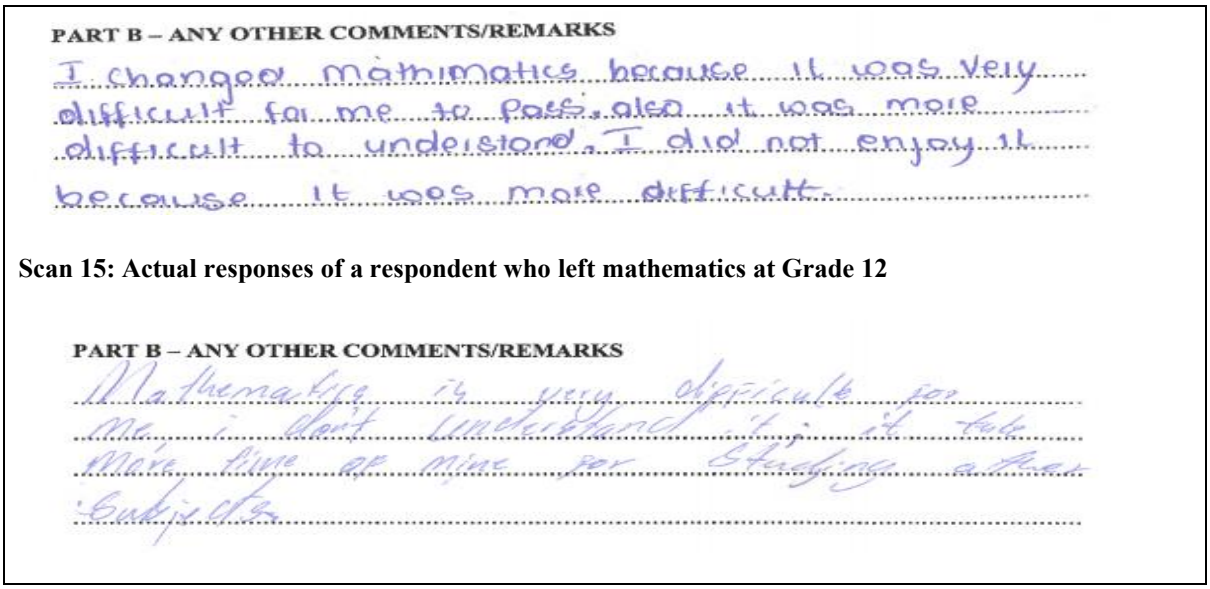
Appendix 3: Excerpts of the actual responses to question 4.

Scan 13: Actual responses of a respondent who left mathematics at Grade 10


PART B – ANY OTHER COMMENTS/REMARKS

I changed mathematics because I could not understand anything, I tried all my best and I did not like the subject

Scan 14: Actual responses of a respondent who exited mathematics at grade 11.


PART B – ANY OTHER COMMENTS/REMARKS

I changed mathematics because it was very difficult for me to pass. also it was more difficult to understand. I did not enjoy it because it was more difficult.

Scan 15: Actual responses of a respondent who left mathematics at Grade 12

PART B – ANY OTHER COMMENTS/REMARKS

Mathematics is very difficult for me i dont understand it it take more time of mine for studying other subjects

References

Abakah, F. & Brijlall, D. (2022). Conjecturing An Effective Problem-Solving Heuristic Instructional Approach For Circle Geometry. Journal of Positive School Psychology (JPSP), ISSN: 2717-7564. Retrieved from https://www.journalppw.com/index.php/ jpsp/

Abakah, F. (2023). Finding an effective problem-solving heuristic instructional approach for circle geometry. Thesis submitted to the University of South Africa for the degree of Doctor of Philosophy. URI: https://hdl.handle.net/10500/30053.

Ahmed, Q. W., Rönkä, A., Perälä-Littunen, S., & Eerola, P. (2024). Parents' involvement in their children's education: Narratives from rural Pakistan. Educational Research, 66(1), 34–50. https://doi.org/10.1080/00131881.2024.2305821

Amelink, C.T. (2012) Female Interest in Mathematics. In B. Bogue & E. Cady (Eds.), Apply ResearchtoPractice(ARP)Resources.Retrievedfrom:http://www.engr.psu.edu/AWE/ARPRResources.aspx.

Audsley, S.M. (2019). 6 Reasons to Study Mathematics. Retrieved from https://www.phdstudies.com/article/6-reasons-to-study-mathematics.

Beethoven, S. & Dekkers, H. (2005). The Influence of Participation, Identification, and Parental Resources on the Early School Leaving of Boys in the Lower Educational Track. European Educational Research Journal, Volume 4, Number 3.

Brijlall, D. (2015). Exploring The Stages of Polya's Problem-solving Model during Collaborative Learning: A Case of Fractions. Department of Mathematics, Durban University of Technology, South Africa.

Cribari-Neto, F., & Zeileis, A. (2010). "Beta Regression in R." Journal of Statistical Software 34: 1–24.

Dahiya, V. (2014). Why Study Mathematics? Applications of Mathematics in Our Daily Life. IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 1 Issue 10, December 2014. www.ijiset.com ISSN 2348 – 7968.

Department of Basic Education. (2018). Mathematics Teaching and Learning Framework for South Africa: Teaching Mathematics for Understanding. Pretoria: DBE.

Department of Basic Education. (2021). National Policy Pertaining To The Programme And Promotion Requirements Of The National Curriculum Statement. Grades R - 12 Grades 10-12. Pretoria: DBE.

Di Martino P., Zan R. (2010). 'Me and maths': toward a definition of attitude grounded on students' narratives), vol.13, n.1, pp. 27-48.

Dietrich, J., Dicke, A.-L., Kracke, B., & Noack, P. (2015). Teacher support and its influence on students' intrinsic value and effort: Dimensional comparison effects across subjects. Learning and Instruction, 39, 45–54. https://doi.org/10.1016/j.learninstruc.2015.05.007

Dietrich, J., Dicke, A.-L., Kracke, B., & Noack, P. (2015). Teacher support and its influence on students' intrinsic value and effort: Dimensional comparison effects across subjects. Learning and Instruction, 39, 45–54. https://doi.org/10.1016/j.learninstruc.2015.05.007

Fan, W., & Williams, C. (2010). The effects of parental involvement on students' academic self-efficacy, engagement, and intrinsic motivation. Educational Psychology, 30(1), 53-74. doi: 10.1080/01443410903353302.

Finn, J.D. & Voelkl, K.E. (1993). School Characteristics Related to Student Engagement, Journal of Negro Education, 62(3), pp. 249–268.

Geissinger, E. A., Khoo, C. L. L., Richmond, I. C., Faulkner, S. J. M., & Schneider, D. C. (2022). A case for beta regression in the natural sciences. Ecosphere, 13(2), e3940. https://doi.org/10.1002/ecs2.3940

Goldin, G. A., Hannula, M. S., Heyd-Metzuyanim, E., Jansen, A., Kaasila, R., Lutovac, S., & Zhang, Q. (2016). Attitudes, beliefs, motivation, and identity in mathematics education: An overview of the field and future directions. ICME-13 topical survey. Cham, Switzerland: Springer.

Gülhan, F. (2023). Parental Involvement in STEM Education: A Systematic Literature Review.European Journal of STEM Education, 8(1), 05. https://doi.org/10.20897/ejsteme/13506.

Gulnaz, M. & Fatima, R. (2019). A Study of Finding the Reasons of not Choosing Mathematics at Senior Secondary Level by Girls in Nawada District of Bihar. Pedagogical Research, 4(4), em0043. https://doi.org/10.29333/pr/5899. issue/view /33.Vol. 6, No. 6, 8933-8946.

Katz, I., Kaplan, A., & Gueta, G. (2009). Students' Needs, Teachers' Support, and Motivation for Doing Homework: A Cross-Sectional Study. The Journal of Experimental Education, 78(2), 246–267. https://doi.org/10.1080/00220970903292868

Khanum, S. (2006). Problem solving in primary school children (unpublished MPhil thesis). National Institute of Psychology Quaid-e-Azam University Islamabad.P- 227.

Kuru Cetin, S., & Taskin, P. (2016). Parent involvement in education in terms of their socio-economic status. Eurasian Journal of Educational Research, 66, 105-122 http://dx.doi.org/10.14689/ejer.2016.66.6.

Luxomo, G., & Motala, S. (2012). Finding Place and Keeping Pace: Exploring Meaningful and Equitable Learning in South African Schools – The Human Sciences Research Council (HSRC). https://www.hsrcpress.ac.za/books/finding-place-and-keeping-pace-1

Mabonga, G. (2021). Children's prior knowledge is very important in Teaching and learning in this era of constructivism. Aga Khan University, Tanzania. DOI: 10.13140/RG.2.2.28470.22083.

Makondo, P. V. & Makondo D. (2020). Causes of Poor Academic Performance in Mathematics at Ordinary Level: A Case of Mavuzani High School, Zimbabwe. International Journal of Humanities and Social Science Invention (IJHSSI) ISSN (Online): 2319 – 7722, ISSN (Print): 2319 – 7714 www.ijhssi.org ||Volume 9 Issue 6 Ser. I || June 2020 || PP10-18.

McDowall, P. S., & Schaughency, E. (2017). Elementary school parent engagement efforts: Relations with educator perceptions and school characteristics. The Journal of Educational Research, 110(4), 348–365. https://doi.org/10.1080/00220671.2015.1103687

Mensah, J. K., Okyere M. & Kuranchie, A. (2013). Student attitude towards Mathematics and performance: Does the teacher attitude matter? Journal of Education and Practice www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) Vol.4, No.3, 2013.

Mertler, C. (2014). Action research: Improving schools and empowering educators. Thousand Oaks, CA: Sage.

Mullis, I. V. S., Martin, M. O., Foy, P., Kelly, D. L., & Fishbein, B. (2020). TIMSS 2019 international results in mathematics and science. Paper presented at the TIMSS & PIRLS International Association for the Evaluation of Educational Achievement.

National Council of Teachers of Mathematics (2014). Principles to Actions: Ensuring Mathematical Success for All. Reston, VA: NCTM.

National Numeracy, (2022). Attitudes Towards Maths: Research & Approach overview. Retrieved from: www.nationalnumeracy.org.uk/attitudes-to-maths.

Onwuka, G. O.; Oladele, O. M.; & Zuoyu, Z. (2019). Unveiling the experiences of student participation in extracurricular activities on campus: a case study in university of cape coast, Ghana. Journal of the International Academy for Case Studies Volume 25, Issue 4, 2019 1 1532-5822-25-4-154.

Pournara, C., Hodgen, J., Adler, J., & Pillay, V. (2015). Can improving teachers' knowledge of mathematics lead to gains in learners' attainment in Mathematics? South African Journal of Education, 35(3), 1–10. https://doi.org/10.15700/SAJE.V35N3A1083

Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. Journal of Educational Psychology, 98(1), 209–218. https://doi.org/10.1037/0022-0663.98.1.209

Shepherd, D. (2013). The impact of teacher subject knowledge on learner performance in South Africa: A within-pupil across-subject approach. International Workshop on Applied Economics of Education, 1–32.

Simegn, Engida & Asfaw, Zeytu & Gashaw, Zeytu. (2017). Assessing the Influence of Attitude Towards Mathematics on Achievement of Grade 10 and 12 Female Students in Comparison with Their Male Counterparts: Wolkite, Ethiopia. 56-69.

Small, R. (2022). SAIPA: Centre of Future Excellence. Retrieved from https://businesstech.co.za/news/business/600426/south-africas-declining-mathematics-numbers-a-concern/.

Stott, A., Dreyer, H. & Venter, P. (2015). Consequences of the progression law in the FET phase: a case study. Journal of Education. 10.17159/i63a04.

Tang, T.T & Tran D.H.T. (2023). Parental influence on high school students' mathematics performance. EURASIA J Math Sci Tech Ed, 2023, 19(4), em2249. EURASIA Journal of Mathematics, Science and Technology Education, 2023, 19(4), em2249 ISSN:1305-8223 (online) OPEN ACCESS Research Paper https://doi.org/10.29333/ejmste/13068.

Volmink, J. (2020). Council for Quality Assurance in General and Further Education and Training, Umalusi, Pretoria, South Africa. Retrieved from https://www.timeslive.co.za/news/south-africa/2020-01-03-maths-teachers-must-teach-differently-says-umalusi- after-poor-matric-results/#.

Wilson, R. & Mack, J. (2014). Declines in High School Mathematics and Science Participation: Evidence of Students' and Future Teachers' Disengagement with Maths. International Journal of Innovation in Science and Mathematics Education, 22(7), 35-48, 2014.

Yadav, S. (2019). Role of mathematics in the development of society. 9 International Journal of Research and Analytical Reviews (IJRAR), Volume 6, Issue 4 www.ijrar.org (E-ISSN 2348-1269, P- ISSN 2349-5138).

The learning styles approach to math instruction: Improving math achievement and motivation among low achievers in Kuwaiti elementary schools

Eisa Albalhan
Kuwait University

Abstract

This study introduced learning styles techniques into mathematics teaching to improve mathematics achievement and motivation among Kuwaiti fourth- and fifth-grade low achievers. The study consisted of two groups. The control group (N = 212) received traditional math tutoring based on a textbook and the tutor's knowledge of math. The experimental group (N = 209) received math tutoring from instructors trained in the Learning Style™ approach. Three instruments were used: Motivation Scale towards Mathematics; Achievement in Mathematics Test; and the manual of learning style approach indicating the individual's preferred learning style: AKV, AVK, KAV, KVA, VAK, or VKA. The participating teachers taught the detected learning style of each student or group. The findings show significant improvement in achievement and motivation towards mathematics in the experimental group. The outcome offers information to variables affecting achievement and motivation towards mathematics and demonstrates the leading role of Kuwait in education within the region.

Keywords: elementary school, learning style, math low achievers, SmartWired™, math instruction, and motivation

Building A Culture Of Knowledge Management To Improve Job Performance Of Non-Academic Staff In Tertiary Institutions: Imperative For School Effectiveness

ADELEKE Foluso Florence, Dr. (Mrs)
Department of Educational Management,
Faculty of Education, Ekiti State University,
Ado-Ekiti, Nigeria
foluso.adeleke@eksu.edu.ng

Abstract

The study examined the relationship between knowledge management and job performance of non-academic staff of tertiary institutions in Ekiti State, Nigeria. The study adopted a descriptive survey of research design. The population consisted of 5328 non-academic staff in the public tertiary institutions in Ekiti State. The sample for the study consisted of 480 selected from four tertiary institutions in Ekiti State. The purposive random sampling technique was used to select two universities which are one federal university and one state university. The only public polytechnic and college of education were purposively selected. This implies that two public universities, one polytechnic and one college of education were selected. Proportionate random sampling technique was used to select 142 non-academic staff from State University, 131 from Federal University, 121 from polytechnic and 86 from college of education. Two instruments tagged: 'Knowledge Management Questionnaire" (KMQ) and "Non-Academic Staff Job Performance Questionnaire" (NASJPQ) were used to collect data for the study. Face and content validity of the instruments were ensured by experts. The test-retest method of reliability was adopted to determine the reliability coefficient of (0.81) for KMQ and (0.79) for NASJPQ. The data collected were analyzed using Pearson Product Moment Correlation (PPMC). The hypotheses formulated were tested at 0.05 level of significance. The finding revealed the significance of the relationship between knowledge management and non-Academic staff job performance in tertiary institutions. Based on the findings of this study, it was recommended among others that management of tertiary institutions need to maximize organizational knowledge to gain an edge in today's competitive global marketplace and build robust knowledge management strategies that can add value to the job performance of staff and invariably impact school effectiveness.

Keywords: Knowledge management, job performance, knowledge utilization, tertiary institution, non-academic staff

Introduction

The relevance of education to economic, industrial and technology development of Nigeria and other countries of the world cannot be overemphasized. Tertiary institutions have pre-determined goals and objectives they intend to achieve. The major determinant of tertiary institutions is the presence of human resources with the appropriate skills to combine with organizational goals and objectives. The non-academic staff of tertiary institutions are employed for the primary purpose, and they are expected to be well equipped and to be more effective in carrying out their assignments. They as well responsible for the day-to-day operations of the institution and they provide advice and support for current and prospective students and academic staff in all matters relating to studying at the institution such as: administrative matters, record keeping, typing and collation of admission lists, production of examination materials, assisting in recruitment of staff, provision of welfare services, among others.

Leaders of successful organizations are consistently looking for better ways to improve performance and results. Employee job performance is frequently interpreted as representative of the organization's performance and

has a direct impact on the organization's image (Silitonga and Sadeli, 2020). Job performance is an aggregate of employee behaviours that have some expected value to organizations either positive or negative. Job performance assesses whether a person performs a job well. It has been observed by the researcher that poor performance among non-academic staff is exhibited through a high level of incompetence and lack of innovation among non-academic staff of tertiary institutions. This poor performance observed may be attributed to deterioration in individual employee performance due to inadequate knowledge management practices in the institutions.

Knowledge management (KM) is the process of capturing, distributing, and effectively utilizing knowledge within an organization. It involves creating systems and practices to collect both explicit and tacit knowledge. Explicit knowledge includes documents, reports, and databases, while tacit knowledge includes expertise, experience, and insights gained by individuals. This knowledge is expected to be shared, stored, and applied to improve decision-making, innovation, and performance. Several authors have contributed to the development and understanding of knowledge management over the years. Nonaka and Takeuchi (1995) focused on the knowledge creation as the process of amplifying the knowledge assets of an organization by converting the tacit knowledge of individuals into explicit knowledge. Wiig (1997) also emphasizes knowledge management as the process of organizing, sharing, and utilizing knowledge to support organizational goals. The contribution of knowledge management to job performance has been well-documented in academic literature. Several researchers have explored how Knowledge management practices influence job performance, highlighting various mechanisms like knowledge sharing, decision-making and organizational learning among others. Nonaka and Takeuchi (1995) discussed how organizations can enhance job performance by creating and sharing knowledge effectively. They highlight how the dynamic process of knowledge creation improves both individual and organizational performance by making tactic knowledge accessible and actionable.

Crucial gap has been identified by Ojo (2016) in knowledge management processes at tertiary institutions and emphasizing the need for strategic implementation to achieve competitive advantage and enhance performance and innovation. Nonaka and Takeuchi (2018) introduced the concept of knowledge management and outlined a framework known as the SECI Model (Socialization, Externalization, Combination, and Internalization), which emphasizes the dynamic interaction between tacit and explicit knowledge. Some individuals uses tactic knowledge which is the kind of knowledge that is not written and used only by verbalizing the knowledge. This can lead to difficulties acceptance for other people, because there is no written information that can be used or read over in a long time; only the person who knows about the knowledge can keep it, but it will remain in the mind. It is gained through personal experience. Explicit knowledge is formalized, codified, and easily communicated in form of documents, databases, and manuals.

Knowledge utilization in the tertiary institutions involves the practical application of both tacit and explicit knowledge, positively impacting project management, performance enhancement and capability development. Knowledge utilization refers to the process of applying acquired knowledge, skills and expertise to perform tasks effectively and achieve organizational goals and objectives. Buchanan et al. (2010) usefully described three types of initiatives that have been undertaken to improve levels of knowledge utilization: improving behavioural skills to make full use of workers' capabilities, linking workforce with industry development, broadening the focus; for example, initiatives to nurture better skills ecosystem. The effective utilization of knowledge helps in solving problems, decision making, innovation, and skill development. The work of Nonaka & Takeuchi (1995) highlights that knowledge utilization fosters innovation and problem-solving and more effective decision-making, leading to improved performance. Moreover, Nonaka and Takeuchi (2007) illustrate in their knowledge management theory, the conversion of tacit knowledge (personal, experimental knowledge) to explicit knowledge (formal, systematic knowledge) as a dynamic process that contributes positively to organizational learning and performance. Observation shows that challenge arises when there is a failure to utilize the knowledge gained effectively. It appears that not all non-academic staff in the tertiary institution always apply their accumulated knowledge effectively, and this may lead to poor job performance. Nevertheless, the inability of the non-academic staff to use their knowledge effectively might be due to various factors such as: lack of encouragement on the part of the employers to apply knowledge in new or challenging scenarios, inadequate training in knowledge management or insufficient systems to capture and disseminate knowledge effectively within the system. A focus on individuals needing both the motivation and opportunity to deploy their skills effectively, and how to foster this, has been highlighted in the UK (Chartered Institute of personnel and Development, 2018) as effective reward and performance management system. In view of the above, there is need to know the relationship between knowledge management and job performance of non-academic staff in tertiary institutions in Ekiti State, Nigeria.

Statement of the problem

The continuous discouraging job performance of non-academic staff in the Tertiary institutions has been a major concern in Ekiti State, Nigeria. The administration set up of the tertiary institutions is the power that should facilitate the smooth running of the entire system. There seems to be decay in the system operation in the tertiary institutions in Ekiti State, Nigeria. It was observed by some stakeholders vis-à-vis students, academic staff, head of units, old students and parents that some non-academic staff appear not to be adequately committed to their duties. The delivery service at the non-academic disposal seems not to be effectively and efficiently handled. Both students and staff records appear to be improperly handled or kept by the non-academic staff in the universities. The long period attached to response given to any written letters to the central administration is equally observed. Poor filing and retrieval of documents is nothing to write home about. Loss of important information on transit was observed. Records are not kept in a timely manner, and this could lead to losing critical data or information. Poor and delays in processing or retrieving information could impact customer service negatively. Customer dissatisfaction caused by the non-academic staff in the university due to their poor attitude to work has been observed by the researcher. Students' notification of results, certificates and transcripts seems not issued as and when due and this has subsequently reduced the number of new intakes, most especially at the postgraduate level. Vital information is mismanaged and gets lost in transit, because of the poor attitude to work. It appears that the observed low job performance of non-academic staff could be linked with the inability of involvement in knowledge management which seems to be reflected in the knowledge utilization, which in turn seems to affect the performance in the entire system.

Research Hypotheses:

The following research hypotheses were formulated to guide the study:

1. There is no significant relationship between knowledge management and non-academic staff job performance in tertiary institutions in Ekiti State, Nigeria.
2. There is no significant relationship between knowledge utilization and non-academic staff job performance.

Methodology

The study adopted descriptive research design of the survey type. The population consisted of 5,328 non-academic staff in the public tertiary institutions in Ekiti State, Nigeria. The sample for the study consisted of 480 non-academic staff selected from four tertiary institutions in Ekiti State. The purposive random sampling was used to select 2 public universities which is one Federal and 1 State universities. The only public polytechnic and college of education were purposively selected. Proportionate random sampling technique was used to select 142 non-academic staff from State University, 131 from federal University, 121 from polytechnic and 86 from college of education. Forty head of units were purposively selected to rate the job performance of non-teaching staff. Two instruments tagged: 'Knowledge Management Questionnaire" (KMQ) and "Non-Academic Staff Job Performance Questionnaire" (NASJPQ) were used to collect data for the study. Face and content validity of the instruments were ensured by experts. The test-retest method of reliability was adopted to determine the reliability coefficient of (0.81) for KMQ and (0.79) for NASJPQ. The data collected were analyzed using Pearson Product Moment Correlation (PPMC). The hypotheses formulated were tested at 0.05 level of significance.

Results

Testing of Hypotheses:

Hypothesis 1: There is no significant relationship between knowledge management and job performance of non-academic staff of tertiary institutions in Ekiti State, Nigeria.

To test this hypothesis, Pearson Product Moment Correlation was used, and the result is presented in Table 1.

Table 1: Relationship between Knowledge Management and Job Performance of Non-Academic Staff

Variable	N	Mean	SD	r-cal	P-value
Knowledge Management	480	3.68	0.17	0.144*	0.02
Non-academic staff job performance	480	9.64	1.48		

P<0.05

Table 1 showed that the r-cal value of 0.144 is significant at 0.05 level of significance, because P-value (0.02) < 0.05. The null hypothesis was therefore rejected. This implies that there was a significant relationship between knowledge management and non-academic staff job performance.

Hypothesis 2: There is no significant relationship between knowledge utilization and non-academic staff job performance.

Table 2: Relationship between Knowledge Utilization and Non-Academic Staff Job Performance

Variable	N	Mean	SD	r-cal	P-value
Knowledge Utilization	480	17.27	1.72	0.121*	0.000
Non-academic staff job performance	480	94.95	5.85		

P<0.05

Table 2 showed that the r-cal value of 0.121 was significant at 0.05 level of significance because, P-value (0.000) < 0.05. The null hypothesis was rejected. This implies that there was a significant relationship between knowledge utilization and non-academic staff job performance.

Discussion

The study revealed that there was significant relationship between knowledge management and non-academic staff job performance in tertiary institutions in Ekiti State, Nigeria. It could be inferred from the finding that the effective management of knowledge resources within these institutions play a crucial role in enhancing the performance of non-academic staff. This finding is in consonance with the finding of Razzaq et al (2019) on public sector employee that knowledge management had a positive and significant impact on employee job performance. The finding is also in line with the findings of Leviadi et al (2024) on research conducted in public sector which stated that knowledge management has a positive and significant relationship on employee performance.

The study revealed that there was significant relationship between knowledge utilization and job performance. The probable reason for this finding is that non-academic staff might be encouraged, motivated and guided to make appropriate use of their knowledge. This finding supported the finding of Okonkwo (2021) who concluded that managers have adequate professional knowledge through training received from self-study, but utilization was poor, because most of the institutions visited do not have facilities that could enhance utilization.

Conclusion

Based on the findings of this study, it was concluded that knowledge management display potent roles in influencing non-academic job performance in tertiary institutions in Ekiti State. Hence, it could be concluded that knowledge management is what the employee needs to interact with to promote non-academic staff job performance in tertiary institutions in Ekiti State, Nigeria.

Recommendations

The following recommendations were made based on the findings:

1. Management of tertiary institutions needs to maximize organizational knowledge to gain an edge in today's competitive global marketplace and build robust knowledge management strategies that can add value to the job performance of staff and invariably impact school effectiveness.
2. Informatics training is required to equip non-academic staff with the skills needed on how to utilize their knowledge and this could be organized through in-serve training.
3. Knowledge management should be encouraged by the employers and make available the resources need at the appropriate time to improve non-academic job performance and invariably impact school effectiveness.

References

Buchanan, J; Scott, L; Yu, S; Schutz, H & Jakubauskas, M. (2010). Skills demand and utilization: an international review of approaches to measurement and policy development, OECD Local Economic and

Employment Development (LEED) working paper, no. 2010/04, OECD, Paris, https://dx.doi.org/10.1787/5km8zddfr2jk-en Uploaded: 3 May 2010.

Chartered Institute of Personnel and Development (2018). Over-skilled and underused: investigating the untapped potential of Uk skills, London, Viewed, 26 July 2019

Leviadi, P. & Aryana, S. (2024). The role of knowledge management, transformational leadership and organizational commitment on employee performance: Empirical study in public sector. *Journal of Theory and Applied Management*, 17(3), 355-371. *Doi:10.20473/jmtt.v7i3.56264*. Updated December, 2024.

Nonaka & Takeuchi (2018). Introduction to "The Nonaka and Takeuchi" knowledge management model. *sis.binus.ac.id/2018*. Updated 5th February 2018

Nonaka, I. & Takeuchi, H. (1995). The knowledge-creating company: How Japanese companies create the dynamics of innovation. Oxford: Oxford University Press.

Nonaka, I. & Takeuchi, H. (2007). The knowledge-creating company: *Harvard business review*, 85(7/8), 162.

Ojo, A. (2016). Knowledge Management in Nigerian Universities. A conceptual model. *Interdisciplinary Journal of information, knowledge, and management*, 11, 331-345. *https://www.informingscience.org/publication/3607*. Retrieved on 10th March, 2022.

Okonkwo, O. C. (2021). ICT knowledge and utilization as determinants of job performance of health information managers in health institutions in South-East Nigeria. *International Journal of Library and Information Science*, 13(2), 21-33. *https://www.academicjournals.org/IJLIS*. Accepted 20th August 2021.

Razzaq, S., Shujahat, M., Hussain, S., Nawaz, F., Wang, M., Ali, M. & Tehseen, S. (2019). Knowledge management, organizational commitment and knowledge-worker performance: the neglected role of knowledge management in the public sector. *Business process management journal*, 25(2) 923-947. *https://doi.org/10.1108/BPM-2018-0079*.

Silitonga, E. W. & Saddi, J. (2020). Factors contributing to employee performance, in contemporary research on business and management (ISCRBM 2019), 27-29, November 2019, Jakarta, Indonesia (P. 15). CRC Press.

Wig, K. M. (1997). Knowledge Management. An *introduction and perspective journal of Knowledge management*, 1(1), 6-14. *https://doi.org/10.1108/13673279710800682*.

Unmasking the Western canon: decolonization of the curriculum as an epistemological balance of knowledge systems.

France Nkokomane Ntloedibe
ntloefn@unisa.ac.za
University of South Africa

Abstract

The debate on the decolonisation of education interrogates the complex dynamics between power, knowledge and pedagogy. Prevailing discussions highlight the dominance of Eurocentric perspectives on knowledge and truth, which perpetuate dehumanising discourses, prompting advocacy for either a decolonised, Africa-centred curriculum or an inclusive approach that integrates the Western canon. This paper critically examines the notion that a decolonised curriculum should merge European knowledge—stripped of its dehumanising elements—with African perspectives. It argues that Western knowledge, when cleansed of its oppressive aspects, can contribute valuable insights that, when integrated with African and global knowledge systems, foster a balanced epistemic environment. The central inquiry guiding this paper is: How can we conceptualise an Africa-centred curriculum that transcends Eurocentric dominance while retaining valuable global insights? Drawing on Mahmood Mamdani's perspective, the paper suggests a nuanced approach to historical legacies, advocating for the retention of relevant elements and the rejection of those that are outdated or harmful.

Keywords: Western canon, African knowledge system, curriculum decolonisation, epistemological balance, democracy, border thinking, Africanisation

INTRODUCTION

The discourse surrounding the decolonisation of education critically addresses the entrenched relationship between power structures, knowledge production and learning paradigms. Scholars, such as Ndlovu-Gatsheni (2018), Asea (2022), Ngugi (1986) and Heleta (2016, 2018) argue that the pervasive Eurocentric and Western monopolies on knowledge and truth necessitate a shift towards a decolonised, Africa-centred curriculum or an inclusive curriculum that also encompasses the dominant Western canon. This paper posits that the existing conceptualisations of a decolonised curriculum, which blend African and European/Western knowledge while excluding their dehumanising elements, have not been sufficiently examined. Despite the inherent biases in Western knowledge against African systems, this paper contends that Western scholarship, once divested of its oppressive components, can be critically integrated with African and other global knowledge systems. This integration aims to achieve an epistemic equilibrium where mutual learning between Africa, Europe and the wider world is possible. The core question addressed is: How can we develop an Africa-centred curriculum that mitigates Eurocentric dominance without disregarding the valuable aspects of global knowledge? This challenge persists partly due to the ongoing entanglement of post-colonial societies with global coloniality. By engaging with the works of scholars like P. du Preez, Jonathan Jansen and le Grange, this paper evaluates the strengths and weaknesses of their arguments regarding curriculum decolonisation. It critiques their methodologies and overgeneralisations, which sometimes obscure rather than clarify the vision for a truly decolonised curriculum and university.

Brief Notes on Oppressive Elements in European/Western Knowledge

The oppressive elements of European/Western knowledge systems are evident in their historical imposition of cultural superiority and systematic marginalisation of non-Western epistemologies. These elements include colonial narratives and historical distortions that have perpetuated degrading depictions of African cultures, histories and identities, as well as other indigenous cultures around the world. For instance, the negative portrayal of Africans, Native Americans, Black Americans, Australian Aborigines and other indigenous societies as primitive, uncivilised, and in need of European intervention has been a central theme in colonial and post-colonial education systems (Conrad, 1841; Spencer & Gillen, 1899; Myrdal, 1944; Herrnstein & Murray, 1994; Roosevelt, 1899; Carroll, 1900; Gray, 1841). Modern scholarship has worked to dismantle the stereotypes evident in these works and provide a better understanding

of diverse cultures. However, some recent narratives continue to portray Africans, Australians, Black Americans and Native Americans as uncivilised and backward. These publications often reflect lingering Eurocentric perspectives and biases, either overtly or subtly, in their content (Herrnstein & Murray, 1994; Tylor, 1997 reprint; Lynn & Vanhanen, 2002; Levin, 2019; Harvard Political Review, 2020). Such narratives justified colonial exploitation and have lingering effects on the self-perception of African students. An example is the depiction of the "White Man's Burden" in colonial literature and history textbooks, which framed colonialism as a benevolent enterprise to civilise African societies (Said, 1978). In history textbooks, colonial conquests are often depicted as bringing "civilisation" to "savage" lands. The biased narratives should be replaced with scholarship that recognises and values the complex histories and cultures of various indigenous groups (Reader, 1997; Clarke, 2019; Alexander, 2010; Behrendt, 2012; Dunbar-Ortiz, 2014). Research shows that students exposed to these one-sided narratives often develop a skewed understanding of their own history and identity (Wa Thiong'o, 1986).

Beyond colonial narratives, racial hierarchies and scientific racism were used to portray Africans and other races negatively. Pseudoscientific theories, such as phrenology and eugenics, were used to justify the superiority of the European race over Africans, Native Americans, Black Americans, Aborigine Australians and other indigenous races. These theories were taught in schools and reinforced racial hierarchies. Texts like "The Inequality of Human Races" by Arthur de Gobineau (1853-1855) propagated racial hierarchies that have been debunked but were influential in educational systems. Additionally, there were texts on human biology and anthropology that once included pseudoscientific theories like phrenology or eugenics. The current scientific consensus rejects these theories as unfounded and harmful. Studies have demonstrated that such content reinforces racial prejudices and has no place in modern education (Gould, 1981). These works should be revised or removed from the curriculum and be replaced with appropriate ones such as Molefi Asante's The History of Africa: The Quest for Eternal Harmony (2007); Jonathan T. Reynolds' Africa in World History: From Prehistory to the Present (2011); Donald R. Wright's The World and a Very Small Place in Africa: A History of Globalization in Niumi, The Gambia (2010); John Reader's Africa: Biography of the Continent (1997); Roland Oliver's The African Experience: From Lucy to the Second Independence; Beverly Daniel Tatum's Why Are All the Black Kids Sitting Together in the Cafeteria? And Other Conversations About Race (1997); Robert Wald Sussman's The Myth of Race: The Troubling Persistence of an Unscientific Idea (2014). ; Ibram X. Kendi's Stamped from the Beginning: The Definitive History of Racist Ideas in America (2016); Robin DiAngelo's White Fragility: Why It's So Hard for White People to Talk About Racism (2018); and Ijeoma Oluo's So You Want to Talk About Race (2018).

Cultural erasure and assimilation policies have also played a role in perpetuating these oppressive elements. Education policies aimed at eradicating indigenous cultures and languages in favour of European norms and languages have contributed to the loss of African cultural heritage. For example, the Bantu Education Act in South Africa, like Jim Crow laws in the USA, aimed to prepare Black students for lives as labourers rather than for higher education or skilled professions (Christie, 1985). Curricula that discourage or exclude the use of indigenous languages in favour of European languages should be revised to include and promote multilingual education, valuing local languages alongside global ones. Research indicates that bilingual education supports better cognitive development and cultural pride among students (Bamgbose, 1991).

While critiquing or removing the oppressive elements from Western knowledge, it is important to recognise and retain its valuable contributions that can enhance a decolonised curriculum. Scientific advancements are among these contributions. Western science has made significant contributions to various fields such as medicine, technology and environmental science. These advancements can be critically integrated with African scientific achievements to address local and global challenges. For instance, the integration of Western medical practices with traditional African medicine to improve healthcare outcomes (Gyasi et al., 2011). Western philosophical and ethical frameworks also offer valuable tools for analysing and addressing contemporary social issues. For example, the use of critical theory in deconstructing power dynamics and promoting social justice (Habermas, 1984). Technological innovations developed in the West can be adapted and applied to support sustainable development in African, Asian, Native American and other contexts. For example, the application of renewable energy technologies developed in the West to address energy poverty in Africa (IRENA, 2015). Educational methodologies such as problem-based learning and experiential learning can be beneficial in fostering critical thinking and practical skills among students. An example

is the implementation of problem-based learning in African universities to enhance student engagement and learning outcomes (Barrows, 1996).

Roman and Greek civilisations are frequently regarded as foundational to Western (European) civilisation due to their profound influence on European culture, law, politics, philosophy and the arts (Herodotus, 1920; Livy 1982). Originating in the Mediterranean region, their substantial impact on European development renders them integral to understanding European heritage (Tacitus, 1964; Plutarch, 2001). Similarly, the Phoenicians, based in the Eastern Mediterranean (modern-day Lebanon), significantly influenced Mediterranean and European societies through their extensive trade networks and cultural exchanges. Their contributions to the alphabet and maritime trade are critical components of European historical development (Pliny the Elder, 1855). While acknowledging the contributions of various groups, the classification of Roman, Greek and Phoenician civilisations as part of European history is based on their profound impact on European development. This classification should not marginalise other contributions but rather situate these civilisations within the context of their influence on Europe (Apuleius, 1998; Ptolemy, 1932).

The study of Roman and Greek civilisations, which often portrayed Africans negatively, raises questions about how to create an epistemologically balanced cu1rriculum. Recognising the interconnectedness of ancient civilisations with indigenous non-Western peoples will encourage a more comprehensive understanding of history that includes the contributions of various cultures and regions. This approach combats the notion of isolated, monolithic civilisations and promotes a more integrated view of world history. For instance, learning about Roman, Greek and Phoenician civilisations provides students with foundational knowledge of significant philosophical, political and scientific ideas that have shaped modern thought and governance. This knowledge is crucial for understanding the roots of many contemporary institutions and practices. However, studying European civilisations alongside African, Asian and other global civilisations allows students to gain a broader perspective on human history and cultural development. This comparative approach fosters a deeper appreciation of the diversity and interconnectedness of human experiences. A balanced curriculum should incorporate the best aspects of both African and European knowledge systems. This involves critically examining and integrating the valuable contributions of various civilisations while addressing and removing any oppressive or harmful elements. For instance, combining the philosophical contributions of ancient Greek thinkers with African philosophical traditions can enrich students' understanding of ethics, governance, and the human condition.

Creating a balanced curriculum necessitates addressing the Eurocentrism inherent in classical civilisation studies. Eurocentrism, a perspective that emphasises European achievements and often downplays or ignores contributions from other cultures, including African societies, pervades these narratives. For instance, classical antiquity narratives often centre on the achievements of Greece and Rome without acknowledging their interactions and exchanges with African civilisations. This was evident in works of Herodotus (1920), Livy (1982), Tacitus (1964), Plutarch (2002) and Juvenal (2014). Additionally, 18th-century Eurocentric scholarship, such as Edward Gibbon's "The History of the Decline and Fall of the Roman Empire," often ignored the contributions of African and other non-European cultures to the development and sustainability of the Roman Empire. By the 19th and 20th centuries, numerous texts influenced by colonialist and imperialist ideologies further entrenched this view, presenting Greek and Roman civilisations as the foundation of Western culture with minimal recognition of African contributions. Notable works include George Grote's "A History of Greece (1846-1856).

By the 20th century, texts such as Henry Smith Williams's "The Historians' History of the World," (1907-1908); William C. Morey's "Outlines of Ancient History" (1904) and James Henry Breasted's "A History of Ancient History" (1905) continued to shape public perception and academic discourse for generations.

Modern scholarship has increasingly challenged and debunked these stereotypes, recognising the interconnectedness of ancient cultures and the significant influence of African civilisations on Greek and Roman societies (Bernal, 1987; Bindman and Gates Jr (2010). To explore African contributions to Greek and Roman civilisations, students should examine a range of primary and secondary texts, including Herodotus (1920), Pliny the Elder (1855), Apuleius (1998), Ptolemy (1932), Siculus (1933). Secondary sources (Bernal, 1987; Lefkowitz, 1996; Freeman, 1996; Bindman and Gates Jr.; 2014) provide valuable insights into African contributions to classical history.

Epistemological blending: Perspectives from African leaders

The notion of a decolonised curriculum as a form of reform rooted in epistemologically decolonised knowledge forms –the central purpose of this paper—finds profound expression in the works of leading postcolonial African theorists. African leaders exhibited varied perspectives on what they considered to be the central tenet of Africanisation. For example, Aime Cesaire, a fierce theorist and critic of colonisation on whose thinking many contemporaries/ decolonisation scholars and postcolonial theorists have built their ideas strongly believed in the idea of blending of epistemologies – blending of human encounters. Although Cesaire saw colonisation as a stumbling block to such human encounters, he never abandoned his ideal of epistemological blending of civilisations or knowledge systems. He wrote,

That being settled, I admit that it is a good thing to place different civilizations in contact with each other; that it is an excellent thing to blend different worlds; that whatever its own particular genius may be, a civilization that withdraws into itself atrophies; that for civilizations, exchange is oxygen; that the great good fortune of Europe is to have been a crossroads, and that because it was the locus of all ideas, the receptacle of all philosophies, the meeting place of all sentiments, it was the best center for the redistribution of energy (Cesaire Discourse on Colonialism p 11)

Cesaire's ideas reverberated in the Africanisation visions of African leaders following colonialism. Julius Nyerere, the former founding president of Tanzania, in recognition of the tension between Africanisation and internationalisation, eloquently remarked:

There are two possible dangers facing a university in a developing nation: the danger of blindly adoring mythical 'international standards' which may cast a shadow on national development objectives, and the danger of forcing our university to look inwards and isolate itself from the world (Nyerere, 1966 (a), pp. 218-219).

For Nyerere, it was important to create an epistemological balance between Africa and the West, namely, "to look inward" while simultaneously and critically embracing 'international standards.' Also, the fact that African leaders relied on Western advisers following independence, provides insights into the extent Africa could not completely break away from the Western ideas in that postcolonial Africa embraced the best of colonial administrative experience. A few examples will illustrate the point: According to Thandika Mkandawire, cited in Ndlovu-Gatsheni, Nyerere surrounded himself with 'Fabian socialists in contrast to Tanzanian intellectuals; Kenneth Kaunda of Zambia closest intellectual associate was John Hatch who even became the first director of the institute for Humanism; Nkrumah surrounded himself with foreign pan-Africanists such like George Padmore and W.E.B. DuBois" (Ndlovu-Gatsheni, 2017, p. 61). In his Africanising effort, Nnamdi Azikiwe, who was trained in American universities – Lincoln, Pennsylvania, Columbia— established a university in Nigeria along American models. There were, of course, some leaders who yearned for Africa's golden "pure past" but with little success. Mobutu Sese Seko, who later became notorious of dictatorship, was one such leader who expressed his vision of Africanisation thus:

We need to emancipate the educational system in the Congo from the Western model by going back to the Authenticity while paying due attention to scientific knowledge: I have always thought it inappropriate for us to train our youth as if they were Westerners. It would be more desirable to have an educational system which shapes the youth according to our requirements. That would make them authentically Congolese. Their ideas, reasoning and actions would be Congolese, and they would see the future in Congolese terms. (Mkandawire, 2005, p. 22-23)

Mobutu interpreted the concept 'Authenticity' "as a rebellion against one's own dependency and imitativeness," which entailed dropping the use of European names as part of the national project of Africanisation. His dictatorial style of leadership, however, destroyed his Africanisation vision.

While African leaders could not reach consensus on the Africanisation of the university, their views speak to the need for a critical inclusion of multiple forms of knowledge in the curriculum. While Nyerere upheld the importance of the balance of knowledge systems, Mobutu criticized the Western system, calling for its replacement with pure Congolese culture "Authenticity"—a call that did not materialise. Nyerere's view of striking the balance between knowledge systems sheds light on the thesis of this paper: that is, an Africa centred curriculum which should eradicate the existing curriculum's dehumanising aspects while embracing the best of the Western canon and critically

embracing other global knowledge forms — a view that will only be possible if Africa is placed at the centre of epistemic traditions, which are free of dehumanizing and oppressive elements of Western knowledge.

Epistemic balance: Integrating useful aspects of Western knowledge in a decolonised curriculum

The decolonisation of education involves a critical examination of how knowledge systems can foster an inclusive curriculum that respects African-centred epistemologies while thoughtfully integrating valuable elements of European thought. Guided by the work of scholars such as Walter Mignolo, Mahmood Mamdani and Ramón Grosfoguel, this analysis proposes an Africa-centred framework that transcends rigid binaries and advocates for a curriculum that harmonises African perspectives with global knowledge. The central question driving this inquiry is: How can we conceptualise an Africa-centred curriculum that moves beyond Eurocentric dominance while valuing relevant insights from global knowledge systems?

Establishing a Cohesive Analytical Framework

The foundation of this framework is Mignolo's concept of "border thinking," which reimagines the boundaries between Western and non-Western knowledge, enabling an integrative approach where African and European epistemologies coexist without hierarchy (Mignolo, 2007). "Border thinking" becomes a core principle for a decolonized curriculum, suggesting that African perspectives need not be isolated from global knowledge but can engage with it on equal terms, fostering an inclusive educational space. Mignolo's concept provides the theoretical basis for merging insights, as it allows for the adaptation of European ideas in ways that respect and uphold African-centred values.

Supporting this vision, Mamdani's notion of "epistemic cleansing" adds a methodological approach to selective knowledge retention. According to Mamdani, South African educators must "scrutinize the historical legacy and contemporary reality, discarding some parts of contentious thought systems and adapting others to a new-found purpose" (Mamdani, 1996, p. 183). In this context, "epistemic cleansing" refers to the process of retaining only the constructive aspects of the Western canon while removing colonial and dehumanizing elements. This selective retention is essential for creating a curriculum that incorporates valuable knowledge from European traditions without perpetuating oppressive legacies. By combining Mignolo's border thinking with Mamdani's epistemic cleansing, this framework constructs an Africa-centred curriculum that both honours African epistemologies and considers global insights, reinforcing the idea that knowledge systems need not be exclusionary but can benefit from intercultural exchange.

Engaging Scholars as Interlocutors

To create a cohesive synthesis rather than a collection of isolated ideas, this paper treats Mignolo, Mamdani and Grosfoguel as intellectual interlocutors, whose ideas are brought into productive dialogue. Mignolo's border thinking and Mamdani's epistemic cleansing, for instance, are examined together as complementary approaches. For instance, while Mignolo's border thinking facilitates a fluid integration of knowledge across cultural boundaries, Mamdani's approach ensures that this integration remains selective, carefully excluding elements of Western knowledge that are irrelevant or harmful to African contexts (Asea, 2022, p. 389). By aligning these concepts, a vision of a decolonised curriculum that is neither a wholesale adoption nor an outright rejection of Western thought but a careful adaptation can be realised.

Grosfoguel's critique of "essentialist pure outside space" also contributes to this dialogue by addressing the dangers of oversimplified rejections of modernity. Grosfoguel argues that viewing African knowledge as inherently separate from modern global knowledge misses the reality of shared global development, noting that "a global problem cannot have a national solution" (Grosfoguel, 2011, p. 21). This perspective reinforces Mamdani's selective approach, suggesting that a decolonised curriculum should reject neither all of modernity nor all of the Western canon but should be open to integrating useful knowledge where it can enrich the educational experience. Together, Mamdani and

Grosfoguel's insights encourage a curriculum design that balances respect for African knowledge with openness to global insights, challenging rigid distinctions that limit intellectual engagement.

Application of key theories in Practice

Moving beyond theory, it is important to employ these scholars' concepts as practical tools for decolonising curriculum content. Mignolo's border thinking, for instance, serves as more than an abstract idea; it becomes an active method for reinterpreting Western constructs within African contexts. One example is the notion of democracy, frequently claimed as a Western concept, which can be redefined through African governance traditions. African practices of community accountability, participatory decision-making, and equitable resource distribution exemplify democratic ideals in an African context, challenging the idea that democracy is exclusively Western and instead showing it as a concept adaptable to African values. This redefinition illustrates border thinking in action, demonstrating how an inclusive curriculum can integrate democratic principles without diluting African epistemologies.

Similarly, the combined perspectives of Mamdani and Grosfoguel on selective adaptation guide the integration of Western scientific methods in African curricula.

For instance, science curricula in South Africa could employ empirical techniques common to Western science but apply them to issues that reflect local environmental and health priorities (Le Grange, 2004). By focusing on African ecological and medical concerns—such as sustainable agriculture, biodiversity conservation and endemic health challenges like malaria and HIV/AIDS—students gain a scientific understanding that is both rigorous and culturally relevant, engaging with global scientific knowledge while respecting the local context (Jansen, 2009). This practical application aligns with the paper's vision of a decolonised curriculum that not only embraces African traditions but thoughtfully incorporates global insights where beneficial (Mamdani, 1996; Asea, 2022).

Clarifying the Contribution of Each Scholar

The contributions of each scholar are directly tied to advancing the thesis of an inclusive, decolonised curriculum. Mignolo's border thinking forms a foundational principle that supports the integration of Western knowledge while preserving African-centred values, providing both a theoretical and practical basis for curriculum development. Mamdani's emphasis on epistemic cleansing complements this by establishing a method of selective retention, ensuring that oppressive aspects of the Western canon are removed from the curriculum. Grosfoguel's critique of essentialism adds an additional layer, advocating for a complex view that allows for intercultural exchange without sacrificing African agency. This synthesis of Mignolo's, Mamdani's and Grosfoguel's perspectives represents a balanced and original framework, promoting an Africa-centred curriculum that integrates global knowledge inclusively and critically.

Drawing on Mamdani's and Asea's concepts of epistemic cleansing establishes a foundation for selectively retaining elements of Western knowledge. It then transitions to Mignolo's border thinking as a tool that enables this selective integration, followed by Grosfoguel's critique of essentialism, which underscores the importance of a balanced, globally aware curriculum. Each section builds upon the previous one, reinforcing the thesis at each stage and ensuring that the analysis remains focused on developing a decolonized, Africa-centred approach.

Other scholars South Africa have noted this need to retain certain aspects of Western knowledge in a decolonized curriculum. Writing from Hamilton, New Zealand, Linda Smith alludes to this idea, arguing that "decolonisation does not mean a total rejection of all theory or research or Western knowledge" (Kemp & Miranda, 2019, p. 120).

This aligns with Lewis Gordon's view that decolonization involves detaching from notions of an epistemic enemy. Linda Smith and Lewis Gordon were not alone to make such assertions. Ngũgĩ wa Thiong'o, in "Decolonising the Mind" (1986), advocates for the reclamation of African languages and cultures while critically engaging with Western

knowledge, emphasizing that decolonization involves embracing indigenous knowledge systems alongside Western ones. Chinua Achebe, in "Hopes and Impediments" (1988), also supports the integration of African perspectives with Western literature and thought. Achille Mbembe's "On the Postcolony" (2001) explores the complexities of postcolonial identity, advocating for a synthesis of African and Western intellectual traditions. Gayatri Chakravorty Spivak, in her essay "Can the Subaltern Speak?" (1988), argues for the need to critique and transform Western intellectual traditions rather than rejecting them. Homi K. Bhabha, in "The Location of Culture" (1994), introduces the concept of hybridity, highlighting the importance of integrating multiple cultural perspectives. Walter Mignolo, in "The Darker Side of Western Modernity" (2011), promotes a decolonial approach that critically engages with Western knowledge while incorporating non-Western perspectives. Sabelo J. Ndlovu-Gatsheni, in "Decoloniality in Africa" (2018), emphasizes the critical engagement with Western knowledge systems and the integration of African perspectives. Kwame Anthony Appiah, in "In My Father's House" (1992), discusses cosmopolitanism and the balanced approach of valuing and integrating both Western and African knowledge systems. Collectively, these scholars argue for a nuanced approach to decolonization that involves critically engaging with and transforming Western knowledge while incorporating diverse perspectives to create a more inclusive and comprehensive understanding of history and knowledge.

Critique and misconceptions surrounding Africa centred curriculum

Despite the extensive body of decoloniality and decolonisation scholarship advocating for the elimination of oppressive elements within the Western canon while preserving its valuable and relevant aspects, numerous publications persist in advocating for the inclusion of dominant Western knowledge in contemporary curricula (Mgeta and Govender, 2018, p. 3; du Preez, 2018, p. 4; le Grange, 2016, p. 6; du Plessis, 2021, p. 13; Jansen, 2017). Although these publications provide insightful interpretations regarding curriculum reform, their proposition that a decolonized curriculum should incorporate dominant Western knowledge warrants careful scrutiny. Incorporating dominant or hegemonic Western knowledge at the centre of African education risks perpetuating epistemic injustice, the very issue that has led to student alienation from the curriculum in Africa and beyond. Furthermore, continuing to expose students to outdated and offensive perspectives, such as the infamous remark by British historian Trevor Roper in 1965, underscores the problematic nature of this approach:

"Perhaps in the future, there will be some African history to teach. But at present, there is none: there is only the history of the Europeans in Africa. The rest is darkness…"

Such perspectives are not only historically inaccurate but also contribute to the ongoing marginalisation and misrepresentation of African histories and cultures within the educational system. Roper was not alone to promote Eurocentric and dismissive perspective on African history, which has been challenged by modern scholarship. Other scholars have advanced similar views to promote racial superiority. For instance, Charles Darwin's The Origin of Species originally published in 1859 was later misappropriated to justify social Darwinism and racial hierarchies, especially in colonial contexts in Africa, the Americas and Australia (Grant 1916; Fukuyama, 1992; Diamond, 1997; Ferguson, 2003; Pinker 2011; N Ferguson, 2011).

These texts should be removed from the curriculum and replaced with works promoting inclusive and accurate historical perspective (Asante, 2007; Raynolds, 2011; Wright 2010; Reader, 1997).

Professors, lecturers and teachers in South Africa and beyond have the academic freedom that empowers them to decide what to teach and not to teach students. They are in a position to cleanse the Western canon of its oppressive and dehumanising elements. There are, of course, two ways to achieve this. First, this can be achieved through border thinking already explained. Second, teachers and professors should not assign degrading material of the Western canon to students because doing so will be tantamount to publicizing them, making them to stand the test of time despite evidence to the contrary.

Calls for the inclusion of dominant Western knowledge in the curriculum led by Oliver Bert, du Preez, le Grange, Jonathan Jansen and Piet Naude are made with the intent to critique Africa centred thesis, especially the view of Africa as a centre of historical analysis, casting some doubts on its feasibility. Their discussion, however, as shown below, is marred with inconsistencies, misuse of evidence and contradictions, making it possible for Africa-centred thesis to withstand their criticism. These critics view Africa-centred curriculum as an attempt to eradicate Western canon and replace it with 'static' pure African past. For instance, Oliver asserts that the decolonisation of universities is "a new ideological drive/movement" whose goal is to unearth or restore "pure African cultural past" (Mail and Guardian, 2016). In support of Oliver's view, Piet Naude argues that an Africa-centred thesis knowledge simply

creates another kind of asymmetry in dealing with curriculum problems (Jansen, 2019, p. 19), while le Grange contended that the argument posed challenges "insofar as it suggests that indigenous knowledges are not influenced by other knowledges" (du Preez, 2018, p. 4). The argument is taken to the extreme when Jansen argued that "knowledge itself has been propagated, contested, nullified, subverted and transformed across more than three centuries stretching from the precolonial society to post-apartheid governance" (Jansen, 2019, p. 9).

There are, of course, various problems with the critique of Africa-centred argument. These critics base their argument on a wrong epistemological premise. Their critique stems from the definition of the word decolonisation as a process whereby a colonial power grants complete political independence to its colony. Thus, in as much as decolonisation meant complete political independence in former colonies, so goes the argument, decolonisation of the curriculum would entail the overthrow of western-based institutions, knowledge skills, values, beliefs, habits, standards, and symbols, and to replace them with African ones.

It should be noted that Africa centred decolonized curriculum does not entail the return to the pure African past or the eradication of the best practices of the European canon. Rather, an Africa-centred decolonised curriculum should entail curriculum change rooted in Africa, which is opposed to the dominance of the Western knowledge while simultaneously appropriating the best of it. Such appropriation should be guided by students' location (context) on the continent and by the relevant realities of their history and day-to-day experiences (Letsekha, 2013, p. 14; Heleta, 2016, p. 6; Ngugi, 1986, 87; du Plessis, 2021, p. 11). In a word, an Africa-centred curriculum must entail the eradication or decolonisation of the dominant Western knowledge without diminishing its proper and relevant scholarship, which should also figure as one of the knowledge systems in Africa-centred curriculum (Asea, 2022, p. ; Sibanda, 2021, pp.11-12; The Conversation, 2017 conversation). Writing from Hamilton, New Zealand, Linda Smith alludes to this epistemic cleansing of the Western knowledge and the incorporation of its relevant aspects into a decolonized curriculum when she argued that "decolonisation does not mean a total rejection of all theory or research or Western knowledge" (Kemp and Miranda, 2019, p. 120).

Scholars such as Ndlovu-Gatsheni (2018), Asea (2022), Ngugi wa Thiong'o (1986), and Heleta (2016, 2018) have argued for a shift toward either a fully Africa-centred curriculum or an inclusive curriculum that integrates the Western canon while critically examining its colonial legacies. This paper contends that a decolonized curriculum should carefully select valuable insights from Western scholarship, divested of its dehumanizing elements, and blend them with African knowledge systems to achieve an epistemic equilibrium. This equilibrium would facilitate mutual intellectual engagement between Africa, Europe, and the broader global community. The core question addressed is: How can an Africa-centred curriculum mitigate Eurocentric dominance while integrating valuable global knowledge?

To address this question, the paper critiques existing approaches to curriculum decolonisation that advocate for blending Western and African perspectives without sufficiently examining potential pitfalls. In doing so, it evaluates the contributions of scholars such as P. du Preez, Jonathan Jansen, and Lesley le Grange, highlighting both the strengths and weaknesses of their arguments. Specifically, it examines the risks of overgeneralizing or mischaracterizing the goals of Africa-centred education, which can inadvertently support the re-centring of Western paradigms.

Critical Engagement with Jansen, du Preez and le Grange

While these scholars have contributed valuable perspectives, their work often reveals contradictions and epistemic assumptions that undermine an Africa-centred curriculum. Jansen, for example, argues that curriculum decolonization risks displacing "colonial" knowledge with African knowledge, framing the Africa-centred curriculum as a nationalist impulse that rejects European influences. However, his critique tends to generalize Africanization as a form of epistemic isolation, overlooking the nuanced goals of an Africa-centred curriculum that incorporates selected Western knowledge without sacrificing African agency (Jansen, 2017, p. 159). This paper critiques Jansen's portrayal by emphasizing the balanced integration of Western and African epistemologies, guided by local contexts and African lived experiences.

Similarly, du Preez's arguments, influenced by Asante's Afrocentricity, propose recentring Africa in historical and educational analysis. However, du Preez's interpretation of "recentring" is problematic, as it misrepresents Asante's intent to "centre" African perspectives rather than "recentre" them. This distinction is significant because "centring"

acknowledges historical marginalization and seeks to place African epistemologies at the forefront, whereas "recentring" can imply a reversal rather than a balanced inclusion. As a result, du Preez's approach risks reinforcing a dichotomy between Western and African knowledge, which does not fully capture the blended epistemology that this paper advocates.

Le Grange, meanwhile, questions the feasibility of integrating indigenous knowledge systems without undermining them through Western frameworks. He warns that the Africa-centred approach might fail to acknowledge the influence of other knowledge systems on African epistemologies. This paper, while recognizing Le Grange's concern, argues that an Africa-centred curriculum need not return to a "pure" African past but rather should thoughtfully incorporate Western insights in ways that respect African cultural integrity. This approach not only addresses the historical imbalance of power in knowledge production but also redefines concepts such as democracy and scientific inquiry within African contexts.

A Systematic Framework for Epistemological Blending

In constructing a more inclusive Africa-centred curriculum, this paper draws on broader decolonial scholarship to establish an epistemological blending framework that is both critical and selective. Mignolo's "border thinking" is proposed as a core principle, allowing African and European epistemologies to coexist without one subordinating the other (Mignolo, 2007). This framework goes beyond simply including Western knowledge; it involves actively redefining and contextualizing such knowledge within African frameworks, as seen in how indigenous communities have adapted democratic principles to align with local governance models.

In tandem with Mignolo's approach, Mamdani's concept of "epistemic cleansing" provides a methodology for retaining constructive elements of Western scholarship while removing oppressive legacies (Mamdani, 1996, p. 183). This method enables the curriculum to include scientifically rigorous methodologies adapted to African ecological and medical priorities, rather than applying Western models uncritically. For example, science curricula could use empirical methods common to Western science but focus on issues of local relevance, such as endemic diseases or sustainable agriculture, thereby respecting both scientific rigor and cultural context (Le Grange, 2004; Jansen, 2009).

Ngugi wa Thiong'o offers a powerful framework for re-centring African knowledge within the curriculum, while still embracing a broader world of epistemologies. Ngugi argues that "decolonisation of knowledge should be about African people seeing themselves in relationship with their surroundings and fellow Africans around the continent, as well as in relation to other cultures and peoples around the world" (Ngugi, 1986, p. 87). His vision underscores a model of "critical hospitality" in which Africa acts as an epistemic centre, engaging with diverse global perspectives not in subordination but through balanced intellectual exchange. For Ngugi, the goal is to create "another world" where "many worlds" can coexist, a perspective that directly supports the idea of an Africa-centred curriculum that includes but does not prioritize the Western canon. This approach aligns with the thesis of this paper: a decolonized curriculum must foreground African epistemologies as a primary framework, while thoughtfully incorporating complementary insights from global traditions to offer a richer, more contextually relevant educational experience. Ngugi's perspective advocates for epistemological blending, where African knowledge remains central and sovereign, even as it interacts with selected global knowledge systems.

Supporting Ngugi's stance, Marie Battiste emphasises the limitations of any single knowledge system, asserting that no epistemology can offer an "ultimate truth" (Battiste, 2013, p. 616). Battiste's assertion underlines the need for a curriculum that respects multiple ways of knowing, aligning with Ngugi's call for a world of coexistence. Her view reinforces the idea that a decolonised curriculum should not isolate African knowledge from global insights but rather engage selectively with those perspectives that can enrich students' understanding of the world. Battiste's perspective further supports the paper's thesis that integrating other epistemologies does not dilute African knowledge, but rather strengthens it by providing a broader, more inclusive educational foundation. Furthermore, Battiste, along with scholars like Airoboman and Asekhauno, critiques the notion of European epistemology as a singular entity. Instead, European traditions are themselves diverse and sometimes contradictory, which allows for the careful selection of

specific aspects that may align well with African educational priorities. By emphasising this multiplicity within European knowledge systems, Battiste and others support a model of epistemological blending that is both integrative and selective.

Adding to this critique of singular knowledge systems, Ndlovu-Gatsheni explores the "epistemic exhaustion" evident within many Western frameworks. Citing Santos (2014), Ndlovu-Gatsheni describes this exhaustion as a condition marked by "irrelevance, inadequacy, impotence, stagnation, paralysis," a crisis that limits the ability of Eurocentric knowledge systems to respond to diverse, global challenges (Ndlovu-Gatsheni, 2018, p. 5). This critique further supports the argument that an Africa-centred curriculum should not rely solely on Western epistemologies, which can often impose concepts that lack relevance to African contexts. Instead, an Africa-centred curriculum should focus on those aspects of the Western canon that genuinely contribute to African students' educational experiences and do not merely serve to uphold Eurocentric paradigms. Ndlovu-Gatsheni's emphasis on the limitations within the Western canon reinforces Ngugi's vision: the curriculum should prioritize African knowledge systems while thoughtfully incorporating aspects of global knowledge in ways that are contextually appropriate.

The perspectives of Ngugi, Battiste and Ndlovu-Gatsheni collectively support the thesis that a decolonised curriculum must position African epistemologies at the centre while remaining open to relevant global insights. Ngugi's call for "many worlds" to coexist within an African-centred intellectual space and Battiste's critique of any "ultimate truth" converge to show that a singular knowledge system should not dominate the educational landscape. Instead, each epistemic tradition offers unique contributions that, when integrated thoughtfully, enhance the depth and relevance of education within a decolonised curriculum. Ndlovu-Gatsheni's critique of Western epistemologies' limitations strengthens the case for selectivity in knowledge integration, advocating that only those Western insights which genuinely complement African perspectives should be included. Together, these scholars shape a vision of epistemological blending that resists hegemonic inclusion, promotes intellectual balance, and supports a curriculum that both respects Africa's cultural narratives and fosters global awareness.

In building on Ngugi's, Battiste's and Ndlovu-Gatsheni's ideas, this paper proposes a model of epistemological blending that is both critical and selective. Rather than uncritically adding elements of the Western canon, this approach carefully curates global knowledge to support African students' identities, experiences, and educational needs. Ngugi's framework of "many worlds" provides a basis for an Africa-centred curriculum that engages with diverse knowledge traditions without compromising African intellectual agency. Battiste's critique of the limitations of any single "truth" reinforces the importance of this approach, showing that African knowledge systems are inherently pluralistic and capable of enriching each other through thoughtful integration of global perspectives. Finally, Ndlovu-Gatsheni's emphasis on the limitations within Western traditions advocates for an Africa-centred curriculum that only incorporates global knowledge selectively, using it as a tool for intellectual empowerment rather than as a measure of legitimacy.

This integrated narrative responds to the critique that Western knowledge should not be included on an equal footing with African epistemic traditions without critical examination. By applying epistemological blending, the paper proposes that selected aspects of the Western canon that align with African cultural, ecological and educational priorities can enrich the curriculum without imposing colonial legacies. For example, South African science curricula might employ empirical techniques common to Western science but focus these methods on issues of local relevance, such as endemic health challenges or sustainable agriculture. This approach respects the rigour of scientific methods while grounding students' learning in issues directly related to their lived experiences. By contextualising Western scientific methodologies within African priorities, the curriculum can provide a globally informed yet locally meaningful education.

In sum, the perspectives of Ngugi wa Thiong'o, Marie Battiste and Ndlovu-Gatsheni collectively provide a robust foundation for a decolonized curriculum that is anchored in African epistemologies while selectively engaging with global knowledge. Ngugi's advocacy for a world of coexisting epistemologies, Battiste's critique of the notion of a single truth, and Ndlovu-Gatsheni's warning against the exhaustion within Western traditions together support a

curriculum model that places African knowledge at the centre. This approach does not isolate Africa from the world but creates a balanced intellectual environment in which African perspectives lead and global insights complement, resulting in an inclusive and empowering educational experience.

Incorporating global knowledge forms in a decolonised curriculum

The incorporation of global knowledge forms into an epistemologically decolonised curriculum requires a deliberate effort to integrate diverse intellectual traditions that challenge the hegemony of Eurocentric narratives and recognise the rich, multifaceted contributions of marginalised cultures. As a relatively recent conceptualisation, the inclusion of globalised knowledge in the curriculum has received scant academic focus and, as a rapidly evolving field, it has gained widespread, albeit uncritical, acceptance in scholarly accounts without adequate probing into what constitutes a decolonised curriculum with global imprints (Ogunfuye, 2004, p. 38; Mignolo, 2011, p. 252; Toure, 2014, p. 95; Msila, 2017, p. 203; Sidhu, 2008, p. 79).

Proponents of the globalisation of knowledge often couch their discussions in generalised expressions such as “the decolonised curriculum should include global imprints,” “inclusion of other epistemic knowledges,” and “open to other spaces outside Africa.” Although Jansen is no stranger to these generalisations, his argument about the need to embrace specific knowledge forms is noteworthy. He explains that curricula, including psychology, medicine, chemistry, and education, should be strengthened with knowledge from Africa, Asia, and Latin America “alongside knowledge from the West. Make them talk to each other” (Litnet, November 2017). Aslam Fataar echoes Jansen’s sentiments, arguing that “decolonization of education is based on the inclusion of all knowledge forms bequeathed to humanity including African, indigenous, Arab Islamic, Chinese, Hindu, Indo-American, Asiatic, and Western knowledge forms” (Fataar, 2018, p. vii).

Although Fataar and Jansen support the inclusion of global perspectives in an Africa-centred decolonised curriculum, they fail to critically engage with global knowledge. Achille Mbembe argues that epistemic diversity, or pluriversality, does not entail "uncritical hospitality to other knowledges" (Mbembe, 2016, p. 37). This perspective is understandable given the historical marginalization of African knowledge systems due to slavery, colonialism, and apartheid. For instance, the Latin American and Asian canons, which Fataar and Jansen reference, contain oppressive elements regarding African people and their heritages, including racism, sexism, and gender-based violence. Similarly, in North America, critical race theory (CRT) discussions are banned in states like Florida, Alabama, Georgia, and Texas (Governing Daily Newsletter, February 2023). The marginalisation of African voices in North American, Latin American, and Asian epistemic knowledge systems raises several questions for decolonisation of education scholars. Given their pursuit of cognitive justice in curriculum transformation, how can they include or celebrate epistemic knowledge systems that have historically silenced African knowledge systems and history? What specific aspects, if any, of Chinese, Latin American, and North American epistemic knowledge systems should be incorporated as part of the epistemic knowledge multiplicity, or what Mbembe calls ‘pluriversality’ (Mbembe, 2016, p. 37; Cesaire, 2012, p. 48).

It is essential that global knowledge forms—whether from Latin America, Asia, or North America—be cleansed of their silences and denigrating and dehumanising aspects regarding African heritages before they can engage constructively with African thought. As Jansen puts it, they must be able “to talk to each other” (Litnet, November 2017). Sonke Msimang also emphasises the need “to question what was once unquestioned and unquestionable” in these global knowledge systems (Mail and Guardian, November 2016). Former South African President Kgalema Motlanthe highlighted the necessity of this epistemic cleansing, noting a “prevailing climate of falsehoods, distortions, and outright lies about our continent generally and black Africans in particular” (Mail and Guardian, November 2016). Thus, any uncritical adoption of global epistemic knowledge systems will not advance effective decolonisation of the curriculum in South Africa but will further perpetuate the marginalisation of African knowledge systems. This view is shared by Achille Mbembe in his assertion that “such hospitality to all knowledge forms is not, however, uncritical studies” (Mbembe, 2016, p. 37). In moving towards global knowledge, Africa-centred universities should promote constructive engagement grounded in truthful, respectful and inclusive intellectual inquiry. Professors, teachers, and other academics have the responsibility to eradicate falsehoods from the existing curriculum by not exposing students to damaging literature. Furthermore, there are Western thinkers who have constructively engaged with African forms of thought, culture and social organization, and these should be included in a decolonised curriculum.

CONCLUSION

This paper has explored the complex notion of a decolonised curriculum that integrates both African and European/Western knowledge systems, stripped of their oppressive and dehumanising elements. The central question guiding this exploration was: How can an Africa-centred curriculum overcome the dominance of Eurocentric/Westernised knowledge while retaining valuable global insights? The discussion highlighted that, although Western knowledge contains elements that have historically denigrated African knowledge systems, it also holds valuable insights that, once divested of their oppressive traits, can be critically incorporated into a balanced and inclusive educational framework.

Through a critical examination of both Western and African epistemologies, this paper argued that neither can claim universality or purity. Both systems are products of historical interactions, exchanges, and mutual influences. Consequently, a decolonised curriculum should not seek to isolate African knowledge from the global context but rather position it within a framework that acknowledges and integrates the contributions of diverse knowledge systems. This perspective aligns with the notion of 'border thinking' from decolonial scholarship, which rejects essentialism and fundamentalism, advocating instead for a critical and inclusive approach. The analysis underscored that globalisation has introduced new dynamics into the discourse on curriculum decolonisation. The inclusion of globalised knowledge requires a critical embrace, given that Africans and their descendants have inhabited every continent, often facing marginalisation and epistemic violence. Thus, a decolonised curriculum must critically engage with global knowledge systems, recognising their potential to both enrich and marginalise African indigenous knowledges. In synthesising these arguments, the paper proposed that a truly decolonised Africa-centred curriculum should be critically hospitable to relevant and non-oppressive elements of European scholarship, while fostering an epistemic environment where Africa, Europe, and the rest of the world can engage in mutual learning and knowledge exchange. This hybrid approach challenges the binary of Eurocentrism versus Afrocentrism, advocating for an educational framework that is dynamic, inclusive, and reflective of our interconnected global reality. By drawing on the strengths and addressing the limitations of existing scholarship on curriculum decolonisation, this paper aimed to contribute to a more nuanced and practical understanding of how to develop an Africa-centred curriculum that is both decolonised and globally relevant.

References

Airoboman, F.A and Asekhauno, A.A. (2012). "Is there an African Epistemology," J*orind*, 10 (3), 13-17.

Asea, W.B. (2022). "Epistemic Decoloniality of Westernised Higher Education: A Discourse on Curriculum Justice and Knowledge Integration at Historically White Universities in South Africa," *Arts and Humanities in Higher Education* 21 (4), 375-393.

Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview. New Directions for Teaching and Learning, 1996(68), 3-12.

Battiste, M. (2013). "Decolonizing education: Nourishing the learning spirit." *Journal of Education Research* 60 (3): 615-618.

Beall, M.L. (2004). Youth Fight for Change: The uprising in Soweto. In NAAS conference proceedings. *National Association of African American Studies*, 799-816.

Cesaire, M. (2001) [originally published in 1950]. *Discourse on Colonialism*. New York: Monthly Review Press.

Chiumbu, S. (2017). "Why decolonise research methods? Some initial thoughts."

Presentation: HSRC Seminar series, 2 May. http://ecommons.hsrc.ac.za/handle/20.500.11910/10905. Retrieved August 14, 2023.

Christie, P. (1985). The Right to Learn: The Struggle for Education in South Africa. Johannesburg: Ravan Press.
Daily Maverick, October 16, 2023. In the Fall: Decolonisation and the Rejuvenation of the Academic Project in South Africa. Retrieved July 12, 2023, from https://www.dailymaverick.co.za/opinionista/2016-10-16-in-the-fall-decolonisation-and-the-rejuvenation-of-the-academic-project-in-south-africa/

Diodorus Siculus. Library of History. Translated by C. H. Oldfather. Harvard University Press, 1933.
Du Plessis, P. (2021). "Decolonisation of Education in South Africa: Challenges to decolonise the University Curriculum," *South African Journal of Higher Education*, 35 (1), 1-69.

Du Preez, P. (2018). "On decolonisation and internalisation of university curricula: What can we learn from Rosi Braidotti?" *Journal of Education*, 74, 1-13.

Fanon, F. (1963). The *Wretched of the Earth*. New York: Grove Press.

Fataar, A. (2018). "Decolonising Education in South Africa: Perspectives and Debates." *Educational Research for Social Change (ERSC)*, 7 Special Issue, vi-ix.
Gyasi, R. M., Asante, F., Abass, K., Yeboah, J. Y., Adu-Gyamfi, S., & Amoah, P. A. (2011). Traditional medicine and healing in Ghana: A public health challenge. Journal of Public Health in Africa, 2(2).

Governing Daily Newsletter, Feb 2023. "The Dangerous Campaign to Ban Studies of Black History and Culture." Retrieved July 15, 2023, from https://www.governing.com/now/the-dangerous-campaign-to-ban-studies-of-black-history-and-culture

Gordon, L.R. (ED) (2010). "Fanon on Decolonizing Knowledge." In Hoppe, E.A; and Nicholls, T. N. (eds), *Fanon and Decolonization of Philosophy*. Lexington Books.

Griffiths, D. (2019). "#FeesMustFall and the decolnised university in South Africa: Tensions and Opportunities in a globalising world," *International Journal of Educational Research*, 6-7.

Grote, George. History of Greece. 12 volumes. London: John Murray, 1846-1856.
Gwaravanda, E., & Ndofirepi, A. (2020), "Eurocentric Pitfalls in the Practice of African Philosophy: Reflections on African universities," *Phronimon*, 21 (1), 1-21.

Grosfoguel, R. (2011). "Decolonizing Post-colonial Studies and Paradigms of Political Economy: Transmodernity, Decolonial Thinking, and Global Coloniality," *Transmodernity: Journal of Peripheral Cultural Production of the Luso-Hispanic World*, 1 (1), 1-38.

Habermas, J. (1984). The Theory of Communicative Action. Boston: Beacon Press.
Herodotus. Histories. Translated by A. D. Godley. Harvard University Press, 1920.
IRENA (2015). Renewable Energy in Africa: Prospects and Limits. International Renewable Energy Agency.

Heleta, S. (2016). "Decolonisation of Higher Education: Dismantling epistemic violence and eurocentrism in South Africa," *Transformation in Higher Education* 1 (1), 1-8.
Heleta, S. (2018). "Decolonizing knowledge in South Africa: Dismantling the 'pedagogy of big lies," *Ufahamu: A Journal of African Studies* 40 (2), 1-21.

Hlabangane, N and Matowanyika, J.Z.Z. (2020). *Decolonising Science, Technology, Engineering and Mathematics (STEM) in an Age of Technocolonialism : Recentring African Indigenous Knowledge and Belief Systems*. Langaa RPCIG

Jansen, J. (2017). *As by fire: The end of the South African university*. Cape Town, RSA: Tafelberg.

Jansen, J. (2019) (ED). *Decolonisation of Universities: The Politics of Knowledge*. Johannesburg: Wits University Press.

Kasturi, B. (2019). "Decolonial Turns, Postcolonial Shifts, and Cultural Connections: Are We There Yet?" *English Academy Review* 36 (1), 58-68

Kemp, S. and Miranda, G. 2019). "Theory in Social Work Science." *In Science of Social Work*. Oxford University Press, pp 102-128.

Le Grange, L. (2016). "Decolonising the University Curriculum," *South African Journal of Higher Education*, 30 (2), 1-2.

Letsekha, T. (2013). "Revisiting the debate on the Africanisation of higher education: an appeal for a conceptual shift," *The Independent Journal of Teaching and Learning* 8, 5-18.

Litnet, November 30, 2017. The Problem with Decolonisation: Jonathan Jansen. Retrieved July 24, 2023, from https://www.litnet.co.za/problem-decolonisation-jonathan-jansen-seminar/

Livy. Ab Urbe Condita. Translated by Betty Radice. Penguin Classics, 1982.

Madonado-Torres, N. (2011). "Thinking through the Decolonial Turn: Post-continental interventions in Theory, Philosophy and Critique—an introduction ," Transmodernity: *Journal of Peripheral Cultural Production of Luso-Hispanic World*, 1 (2), 1-15

Mail and Guardian, September 16, 2018. Conceptual clarity on the makings of an African University. Retrieved May 21, 2023, from https://mg.co.za/article/2016-09-16-00-conceptual-clarity-on-the-makings-of-an-african-universityhttps://mg.co.za/article/2016-09-16-00-conceptual-clarity-on-the-makings-of-an-african-university

Mail and Guardian, March 26, 2015. #Rhodes must fall spread to other campuses. Retrieved July 16, 2023, from https://mg.co.za/article/2015-03-26-rhodesmustfall-protest-spreads-toother- campuses

Mail and Guardian, November 18, 2016. Coloniality persists in our universities and we urgently decolonise. Retrieved August 14, 2023, from https://mg.co.za/article/2016-11-18-00-coloniality-persists-in-our-universities-and-we-must-urgently-decolonise/

Mail and Guardian, March 23, 2016. Decolonisation, the New Ideology. Retrieved May 21, 2023, from http://thoughtleader.co.za/bertolivier/2016/03/23/decolonisation-the-new-ideology/

Mamdani, M. (1996). *Citizen and Subject: Contemporary Africa and the Legacy of Late Colonialism*. Princeton, NJ: Princeton University Press.

Mazrui, A. (1978). *Political Values and the Educated Class in Africa*. Berkeley, CA: University of California Press.

Mbembe, A.J. (2016). "Decolonizing the University: New Directions," *Arts and Humanities in Higher Education*, 15 (1), 29-45.

Memmi. A. (1974). *The Colonizer and the Colonized*. London: Earthscan

Menkiti, I.A. (1984). "Person and Community in African Traditional Thought," in Wright, R.A. (ED). *Africa Philosophy: An Introduction*. Lanham: University Press of America, 171-181.

Mgeta, G., Lungu, B.N., Govender, T. (2018). "Decolonisation of the Curriculum: A case study of the Durban University of Technology in South Africa." *South African Journal of Education*, 38 (4), 1-7

Mignolo, W.D. (2011). *The Darker side of Western Modernity: Global Futures, Decolonial Options.* Durham, NC: Duke University Press.

Mignolo, W.D. (2007). "Introduction: Coloniality of Power and De-colonial Thinking," *Cultural Studies*, 21 (2-3), 155-167.

Mkandawire, T. (ed) (2005). African Intellectuals: Rethinking Politics, Language. Gender and Development. Dakar and London: Codesiria and Zed Books.

Mungwini, P. (2016). "The question of recentring Africa: Thoughts on issues from the global South." *South African Journal of Philosophy* 35 (4), 523-536.

Msila, V.T. (2017). *Decolonizing Knowledge for Africa's Renewal*. Pretoria, South Africa: Krap Publishing.

Ndlovu-Gatsheni, S.J. (2018 (a). *Epistemic Freedom in Africa: Deprovinciliazation and Decolonization.* Taylor and Francis Group.

Ndlovu-Gatsheni, J.S. (2018 (b). "The dynamics of epistemological decolonisation in 21st century: towards epistemic freedom." *Strategic Review for Southern Africa*, 40 (1). 16-45.)

Nwosimiri, O. K. (2019). *Epistemology in African Philosophy: A Critique of African Concepts of Knowledge*. Ph.D. Dissertation. University of Kwazulu-Natal.

Nyerere, J.K. (1966 (a). *Freedom and Unity: Uhuru na Umoja. A Selection from Writings and Speeches 1952-65*. Dar es-Salaam: Oxford University Press.

Nyerere, J.K. (1968 (b). *Ujamaa: Essays in Socialism*. London: Oxford University Press.

Ogunfuye, P.B. (2004). *Pan African and Intellectualism: Africa in Neoliberal World Order*. San Francisco, CA. Doubleday Currency Book.
Oxford dictionary. Online.
Parker, K. R. (2016). "Introduction Decolonizing the University: A Battle for the African Mind. *College Language Association (CLA) Decolonizing the University: A Battle for the African Mind,"* 60 (20), 164-171

Pinar, W.F. (2012). *What is Curriculum Theory*. 2nd Edition. New York: Routledge.
Plutarch. Lives. Translated by John Dryden. Modern Library, 2001.
Ptolemy. Geographia. Translated by Edward Luther Stevenson. New York Public Library, 1932.
Du Plessis, P. (2021). "Decolonisation of Education in South Africa: challenges to decolonise the university curriculum." *South African Journal of Higher Education* 15 (1), 1-16.

Quijano, A. (2000). "Coloniality of Power, Eurocentrism and Latin America," *International Journal of Sociology*, 15 (2), 533-580.

Recommendations of the Task Team for the Decolonisation of the Stellenbosch University Curriculum. Retrieved, July 31, 2017, from https://www.sun.ac.za/english/transformation/Documents/SU%20Decolonisation%20Task%20Team%20Final%20Report%20with%20Annexures.pdf

Said, E. (1978). Orientalism. New York: Pantheon Books.
Sibanda, J. (2021). "Academics' Conceptions of Higher Education Decolonisation." *South African Journal of Higher Education* 35 (3), 182-199.

Sidhu, N. (2008). *Decolonisation of Higher Education Content: Towards the Curricula*

Philosophy of Articulation in South Africa. Grand Rapids, MI: Zondervan Publishing House.
Sowetan, October 19, 2016. Students in South Africa feel unheard. Here's one way to listen. Retrieved July 15, 2023, from https://www.sowetanlive.co.za/news/2016-10-19-students-in-south-africa-feel-unheard-heres-one-way-to-listen/

Serequeberhan, T. (1991). "African Philosophy: The Point in Question," in Serequeberhan, T. (ED). African Philosophy: The Essential Reading. New York: P House, 3-28.

Sowetan, June 19, 2017. UJ to compile manual guide decolonisation of curriculum. Retrieved May 21, 2023, from https://www.sowetanlive.co.za/news/2017-06-19-uj-to-compile-manual-toguide- decolonisation-of-curriculum/

Tavernaro-Haidarian, L. (2018). "Deliberate Epistemology: Towards an Ubuntu-based Epistemology that counts as a Prior Knowledge and Objective Truth." *South African Journal of Philosophy*, 37 (2), 229-242.
Tacitus. Histories and Annals. Translated by Kenneth Wellesley. Penguin Classics, 1964.

The Daily Vox, March 25, 2015. #RhodesMustFall: No end in sight as students sit tight. Retrieved May 21, 2023, from http://www.thedailyvox.co.za/rhodesmustfall-uct-studentsoccupy- bremner-building-photos/

The Guardian, March 16, 2016. The real meaning of Rhodes must Fall. Retrieved July 16, 2023, from https://www.theguardian.com/uk-news/2016/mar/16/the-real-meaning-of-rhodes-must-fall

The Conversation, February 14. What 'decolonised education' should and shouldn't mean. Retrieved August 12, 2023, from https://theconversation.com/what-decolonised-education-should-and-shouldnt-mean-72597

Toure, N. (2014). *Africanisation and Decoloniality of Knowledge: Laying a Foundation for creating Counter-hegemonic Discourses on Curriculum*. Trenton, NJ: Africa World Press.
Tutu, D. (1999). No Future Without Forgiveness. New York: Random House.
Udefi, A. (2014). "The Rationale for an Epistemology: A Critical Examination of the Igbo Views on Knowledge, Belief and Justification." *Canadian Social Science*, 10 (3), 108-117.

Wa Thiong'O, N. (1986). *Decolonising the mind: The Politics of Language in African Literature*. James Currey.

Williams, Henry Smith, editor. The Historians' History of the World. 25 volumes. London: The Times, 1907-1908.

Applying computational linguistics in the "The World Café" management strategy: A case study at the University of Nariño.

Jesus Insuasti, Alexander Baron, Jairo Guerrero
{*insuasti, abaron_98, jg}@udenar.edu.co University of Nariño
Pasto, Colombia

*Corresponding author

Abstract

This paper explores the application of computational linguistics within the context of 'The World *Café*' strategy, implemented at the University of Nariño. The strategy involved 190 members from 11 faculties, including deans, department directors, and professors, who engaged in discussions across nine working tables, each addressing key administrative topics in the context of the University of Nariño, southern Colombia, such as academics, research, infrastructure, and budgeting. Using a qualitative approach, participants provided written responses to three specific questions at each working table. Computational linguistic techniques were employed to analyze the extensive dataset of textual responses, revealing significant insights that form the foundation for experiential learning in the university's administrative processes. The results demonstrate how this interactive, data- driven strategy offers a deeper understanding of real-life administrative practices, fostering improved decision-making and institutional development.

Keywords

Computational linguistics, Management, The World *Café* strategy, qualitative analysis.

Introduction

In the evolving landscape of higher education, universities must continually adapt their administrative practices to meet the demands of both internal and external stakeholders. At the University of Nariño, a unique strategy, 'The World Café,' was implemented to engage faculty members and administrators in a collective effort to improve institutional performance. This strategy, traditionally used in business and organizational development contexts (Brown & Isaacs, 2005), fosters open dialogue and collaborative problem-solving across diverse groups. By organizing working tables around key administrative themes, participants had the opportunity to share their insights, experiences, and recommendations in a structured yet flexible manner.

The World Café methodology is a simple, effective, and flexible format for hosting considerable group dialogue. It assumes that people already have within them the wisdom and creativity to confront even the most difficult challenges. This method encourages discussion in small, rotating groups, with participants writing or drawing their ideas on shared pieces of paper. This process creates a rich and diverse collection of responses, fostering a greater sense of ownership and involvement in problem- solving (Schieffer et al., 2004).

At the University of Nariño, 190 participants from 11 faculties, including deans, department heads, and faculty members, were invited to engage in this strategy. Over 11 days, groups rotated between 9 working tables, each focused on a different aspect of university administration—academics, research, infrastructure, budgeting, social interaction, and more. The groups were tasked with responding to three specific questions at each table, facilitating the generation of extensive qualitative data. The collected responses represented diverse perspectives and experiences, offering a comprehensive view of the university's administrative landscape.

The large volume of textual responses generated through The World Café sessions presented an ideal opportunity

for applying computational linguistics to enhance the data analysis process. Computational linguistics, the scientific study of language through computational methods, has proven effective in processing large datasets to reveal patterns, trends, and insights that may not be immediately apparent through manual analysis (Jurafsky & Martin, 2023). In this case, advanced linguistic techniques, such as keyword extraction, sentiment analysis, and topic modeling, were utilized to distill the key themes from participants' responses.

Using computational tools allowed for a deeper, more objective data analysis, highlighting recurring concerns and priorities among the university's faculties. For example, automated keyword analysis revealed a strong emphasis on resource allocation and infrastructure development. In contrast, sentiment analysis provided insight into participants' general satisfaction or dissatisfaction regarding various aspects of the university's operations. These results formed the basis for further discussion and decision-making and served as a mechanism for experiential learning within the administrative context.

Experiential learning, as defined by Kolb (1984), involves learning through reflection on doing, which allows participants to engage more deeply with real-world problems and develop practical solutions. In this case, the interaction between faculty members and administrators through The World Café exemplified experiential learning. By participating in discussions that mirrored administrative challenges, the participants gained insights into the complexities of university governance and developed a better understanding of the interdependencies between various administrative functions. Moreover, applying computational linguistics to analyze the collected responses further enhanced the learning experience, offering participants a data-driven perspective on the issues they had discussed.

This approach aligns with the growing emphasis on data-driven decision-making in higher education, where institutions increasingly rely on qualitative and quantitative data to inform policy and strategic planning (Daniel, 2019). By leveraging computational linguistics to analyze the results of The World Café, the University of Nariño gained valuable insights into its administrative processes and fostered a culture of learning and continuous improvement.

This paper explores how computational linguistics can enhance experiential learning in the context of university administration, using the case of The World Café strategy at the University of Nariño. Specifically, the study will examine the results of the qualitative analysis conducted on the responses collected from 190 participants across nine working tables. By investigating the patterns and insights derived from the data, the study seeks to demonstrate how computational techniques can contribute to a deeper understanding of administrative practices and support institutional development. This case study provides a model for other higher education institutions seeking to integrate experiential learning and computational analysis into their administrative processes.

Literature review

This literature review explores the key concepts underpinning the integration of computational linguistics in educational and administrative contexts, the application of The World Café strategy in organizational development, and the relevance of experiential learning in university administration. These areas form the foundation for analyzing how computational linguistic techniques can enhance experiential learning outcomes in higher education administration.

Computational linguistics, as a discipline, involves using computational methods to process and analyze large volumes of natural language data (Jurafsky & Martin, 2023). The application of these methods has grown significantly in recent years, particularly in educational settings where qualitative data analysis—such as student feedback or textual responses from participants in surveys and focus groups—can yield valuable insights. By applying algorithms for keyword extraction, sentiment analysis, and topic modeling, computational linguistics allows researchers to systematically analyze large datasets that would be too time-consuming or difficult to interpret manually (Manning et al., 2008).

In the context of university administration, computational linguistic techniques have proven helpful in analyzing written responses collected from faculty members, students, and administrators. Studies have shown

that these techniques can reveal patterns in textual data that reflect the respondents' underlying concerns, attitudes, and priorities (Bamman et al., 2020). For instance, keyword extraction can highlight recurring themes or topics, while sentiment analysis can assess the emotional tone of responses, providing deeper insight into institutional challenges and opportunities (Bird, Klein, & Loper, 2009).

The World Café is a conversational process that fosters collaborative dialogue, particularly in large groups (Brown & Isaacs, 2005). Its origin lies in organizational development and change management, where it has been used to engage diverse stakeholders in meaningful discussions about complex issues. The methodology revolves around the idea that conversations matter and collective intelligence can emerge from exchanging ideas in a structured environment (Schieffer et al., 2004).

The strategy has been widely adopted in educational institutions to gather input from various stakeholders, including faculty, administrators, and students. By organizing participants into small, rotating groups, The World Café allows for diverse perspectives to be shared, facilitating the co- creation of knowledge. Studies have demonstrated that this methodology can lead to more inclusive

decision-making processes, empowering participants to voice their opinions in a relaxed, informal setting (Fouché & Light, 2011).

In higher education, The World Café has been used to address issues ranging from curriculum design to administrative restructuring. The process encourages participants to engage with real-world challenges, such as resource allocation or institutional governance, in a way that promotes both reflection and action (Brown & Isaacs, 2005). Furthermore, the collaborative nature of the strategy aligns with the principles of experiential learning, which emphasize learning through doing and reflecting on practical experiences (Kolb, 1984).

Experiential learning theory, developed by David Kolb (1984), posits that individuals learn most effectively when actively engaged in real-world experiences and can reflect on those experiences. In the context of university administration, experiential learning can take the form of participation in decision-making processes, working groups, or strategic planning exercises. Such engagement allows administrators and faculty members to understand better the complexities of managing educational institutions.

Research has shown that experiential learning can foster the development of critical thinking and problem-solving skills, particularly in complex, dynamic environments such as higher education administration (Moon, 2004). By engaging directly with challenges such as budget management, infrastructure development, or faculty recruitment, participants are better equipped to contribute meaningfully to institutional decision-making processes.

The application of experiential learning in university administration is particularly relevant in the case of The World Café strategy, where participants are asked to engage in discussions that mirror real- life administrative challenges. This method allows participants to reflect on their experiences and insights, thereby deepening their understanding of the issues and fostering a more collaborative, learning-oriented approach to university governance (Fry et al., 2009).

The intersection of computational linguistics and experiential learning offers new possibilities for enhancing administrative processes in higher education. By applying computational techniques to the textual data generated through experiential learning activities such as The World Café, institutions can gain deeper insights into the concerns and priorities of their faculty and administrators. This combination allows for a more nuanced, data-driven approach to decision- making, as it brings together the human insights generated through experiential learning with the objective, large-scale analytical power of computational linguistics (Daniel, 2019).

Using computational linguistics in analyzing qualitative data also supports a more democratic, inclusive form of institutional governance, allowing all participants' voices to be heard and considered. This approach aligns with the growing trend toward data-driven decision-making in higher education, where institutions increasingly rely on qualitative and quantitative data to inform their strategic planning and operational decisions (Baepler & Murdoch, 2010).

By enhancing the experiential learning process by applying computational linguistic techniques, universities like the University of Nariño can improve their administrative performance and foster a culture of continuous learning and improvement. This study will build on the existing literature by

examining how these concepts can be applied in the context of university administration, using The World Café as a case study.

Method and Materials

This study employed a mixed-method approach that combined qualitative and computational linguistic techniques to analyze textual data collected from participants involved in 'The World Café' strategy at the University of Nariño. The research was designed as a case study, focusing on improving the administrative performance of the university through the application of The World Café. This method was chosen for its ability to provide in-depth insights into complex, real-world phenomena, where the participants' experiences and contexts are crucial to understanding the outcomes (Yin, 2018). The combination of qualitative and computational methods offered a comprehensive data analysis, enabling a deeper understanding of the content of participants' responses and the broader patterns within the data.

The participants in this study were 190 faculty members from 11 faculties at the University of Nariño, including deans, department heads, and some professors. These participants were purposefully selected to ensure that the individuals directly involved in or impacted by the university's administrative processes were included in the discussions. Their involvement guaranteed that the data collected would be relevant and insightful for the study's goal of enhancing experiential learning and improving administrative performance.

The data was collected over 11 days, during which the participants participated in The World Café strategy. Each participant rotated through nine working tables, each focusing on a key theme of university administration, such as academics, research, social interaction, budget management, and infrastructure investment. At each table, participants were presented with three questions to prompt discussion and reflection on the given topic. The participants wrote their responses on large sheets of paper, contributing openly and spontaneously to the group's collective input. By the end of the process, a large body of qualitative data in written responses was gathered, offering a wealth of information for analysis.

The qualitative analysis of the data involved reviewing the written responses to identify recurring themes and patterns related to the administrative challenges discussed. Thematic analysis was employed as the primary qualitative method, which is well-suited for identifying, analyzing, and interpreting patterns within data (Braun & Clarke, 2006). This method allowed for the extraction of critical themes that reflected the collective insights and concerns of the participants.

In addition to qualitative thematic analysis, computational linguistic techniques were used to enhance the analysis of the large dataset. These techniques included keyword extraction, sentiment analysis, and topic modeling. Keyword extraction helped identify the most frequently mentioned topics and terms within the participants' responses. At the same time, sentiment analysis assessed the emotional tone of the responses, revealing participants' attitudes toward various administrative issues (Jurafsky & Martin, 2023). Topic modeling, specifically Latent Dirichlet Allocation (LDA), was used to uncover hidden thematic structures within the data, allowing for a deeper, more nuanced understanding of the concerns and priorities raised by the participants (Blei et al., 2003).

The use of computational linguistics provided several advantages. It enabled the efficient processing and systematic analysis of a large text volume, which would have been difficult to analyze manually within the study's time limit. Moreover, computational analysis offered an objective perspective on the data, complementing the subjective insights gained from the thematic analysis. This dual approach helped uncover trends and patterns that were not immediately apparent through manual analysis, enriching the overall understanding of the university's administrative landscape.

The primary materials used in this study were the written responses collected from participants during The World Café sessions. These responses were digitized and stored as text files for subsequent analysis. In addition, several computational tools were employed to process data, including the Natural Language Toolkit (NLTK) for keyword extraction and sentiment analysis (Bird et al., 2009) and the Gensim library for topic modeling using Latent Dirichlet Allocation (Rehurek & Sojka, 2010). These tools allow for a more comprehensive and structured data analysis, helping to distill meaningful insights from the extensive textual dataset.

Ethical considerations were a vital component of this study. All participants were informed about the study's purpose and consented to participate. Their written responses were anonymized to ensure confidentiality and protect their identities throughout the data collection and analysis. The research adhered to ethical guidelines, ensuring voluntary participation and taking steps to safeguard participants' privacy.

While this study provides significant insights into applying computational linguistics to enhance experiential learning in university administration, it has limitations. One limitation is the exclusive reliance on written responses, which may overlook non-verbal cues or other contextual information that could have enriched the analysis. Furthermore, the study was conducted solely at the University of Nariño, which may limit the generalizability of the findings to other higher education institutions. Future studies could address these limitations by incorporating additional data sources, such as interviews or focus groups, to complement the written responses collected during The World Café.

Findings

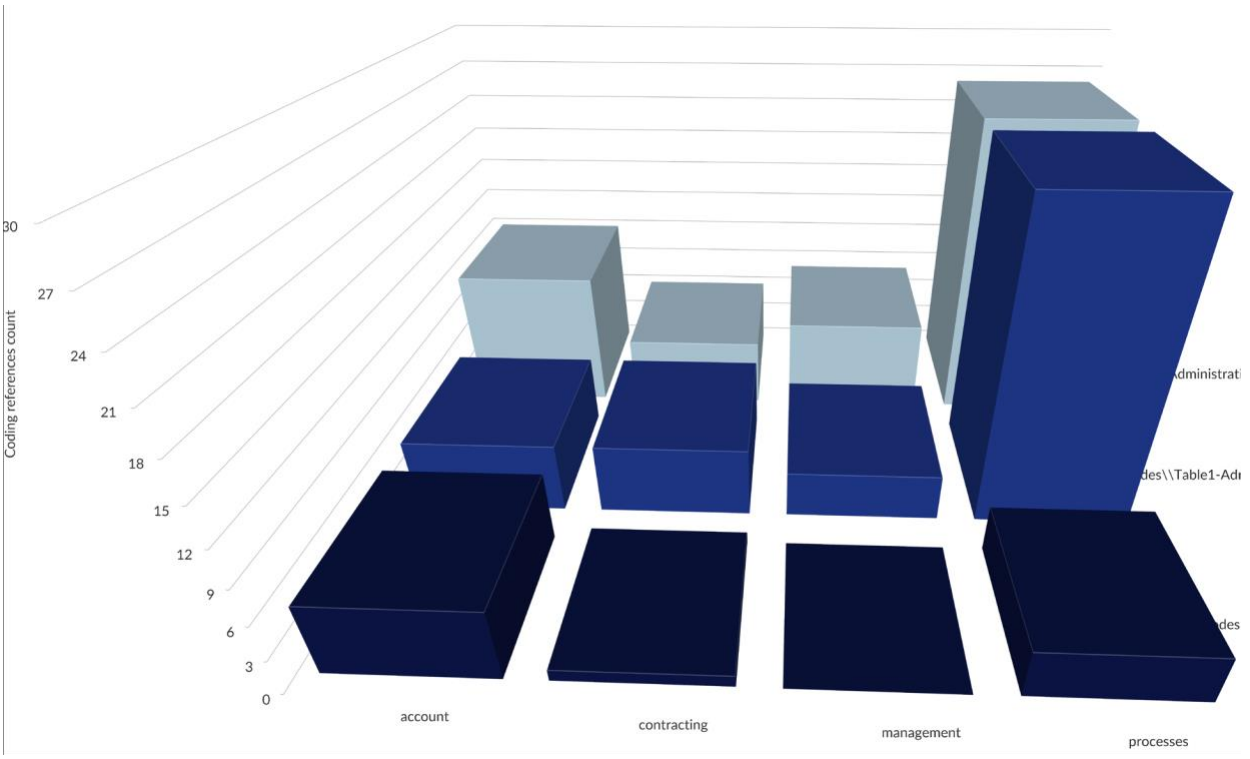
This chapter explores the implementation of the World Café strategy at the University of Nariño, which aims to improve institutional management processes. The strategy, involving nine thematic worktables, gathered feedback from various university faculties. This feedback was analyzed using computational linguistics, yielding insights into critical areas such as administration, budgeting, academic work, research, social interaction, and infrastructure. The thematic analysis is complemented by nine figures illustrating critical findings from the discussed areas.

The World Café strategy employed nine worktables, each dedicated to a specific functional area within the university. Participants from all faculties provided feedback, which was compiled into a linguistic corpus. This corpus was analyzed using computational linguistics to identify themes, gaps, and suggestions for future improvements. The findings from each worktable are illustrated using corresponding figures to represent the coding references and thematic focus areas.

Administration and Procurement

Worktable 1 focused on administration, particularly account review, purchasing, and contracting. The feedback analysis revealed that improvements have been made in administrative management, but contracting processes remain an area of concern. Proposed improvements include the decentralization of decision-making and the development of unified information systems to streamline procedures.

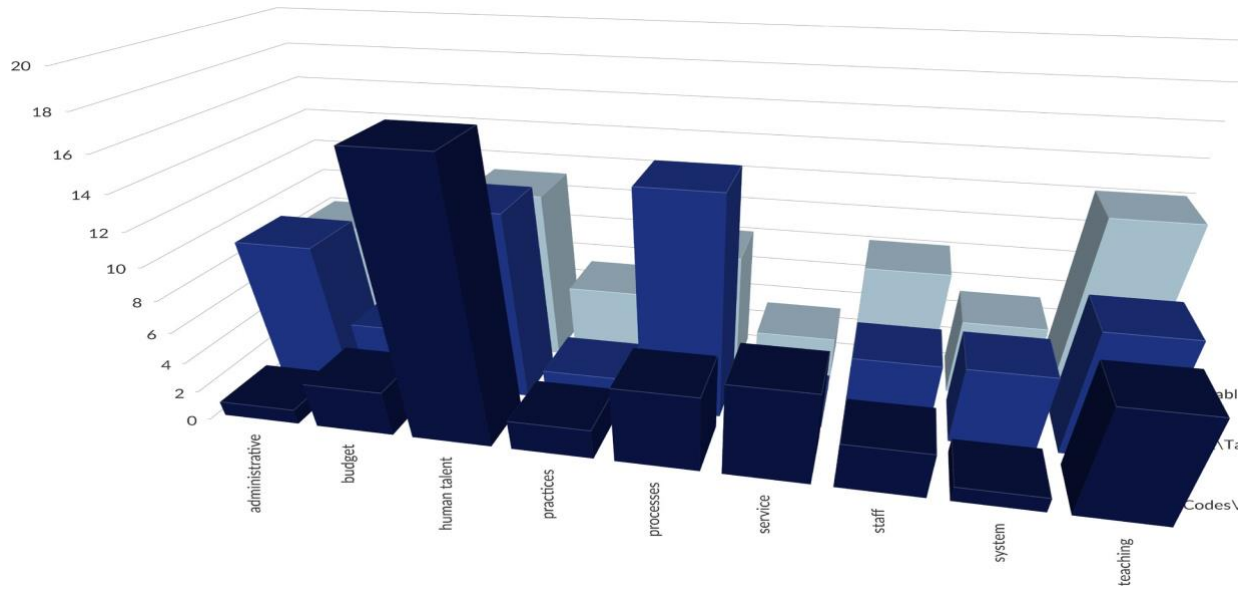
Figure 1: Thematic analysis of administration, procurement, and contracting feedback.



Budget and Human Talent

Worktable 2 covered budget management and human talent. The university has made efforts to allocate yearly budgets and manage human talent effectively. However, participants identified budget distribution and inclusion gaps, particularly for underrepresented faculties. Proposals for future improvements include standardizing processes and providing better resources for human talent management.

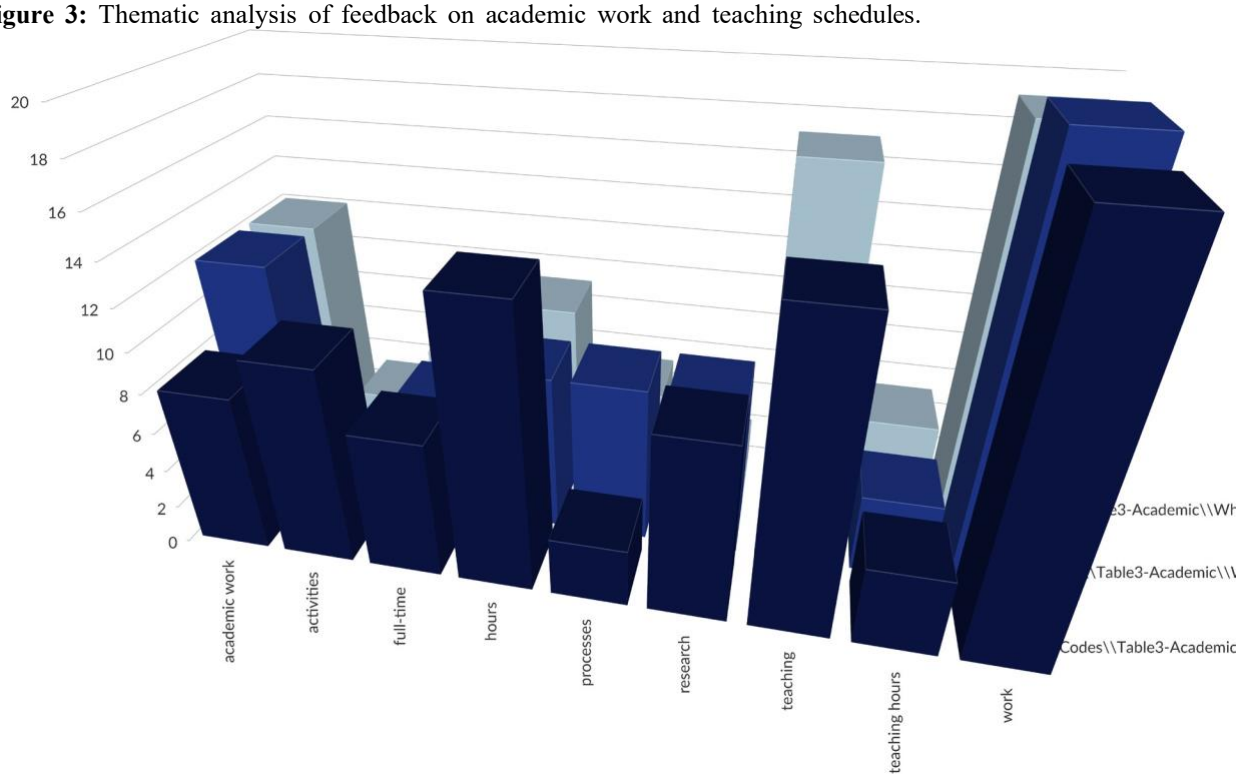
Figure 2: Thematic analysis of feedback on budget and human talent management.



Academic Work

Worktable 3 examined changes in academic work. Recent modifications in academic hours and teaching schedules have been well-received, but participants indicated a need for better-integrating research activities into the academic workflow. Future priorities should include encouraging faculty and student research while improving systems like the Sapiens platform.

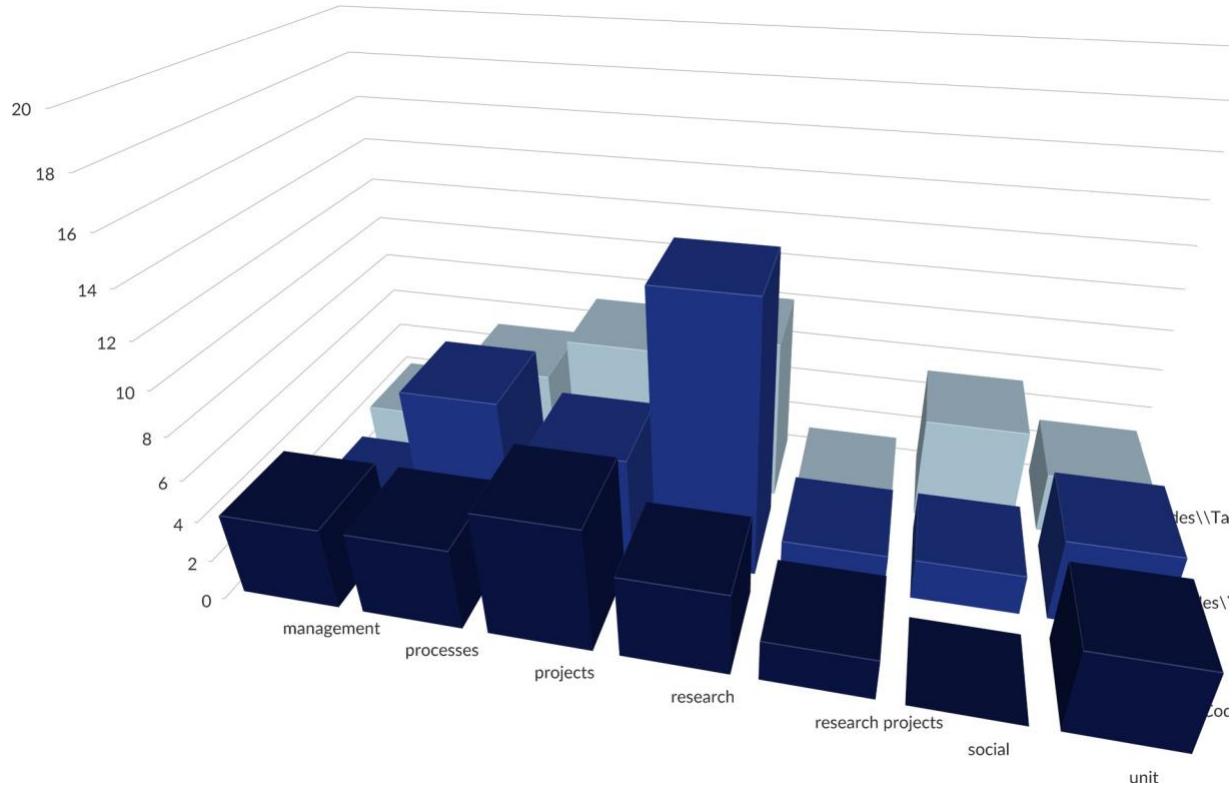
Figure 3: Thematic analysis of feedback on academic work and teaching schedules.



Research and Social Interaction

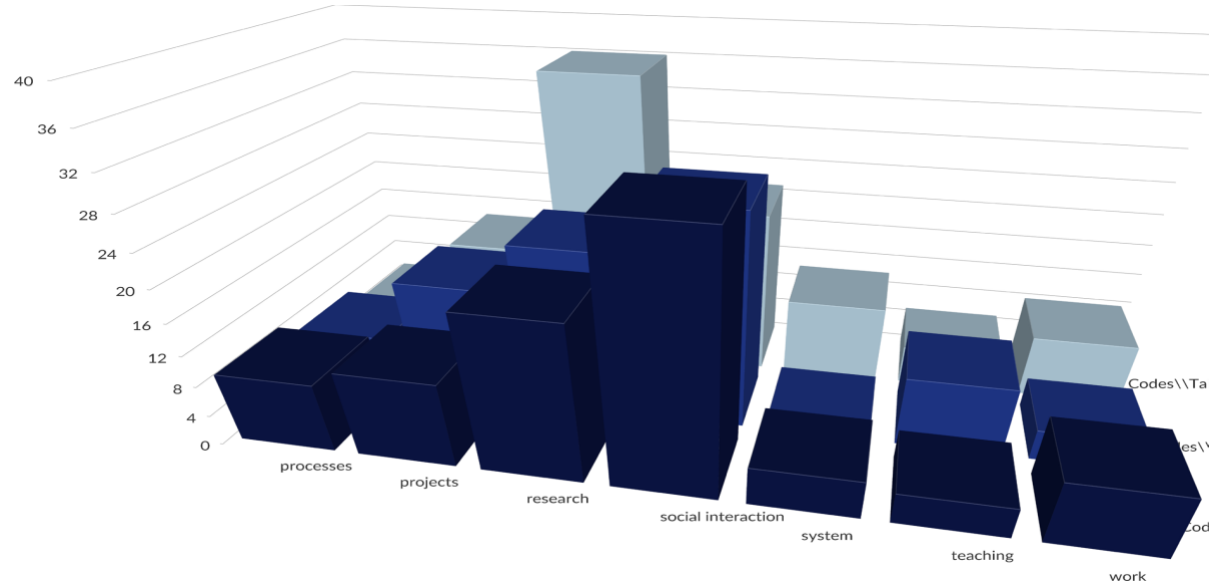
Worktable 4 analyzed the university's research mission, focusing on implementing the UGP (VIIS) and other research units. Feedback highlighted the need for better research support and improved articulation of responsibilities between units. Suggested improvements include forming international alliances to facilitate publications and conducting workshops to clarify research processes.

Figure 4: Thematic analysis of feedback on research mission and social interaction.



Worktable 5, also addressing research and social interaction, emphasized the creation of visibility for social interaction efforts. While positive developments have occurred, participants called for greater flexibility in managing supplier systems and expanding support for research initiatives.

Figure 5: Thematic analysis of feedback on social interaction and research support.



University Wellbeing

Worktables 6 and 7 focused on university wellbeing, particularly mental health, institutional coexistence, and

the U project. Participants appreciated the ongoing efforts to improve mental health services and institutional coexistence programs. However, they also suggested the need for more inclusive wellness programs and better dissemination of information about existing resources. The U project, aimed at promoting community health and student engagement, received praise for its initiatives, but further improvements in addiction prevention and well-being spaces were recommended.

Figure 6: Thematic analysis of feedback on mental health and institutional coexistence.

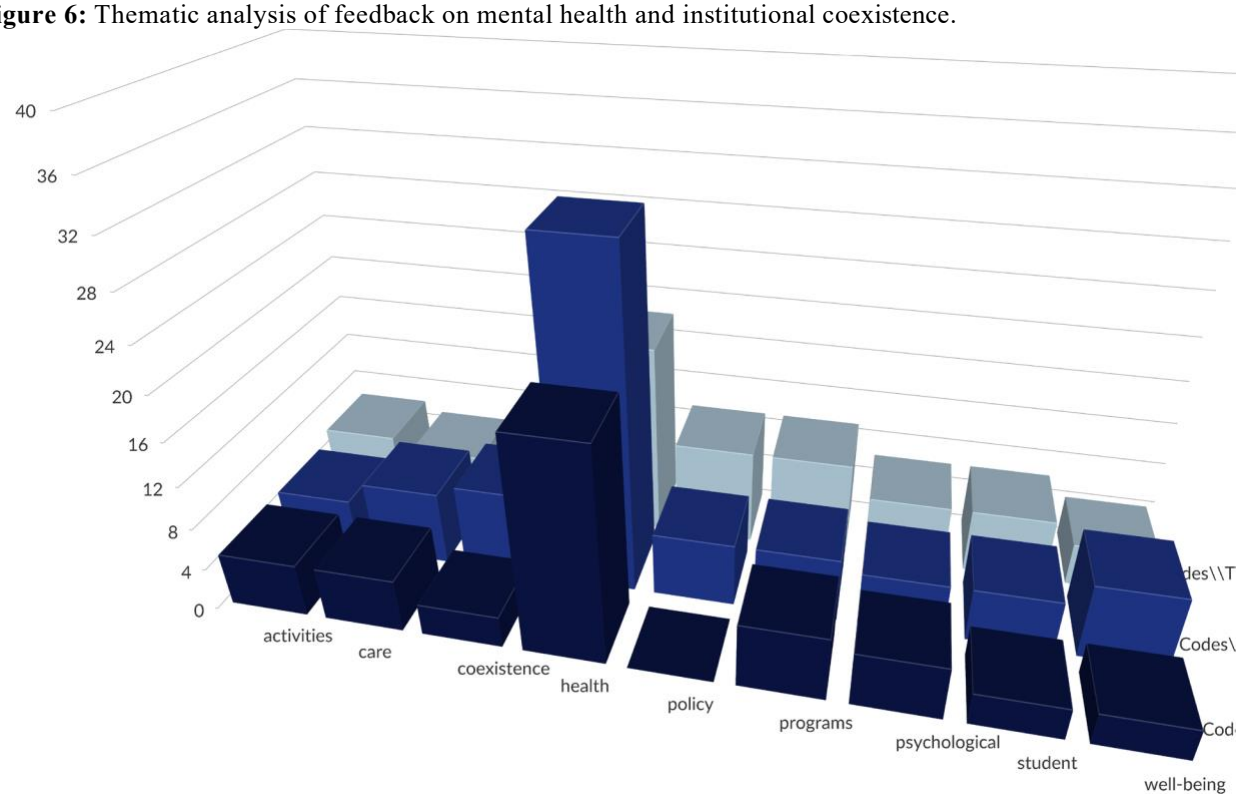
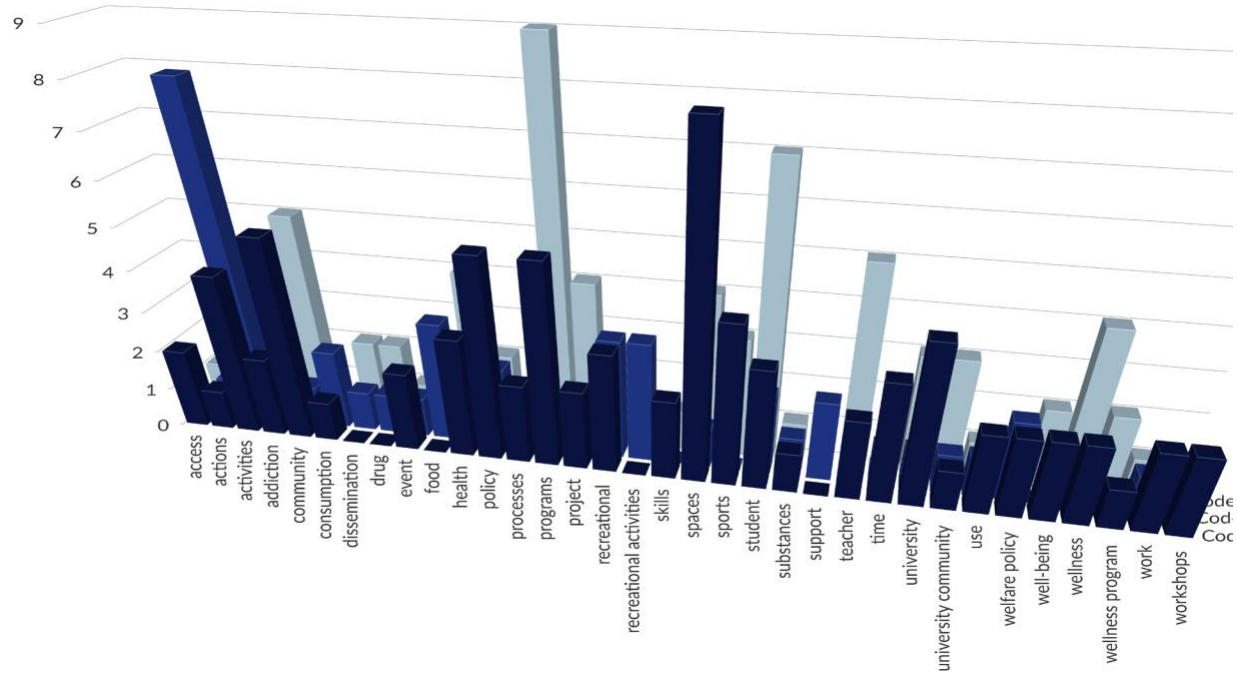


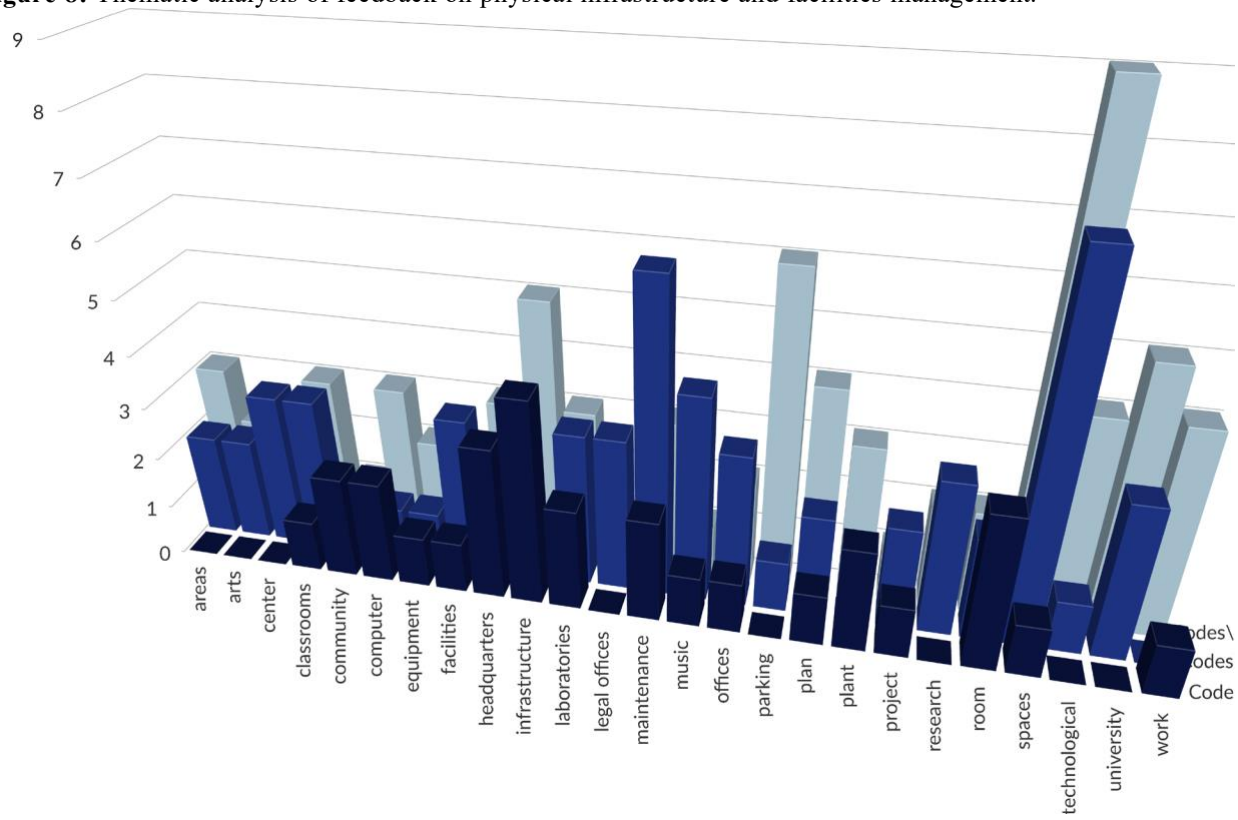
Figure 7: Thematic analysis of feedback on the U project and community well-being.



Physical and IT Infrastructure

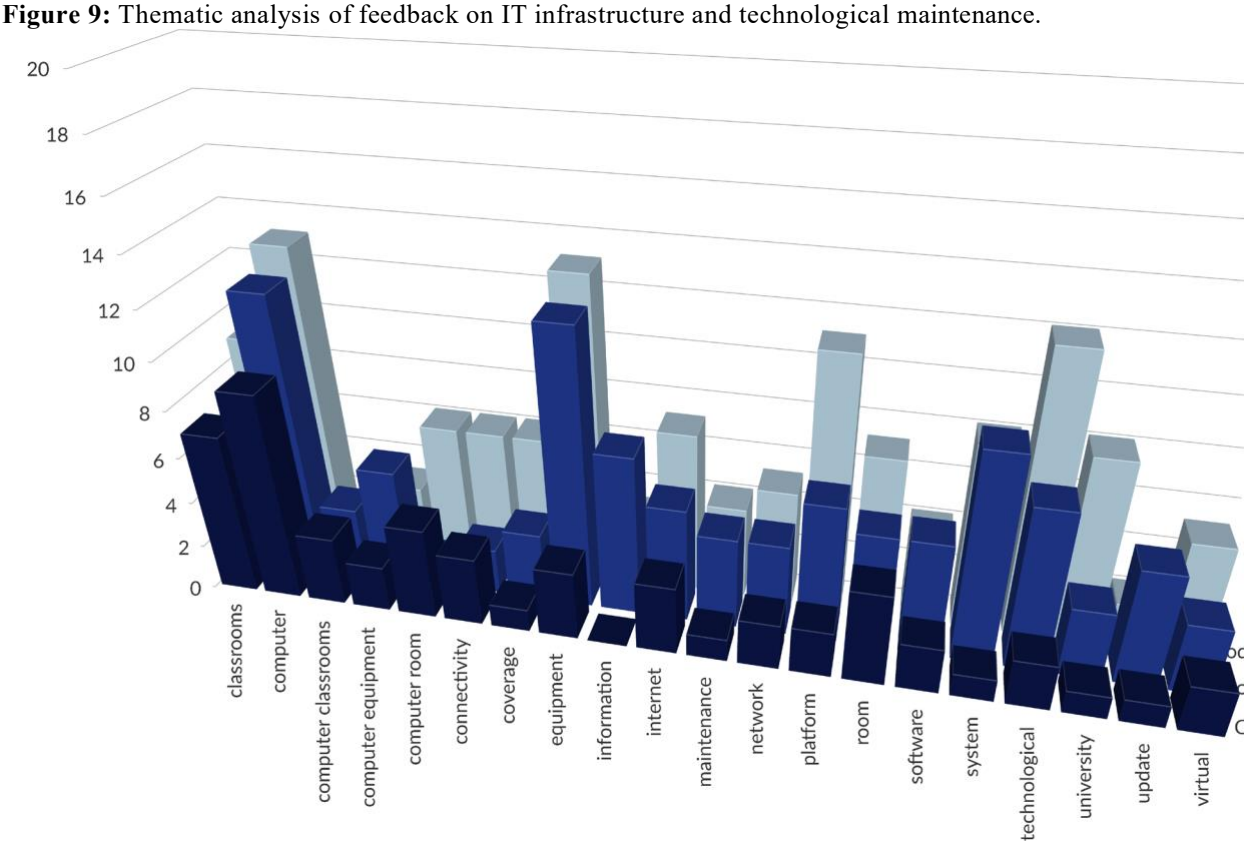
Worktable 8 reviewed the university's physical infrastructure. The feedback emphasized the need for better maintenance of classrooms and recreational spaces. Participants also highlighted the need for upgrades to gym and pool facilities and centralized maintenance services to address infrastructure gaps promptly.

Figure 8: Thematic analysis of feedback on physical infrastructure and facilities management.



Worktable 9 discussed IT infrastructure and technological adaptations. The feedback indicated that while improvements have been made, significant gaps remain in-network coverage, internet reliability, and access to critical platforms. Proposed improvements include activating specialized IT laboratories and increasing investment in digital infrastructure.

Figure 9: Thematic analysis of feedback on IT infrastructure and technological maintenance.



The World Café strategy provided a comprehensive platform for the academic community at the University of Nariño to share their insights on improving institutional management. Analyzing the feedback from nine worktables has uncovered vital areas of progress and highlighted critical gaps in administration, budgeting, academic activities, research, social interaction, infrastructure, and IT systems. The figures presented offer a visual representation of the thematic priorities discussed by the participants. Moving forward, the university's focus on decentralization, transparency, research support, and enhanced infrastructure will be essential to fostering sustainable growth and development.

Conclusions

Implementing the "The World Café" strategy at the University of Nariño has provided a comprehensive framework for collecting and analyzing qualitative data to improve the university's administrative performance. By engaging 190 participants across 11 faculties in structured discussions, the strategy successfully captured diverse perspectives on critical areas such as administration, academic work, research, social interaction, infrastructure, and university well- being. Using computational linguistic techniques to analyze the large volume of textual data enabled the identification of recurring themes, gaps, and opportunities for future improvement.

The findings reveal considerable progress in process management, resource allocation, infrastructure development, and mental health initiatives. However, the analysis also highlights critical areas that require further attention, including the decentralization of decision-making, the need for more robust information

systems, the enhancement of research support structures, and the improvement of physical and technological infrastructure. In particular, the integration of legal processes within administrative functions, the development of unified document management systems, and the implementation of policies like zero-paper were identified as crucial steps toward enhancing operational efficiency.

Additionally, the data suggests that experiential learning is vital in administrative performance improvement. The participatory nature of "The World Café" allowed faculty members and administrators to share their insights and provided a reflective space for them to learn from one another. This experiential approach facilitated the exchange of real-world knowledge about the university's operations, fostering a deeper understanding of how administrative decisions impact the broader academic community.

In conclusion, combined with computational linguistic analysis, "The World Café" strategy offers a powerful tool for improving higher education institutions' administrative processes. The University of Nariño's experience is a model for other institutions seeking to engage their academic communities in meaningful dialogue and using data-driven insights to inform strategic decision-making.

Future Work

While the findings from the "World Café" strategy at the University of Nariño have provided valuable insights into the current state of the university's administrative processes, further research and development are needed in several areas to sustain and enhance these improvements.

One area of future work involves expanding the application of computational linguistics to analyze qualitative data in other contexts within the university. While this study focused primarily on administrative processes, future research could apply similar techniques to assess faculty performance, student feedback, and curriculum development. Extending data-driven analysis to other areas could yield more profound insights into the university's operations and contribute to a more holistic understanding of its performance.

Another promising area for future work is the development of more advanced information systems and platforms to support decision-making processes. The findings indicated a clear need for unified information systems and document management platforms to streamline administrative functions and reduce redundancy. Future research could explore the design and implementation of such systems, integrating them with existing academic and administrative platforms to create a more efficient and transparent workflow.

Additionally, future efforts should focus on strengthening research support at the university. This includes encouraging the formation of research groups, increasing funding for research activities, and fostering partnerships with external institutions for collaborative projects. Prioritizing research as a core mission of the university has the potential to enhance both academic outcomes and administrative efficiency.

Further development of university well-being initiatives also presents a key area for future work. The findings highlighted mental health and institutional coexistence as critical themes, with a need for expanded programs and spaces dedicated to wellness. Future work could explore creating dedicated wellness centers and developing long-term strategies to improve mental health services for students and faculty.

Lastly, future research should also address the challenges posed by technological infrastructure. Improving access to internet connectivity, enhancing ICT facilities, and providing more specialized laboratories are crucial steps toward modernizing the university's operations. As the university grows, future investments in technology will be essential for supporting academic and administrative functions.

In summary, the insights gained from this study provide a solid foundation for future improvements at the University of Nariño. The university can remain at the forefront of higher education innovation by continuing to apply data-driven techniques, developing robust infrastructure, and fostering a culture of continuous learning and improvement.

References

Baepler, P., & Murdoch, C. J. (2010). Academic analytics and data mining in higher education. *International Journal for the Scholarship of Teaching and Learning, 4*(2), Article 17. https://doi.org/10.20429/ijsotl.2010.040217

Bamman, D., Underwood, T., & Smith, N. A. (2020). The transformation of gender in English-language fiction. *Journal of Cultural Analytics, 4*(1). https://doi.org/10.22148/001c.11858

Bird, S., Klein, E., & Loper, E. (2009). *Natural language processing with Python: Analyzing text with the Natural Language Toolkit*. O'Reilly Media.

Blei, D. M., Ng, A. Y., & Jordan, M. I. (2003). Latent Dirichlet Allocation. Journal of Machine Learning Research, 3, 993–1022.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Brown, J., & Isaacs, D. (2005). The World Café: Shaping our futures through conversations that matter. Berrett-Koehler Publishers.

Daniel, B. (2019). Big data and data science in higher education: Opportunities and challenges. British Journal of Educational Technology, 50(5), 1015–1038. https://doi.org/10.1111/bjet.12764

Fouché, C., & Light, G. (2011). An invitation to dialogue: The World Café in social work research. *Qualitative Social Work, 10*(1), 28-48. https://doi.org/10.1177/1473325010376016

Fry, H., Ketteridge, S., & Marshall, S. (Eds.). (2009). A handbook for teaching and learning in higher education: Enhancing academic practice (3rd ed.). Routledge.

Jurafsky, D., & Martin, J. H. (2023). Speech and language processing (3rd ed.). Pearson.

Kolb, D. A. (1984). Experiential learning: Experience as the source of learning and development. Prentice-Hall.

Manning, C. D., Raghavan, P., & Schütze, H. (2008). Introduction to information retrieval. Cambridge University Press.

Moon, J. A. (2004). A handbook of reflective and experiential learning: Theory and practice. Routledge Falmer.

Rehurek, R., & Sojka, P. (2010). Software framework for topic modeling with large corpora. In Proceedings of the LREC 2010 Workshop on New Challenges for NLP Frameworks (pp. 45–50). ELRA.

Schieffer, A., Isaacs, D., & Gyllenpalm, B. (2004). The World Café: Part one. World Business Academy.

Yin, R. K. (2018). Case study research and applications: Design and methods (6th ed.). SAGE Publications.

Mapping COVID – 19 Infections and Fatality in Saudi Arabia: An Exploration

Hamad Mansour Aldossari
Department or Geography and Geographical Information Systems,
Imam Mohammad Ibn Saud Islamic University, Riyadh, Saudi Arabia.

Abstract

Background:

Geospatial mapping techniques can be creatively utilized to consolidate and describe events sequentially, especially in instances of epidemics such as COVID-19. Saudi Arabia was seriously affected by this epidemic across its 13 administrative areas, beginning in March 2020 and ending in May 2023. This research, utilizing mapping as a tool, explores the spread of disease over the period, illustrating its locational spread, geographic variations, prevalence, and burden.

Methods:

This research utilized daily reports published by the Ministry of Health, Saudi Arabia. Analyses were carried out by dividing the infections into three periods 2000-2021; 2021-2022; and 2022-2023 for exploratory purposes. Analyzed data were then transferred to maps for visual presentations. They are presented in six panels of varying interpretations.

Results:

During these periods, 205 locations in the country were affected, with fewer cases in the first year, a wider spread in the second year, and subsidence in the third year. Although this pattern holds for infections, fatality continued beyond the period, as an aftereffect.

Conclusions:

Severe prolonged infections and fatalities were observed in smaller administrative areas, especially in the southwestern regions, including Jazan, Najran, Aseer, and Al-Baha administrative areas. Analyzing data using mapping is crucial for understanding the real picture of the rise and fall of COVID-19 infections and Fatality, which is instrumental in planning and implementing precautions and control measures in similar future epidemic and disaster situations.

Keywords: picturesque descriptions; geographic locations; crude infection rate; number of cases; cases in a month; case fatality rate.

Introduction:

The Kingdom of Saudi Arabia is located on the Arabian Peninsula in the far southwest of the Asian continent, at the crossroads of Asia, Africa, and Europe. The Kingdom of Saudi Arabia covers an area of approximately 2 million km^2, constituting approximately 70% of the Arabian Peninsula (Figure 1). The Kingdom of Saudi Arabia is bordered to the north by Jordan, Iraq, and Kuwait; to the east by the Arabian Gulf, Bahrain, Qatar, and the United Arab Emirates; to the south by Oman and Yemen; and to the west by the Red Sea and the Gulf of Aqaba. According to the General

Authority for Statistics in 2024, the Kingdom's population is approximately 35.3 million, including citizens and residents.

Figure 1: Kingdom of Saudi Arabia location map

The Kingdom of Saudi Arabia is organizationally divided into 13 administrative areas and 151 governorates which in turn include several centers that are linked to them administratively. This diverse geography brings together varying conditions — Topographical, meteorological, demographical, and socio-economical — into a common agenda characterized by lifestyle and living standards. These conditions and infrastructure levels vary across geographic units. Urbanization significantly influences lifestyle, with major urban areas fully developed with modern technologies, while secondary areas are gradually modernizing with new structures and systems through redistribution strategies. Additionally, there are typical rural and remote geographic clusters. Within this context, COVID-19 spread as a pandemic. However, it was effectively addressed through innovative strategies that proved rapidly as a model (Asdaq et al., 2022; Yezli and Khan, 2020).

Africa, Europe, and the Americas, have exhibited diverse health, epidemiological, physiological, and morphological characteristics from this infectious disease. This interconnected population faces various natural and manmade risks. The readiness of the accounted governance intervenes with empathetic and compassionate care systems, providing services through digital technology and telephonic support without discrimination (Ali et al., 2020; Al-Knawy et al., 2020; Banjar and Alfaleh 2021). Consequently, the burden of COVID-19 and the case fatality have been managed to a low level, comparable to neighboring Arabian and other Arabian Gulf countries, significantly lower than in Western countries where population age structure, senility, and morbidity patterns played crucial roles in this pandemic (Meo, 2020; Elawad et al., 2021; Alabdulkarim et al., 2020; Robert and Al-Dawish, 2021). Asdaq et al., (2022) highlights a higher epidemic burden in Riyadh, Jeddah and Makkah in terms of positivity, infections, and mortality, with an emphasis on age factors.

In the present paper, the COVID-19 infection and fatality cases are presented on maps to visually facilitate discussions and deliberations. These maps display the affected locations in the country, indicating the intensity of cases year by year. Locations are categorized by levels of COVID-19 cases, infection rate and fatality. This exercise was carried out with the hypothesis that, beyond the well-known facts, there are locally hidden truths influenced by regional disparities and infrastructure development from the beginning till end of the disease spread.

Data and Method:

This analysis relies exclusively on the daily reports of COVID-19 cases published officially by the Saudi Arabia Ministry of Health (https://sehhty.com). Daily data was published for 1141 days beginning from 15th of March 2020, and ending on 30th of April 2023, this data was used for the present analysis, on an annual basis. The daily data was divided into three periods for better analysis and understanding, which are 2020-2021, 2021-2022, and 2022-2023: first period includes data from March 15th, 2020 to March 31st, 2021; the second period encompasses data from April 1st, 2021 to March 31st, 2022, and finally the third period spans data from April 1st, 2022 to April 30th, 2023. This study estimated crude infection rate (per 1,000 population) based on the population size in 2022, and case fatality rate (as deaths per 1,000 COVID-19 reported cases). Additionally, the average monthly COVID-19 cases were estimated for the same specified periods, and identified the month with the maximum COVID-19 reported cases and deaths. In this analysis, location-specific data was visually presented on maps to depict the geographic distribution of the burden of COVID-19 in Saudi Arabia. Shapefiles for Saudi Arabia's administrative areas were digitized, and geo-codes for the 205 COVID-19 examination locations used for plotting. The maps were created using ArcGIS Pro version 3.0.2 and QGIS desktop version 3.30. The COVID-19 cases, deaths, crude infection rates, and case fatality rates were grouped to present them on the maps for the 205 geographic locations according to the specific periods mentioned.

Results and Discussion:

A total of 390,325 COVID-19 cases were reported during the first period (2020-2021); 360,239 cases in the second period (2021-2022); and 89,871 cases in the third period (2022-2023). Infections were rapidly controlled in the country through great coordination and cooperation between various governmental and non-governmental agencies, especially the healthcare, medicines, and public distribution of basic necessities. This rapid decline in COVID-19 cases over a short period of time brought down the crude infection rate (per 1,000 population) from 12 in the first period (2020-2021) to 3 in the third period (2022-2023): a praiseworthy achievement that kept vital events and burden of disease within the limits, despite the spread to 205 geographic locations. Al-Knawy et al., (2020) highlighted the extensive introduction of digital technology during this period, which supported health systems and governments in effectively managing the pandemic and preparing for future threats and global challenges.

A. Infections:

Geographically, during 2020-2021, 80 out of the 205 locations (39%) were identified as having had high COVID-19 infections with more than 500 reported cases. Over the same period, the number of cases reduced in many of these hotspot locations. However, three administrative areas – Riyadh, Eastern Province and Aseer, had the highest number of locations with more than 500 cases (17, 15, 13) locations, respectively), as detailed in Panel 1.

Crowding at residences, streets, commercial areas, and workplaces with a high proportion of immigrants in Riyadh and the Eastern Province administrative area might have contributed to this situation. Aseer administrative area, on the other hand, has many rapidly developing urban areas such as Abha, Khammis Mushayt, Ahad Rufaydah and Mahayel Aseer, with significant infrastructure development activities. The work and living arrangements in these areas, including common spaces like elevators and restrooms, as well as office designs, may have exacerbated transmission, as explained by Aburas (2020). While offices and public utilities in the country are spacious, commercial establishments, private sector service utilities, shops, supermarkets, and immigrant labor accommodations are often not and this might have participated in such high COVID-19 numbers according to Al-Khraif et al. (2019). Additionally, massive construction activities in these areas create challenging living conditions even for the natives. These conditions, coupled with frequent interpersonal and socio-religious contacts, travel, and gatherings, contribute to the spread of the virus. Suburban developments and urban sprawl, along with future city programs add to this complexity, as stated by Al-Khraif et al., (2023).

Panel 1: Number of COVID-19 cases, various periods, in Saudi Arabia by locations

Figure 1A: COVID cases in the time period 2020-21 in the Kingdom of Saudi Arabia by locations

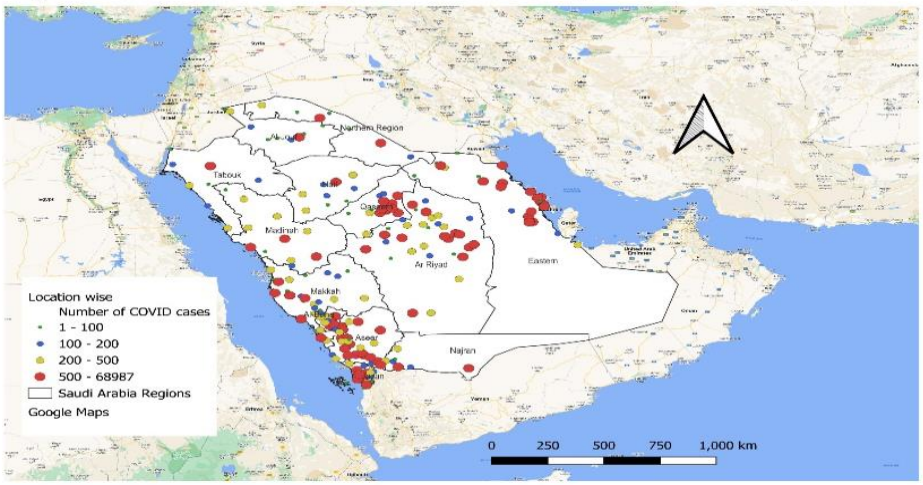


Figure 1B: COVID cases in the time period 2021-22 in the Kingdom of Saudi Arabia by locations

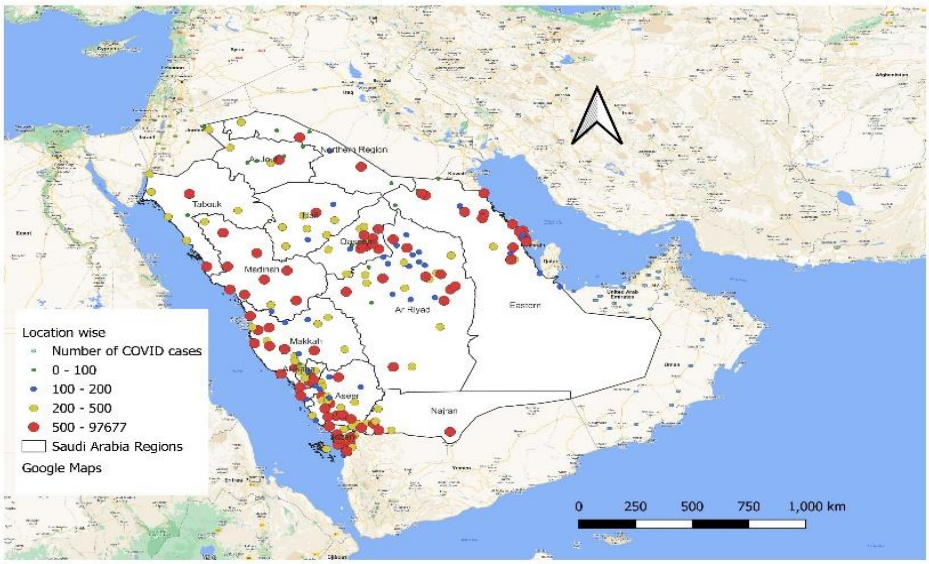
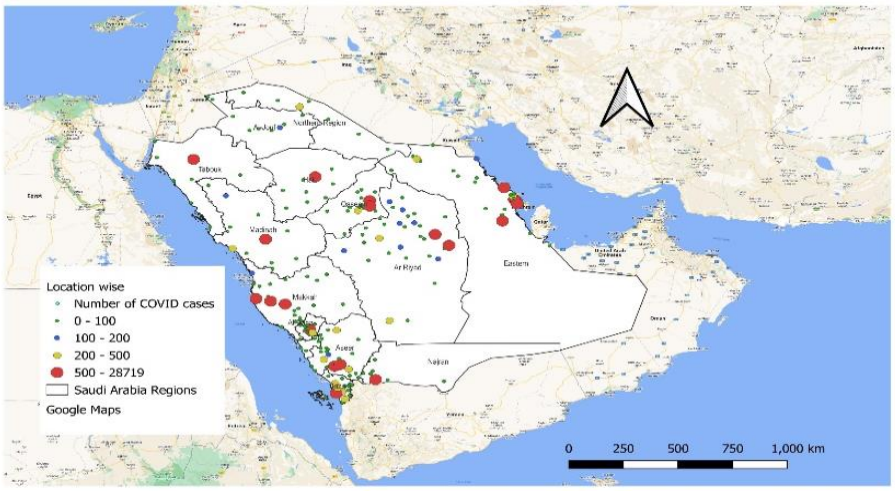


Figure 1C: COVID cases in the time period 2022-23 in the Kingdom or Saudi Arabia by locations



As Ali et al., (2020) and Khraif et al. (2019) point out, the immigrant load, incongruence with native living arrangements in various neighborhoods, leads to this complexity. Nevertheless, COVID-19 infections were strong enough to spread the virus quickly from one residential building to another. Such rapid, challenging transmissions were addressed through digital technologies, tele-medicines, and related epidemic specific healthcare delivery systems (Al-Knawy, et al., 2020; Banjar and Alfaleh 2021).

In contrast, 38 locations had fewer than 100 COVID-19 cases during the 2020-2021 period. Geographic areas reported by the Ministry of Health vary not only in terms of area and population (demarcated into small, medium-sized, and large) but also in livelihoods, urbanization, and infrastructure. Researches from the country support this heterogeneity (Aldossari and Salam, 2024; Ali et al., 2020; Khraif et al., 2019, 2016; Salam et al., 2014; Salam, 2013). Variations in disease spread can be attributed to these heterogeneities, which determine space per person standards – both at work and in living conditions- environmental hygiene, climatic conditions, livelihoods, and interpersonal relations.

During 2020-2021, certain months – July and August – experienced a severe spread (called the first wave). A similar pattern was observed in 2021-2022 (called the second wave), especially during January and February. Although the number of affected cases decreased overall, heavier waves at specific months strained the healthcare system (Salam et al., 2022[1]: Aldossari and Salam, 2024). These monthly waves reduced the number of locations with fewer than 100 cases to 20 locations, but increased those with more than 500 cases from 80 in 2020-2021 to 84 in 2021-2022, despite the overall decrease in the number of cases. This wider geographic spread created an increased burden, challenging the reach of healthcare delivery and public distribution systems.

The increase in locations with over 500 cases could be due to the widespread infections in Makkah, Madina, and Jazan administrative areas. Previous research by Salam et al., (2022[1&2]) and Aldossari and Salam (2024) support these findings. Slowly and notably, the number of locations with fewer than 100 cases increased to 156, resulting from an overall reduction in cases, over the period. While Makkah and Madina were popular pilgrimage destinations, Jazan's population density and massive development served as explanatory variables for the superspreaders (Ebrahim and Memish, 2020).

Riyadh governorate (in Riyadh administrative area) considered as a single location (a wide geographic area) has recorded the highest number of infection cases during all three time periods, with 68,987 cases in the first period, 97,677 cases in the second period, and 28,719 cases in the third period. This could be attributed to the high population density, administrative and service infrastructure, and commercial activity at this national capital. It is with these well-set systems and structures aided by digital technologies and tele-medicines, infections controlled, effectively, in a short span (Al-Knawy, 2020; Banjar and Alfaleh, 2021). During 2022-2023, infections reduced significantly but had few locations specific waves in the small administrative areas of Najran, Hail, and Al-Baha freeing the major ones.

This period was a subsiding one with powerful vaccinations and related control measures (Aldossari and Salam, 2024; Aldossari, 2023; Salam et al., 2022[1&2]).

While analyzing the crude infection rate across locations, a decrease in the number of locations with an infection rate below 5 per 1,000 population between 2020-2021 and 2021-2022 was observed (Panel 2). Accordingly, there was a rise in the number of locations with an infection rate above 15 per 1,000 population in 2021-2022 compared to 2020-2021. This indicates an increase in severity of disease spread in the second year, due to the second wave, as well as the casualties and side effects of first wave. These differentials had geographic and seasonal factors. Waves of infection were strong during these periods, not only in Saudi Arabia and nearby Arab countries but also across the globe.

In 2020-2021, the highest number of locations with an infection rate above 15 per 1,000 population was found in Riyadh administrative area (14), followed by the Eastern Province (13) and Aseer administrative area (11). However, in 2021-2022, the maximum number of locations with an infection rate above 15 per 1,000 population was observed only in Makkah governorate, the holy city of domestic and international pilgrimage. A study from Al-leith, a town in this administrative area, revealed that age is a significant variable in transmission through direct contact, particularly when precautionary measures are not followed (Elawad et al., 2021). Age distribution has a direct impact on morbidity and mortality, especially of infectious diseases.

Panel 2: Crude infection rate, various periods, in Saudi Arabia by locations

Figure 2A: Crude infection rate (per 1000 population) in the time period 2020-21 in the Kingdom of Saudi Arabia by locations

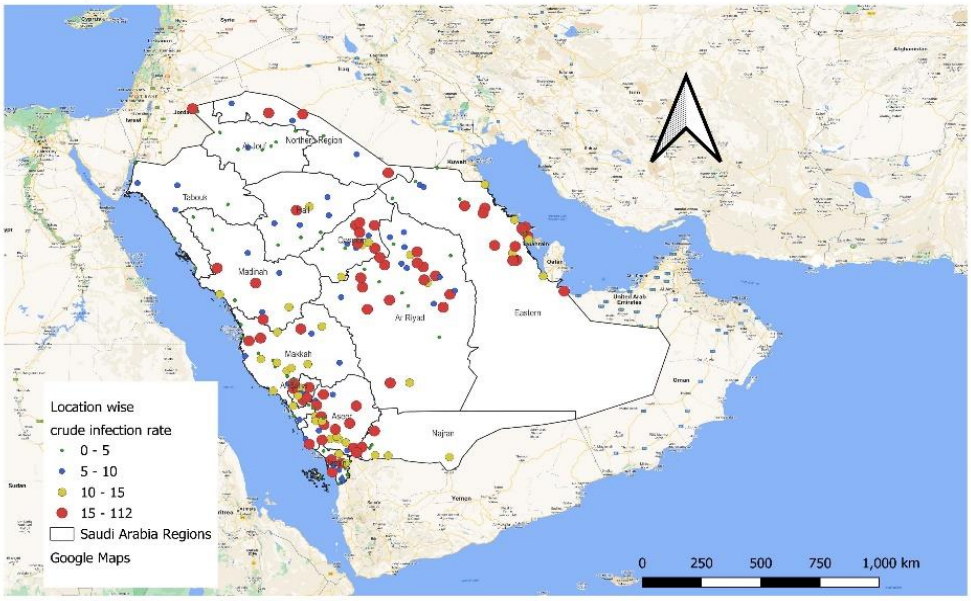


Figure 2B: Crude infection rate (per 1000 population) in the time period 2021-22 in the Kingdom of Saudi Arabia by locations

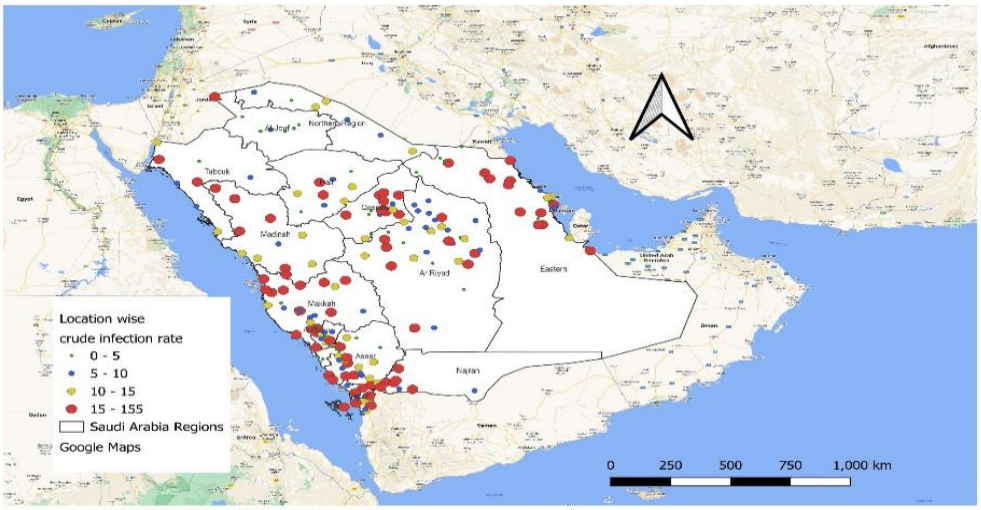
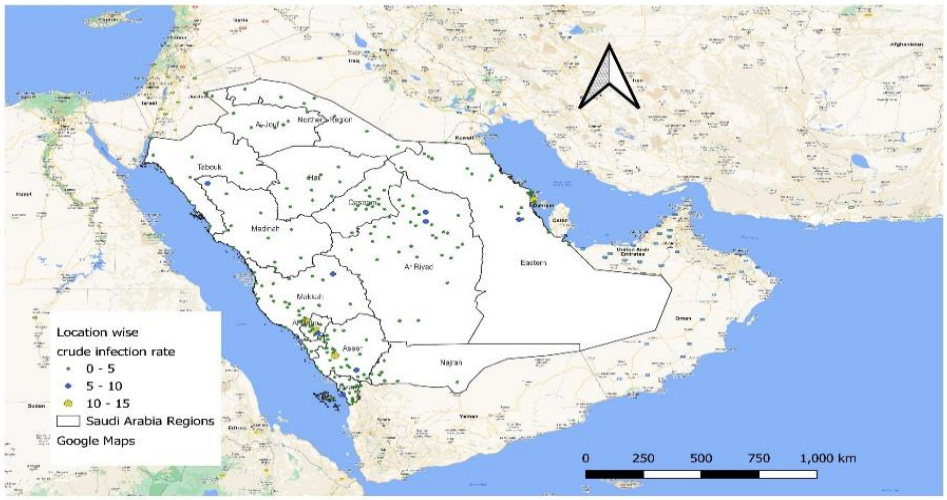


Figure 2C: Crude infection rate (per 1000 population) in the time period 2022-22 in the Kingdom of Saudi Arabia by locations



However, the highest infection rates per 1,000 population during different time periods were observed Aseer administrative area and namely in Ballasmar governorate for 2020-2021 and 2021-2022 and in Ad-Dhahran governorate (Eastern Province) for 2022-2023. These findings indicate vulnerability of medium-sized locations to epidemic spread, reflecting low infrastructure provisions and preparedness (Aldosari and Salam, 2024). This vulnerability is particularly due to massive developments creating substandard living arrangements for workers engaged in construction and supplementary services, often hired from other countries. While the first and second waves had serious repercussions, they were largely controlled, to a great extent, leading to a lesser impact in 2022-2023. Vaccinations have created herd immunity in the country.

Next, the highest number of reported cases in a month across different locations was analyzed. Overall, the peak count in a month exceeded 500 in 35 locations in the first period (2020-2021), 34 locations in the second period (2021-2022), and 9 locations in the third period (2022-2023) as shown in Panel 3. The Eastern Province constantly reported the highest number of locations with more than 500 cases in a month, throughout the study period. However, Riyadh governorate (Riyadh administrative area) reported the highest counts (25,946, 39,752, and 10,158 cases, respectively), followed by Jeddah (Makkah administrative area) (10,980, 19,770, and 4,159, respectively) in a month. These two localities, considered as the metropolitan cities of the country, feature high-density living with diverse neighborhoods,

including high rises, modern townships, villa congregations, independent houses, old dilapidated settlements. Consequently, they have populations ranging in all socio-economic and demographic variables. Additionally, many industrial and commercial hubs are located here, where people with different backgrounds frequently interact. Such interactions lead to crowding while travelling, during refreshments, shopping, praying, and at other common places. All these factors may have contributed to the increased infection rate in these two geographic areas. In the Eastern Province, major cities like Dammam, Al-Khubar, Jubail, Al-Ahsa, and rapidly developing future cities exhibit similar patterns. As noted earlier, there were fewer cases in 2022-2023, with a subsidized infection rate on a month-by-month basis.

Panel 3: Highest number of cases in a month, various periods, in Saudi Arabia by locations

Figure 3A: Highest number of cases reported in a month in the time period 2020-21 in the Kingdom of Saudi Arabia by locations

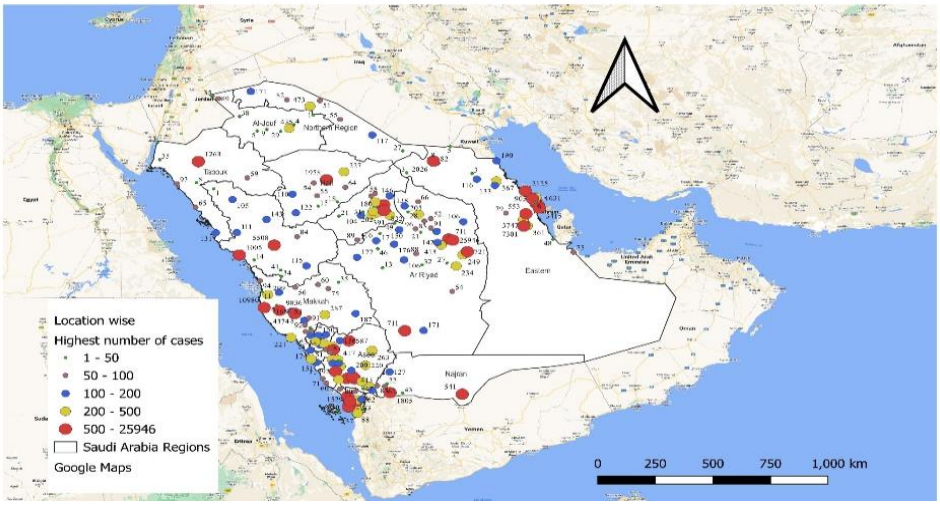


Figure 3B: Highest number of cases reported in a month in the time period 2021-22 in the Kingdom of Saudi Arabia by locations

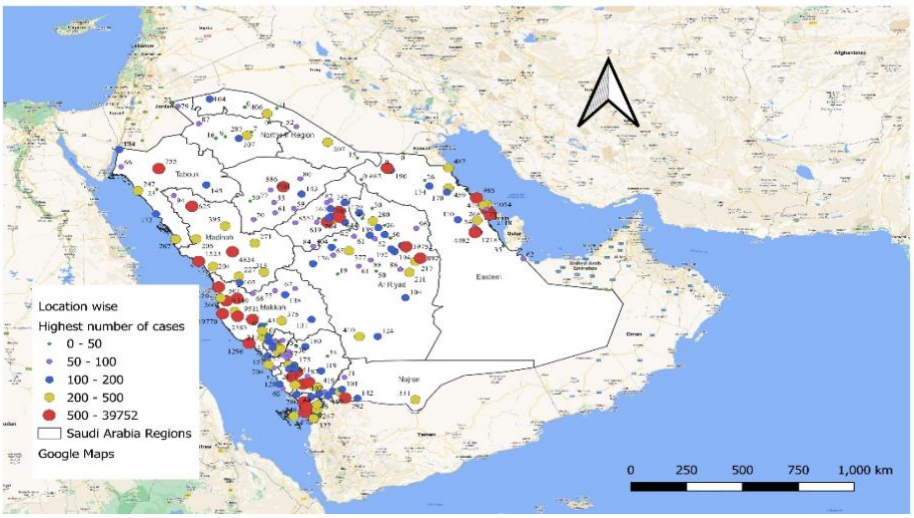
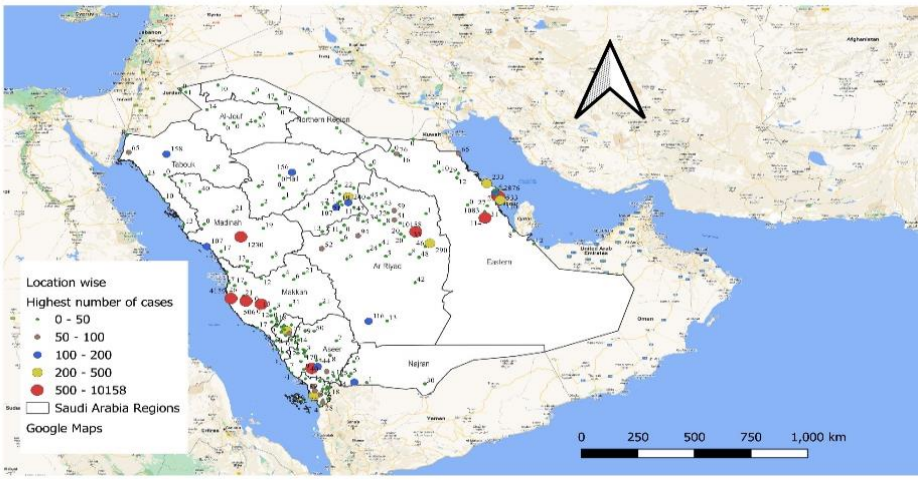


Figure 3C: Highest number of cases reported in a month in the time period 2022-23 in the Kingdom of Saudi Arabia by locations



B. Fatality:

As pointed out by Alabdulkarim et al. (2020), case fatality in general was low in the Arabian Gulf countries, including Saudi Arabia, despite recorded COVID-19 deaths of 6,667 in the first period (2020-2021), and 2,369 deaths in the second period (2021-2022); and 600 deaths in the third period (2022-2023), as charted by location (Panel 4). The two waves mentioned earlier caused a heavy burden of COVID-19, which was controlled to limit within a short span. The spatial distribution of COVID-19 death cases revealed a consistent increase in the number of locations with fewer deaths over time. This reduction in epidemic burden can be attributed to various programmatic measures, including vaccinations, credited to the Ministry of Health. For instance, the number of locations reporting less than 2 deaths increased significantly from 131 locations in 2020-2021 to 166 locations in 2022-2023. In both the 2020-2021 and 2021-2022 periods, the highest number of deaths was reported in Jeddah governorate, while in 2022-2023, it was in Ad-Dammam in the Eastern Province. This shift could be attributed to the strategic location of the Eastern Province, with its numerous urban agglomerations, ports (air and sea) and overall heterogeneity.

Panel 4: Number of COVID deaths, various time periods, in Saudi Arabia by locations

Figure 4A: COVID deaths in the time period 2020-21 in the Kingdom of Saudi Arabia by locations

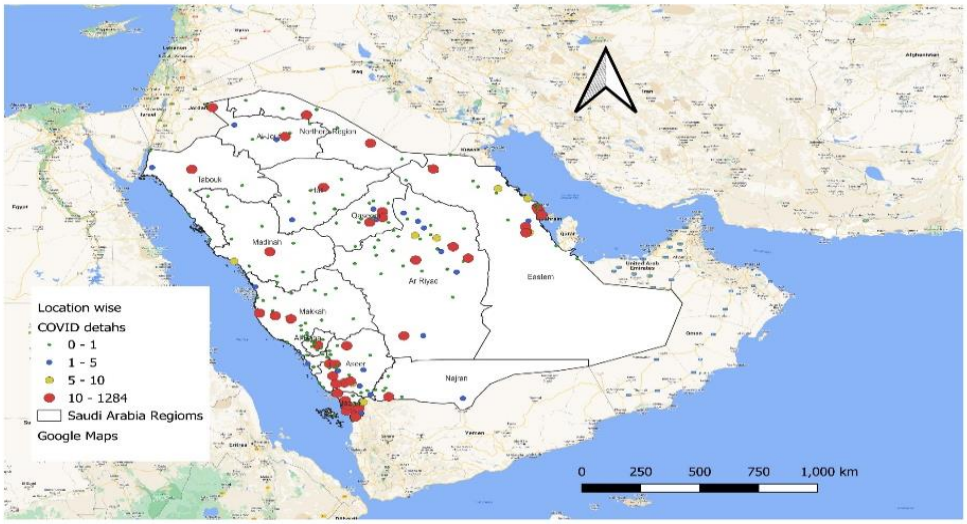


Figure 4B: COVID deaths in the time period 2021-22 in the Kingdom of Saudi Arabia by locations

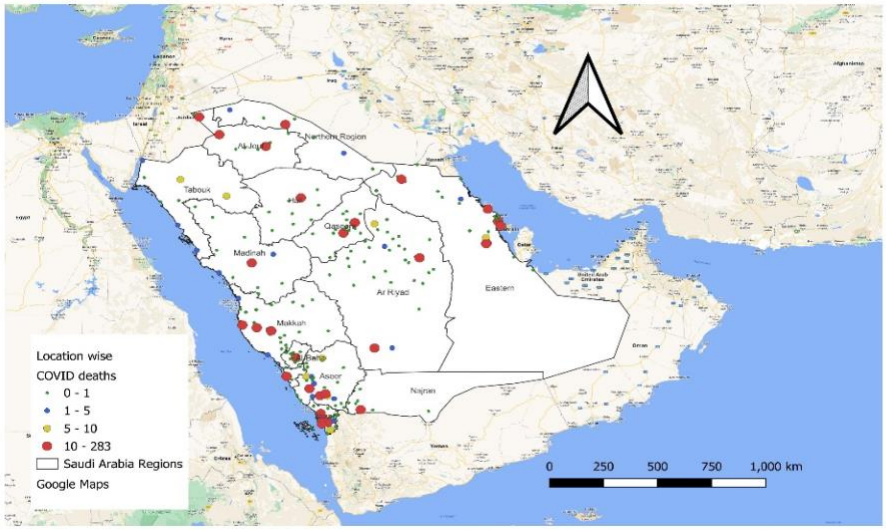
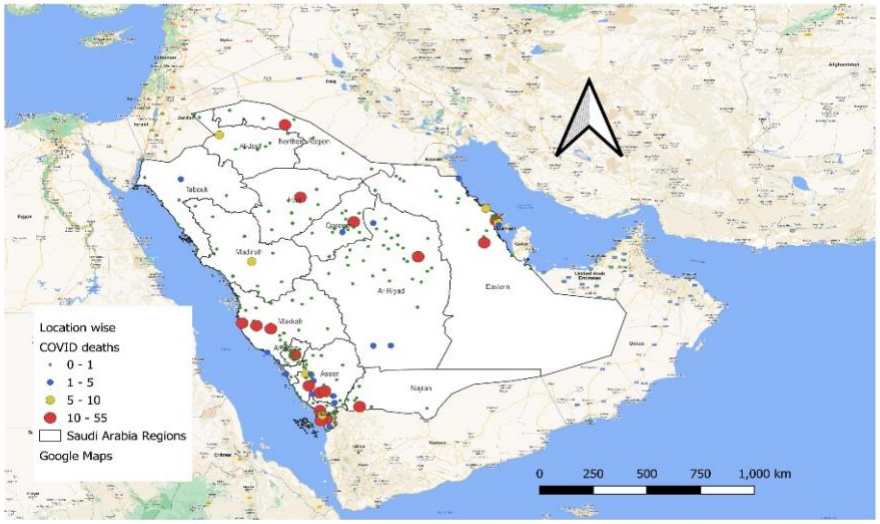


Figure 4C: COVID deaths in the time period 2022-23 in the Kingdom of Saudi Arabia by locations



Population age distribution differs in Saudi Arabia from one geographical area to another due to demographic heterogeneity, influencing case fatality (Aldossari, 2023; Salam et al., 2022[1&2]; Elawad et al., 2021; Alabdulkarim et al., 2020). Apart from those geographic divisions, the Southwestern side bordering Red Sea and Yemen comprising of small administrative areas of Jazan, Najran, Aseer, and Al-Baha have serious effect in all the three periods, similar to the infections. The spatial distribution of the case fatality rate in 2020-2021 revealed three locations with the highest rates: Al-Aridah followed by Al-Harth both in Jazan administrative area, and Al-Baha governorate in Al-Baha administrative area (see Panel 5). In 2021-2022, the areas of Al-Qurayyat and Tubarjal governorates (Al-Jouf administrative area), along with Al-Qunfudhah governorate in Makkah administrative area, reported the highest rates. All these are small governorates in terms of size and population, but rapidly developing towns (small cities), where infrastructure for healthcare networking are not in a full place.

However, bearing in mind the declining number of cases over the period, interpreting the case fatality rate by location for the year 2022-2023 should be done with caution. For example, it was found that an increase in the number of locations estimating a case fatality rate of 10 per 1,000 cases, rising from 22 to 35 locations between the periods 2021-

2022 and 2022-2023. Perhaps, the consequences of the epidemic that created chronic conditions that resulted in fatality, in the third year (2022-2023). In other words, fatality continued even after the infections ceased. This is the nature of pandemics precipitating diseases by damaging physiological functions and decaying body organs ultimately leading to fatality. Rightly put, aftereffects of COVID-19 are inherent in the population as a future threat. The most affected geography is the Southwestern part of Saudi Arabia, in terms of affected locations, for all three periods. This location is a conflict prone, with issues of illegal migration and border disputes. Consequently, the overcrowded floating population with unstable living arrangements and distributions, along with calamities and disaster increased vulnerability. While the major administrative areas have well equipped infrastructure to cope with threats, the medium sized emerging areas have average capability, and the smaller ones have low levels of capability. This disparity in infrastructure, systems, and structures explains the inconsistency.

Panel 5: Case fatality rate, various periods, in Saudi Arabia by locations

Figure 5A: Case fatality rate (per 1000 cases) in the time period 2020-21 in the Kingdom of Saudi Arabia by locations

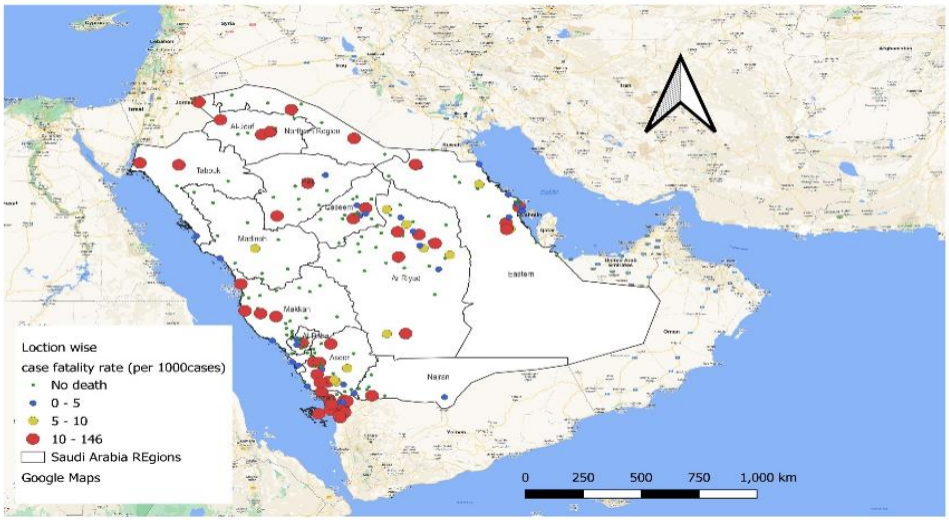


Figure 5B: Case fatality rate (per 1000 cases) in the time period 2021-22 in the Kingdom of Saudi Arabia by locations

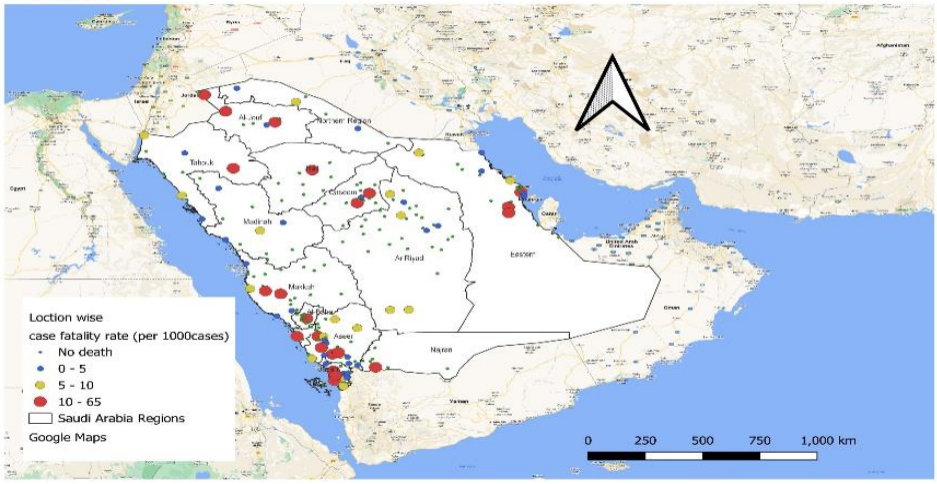
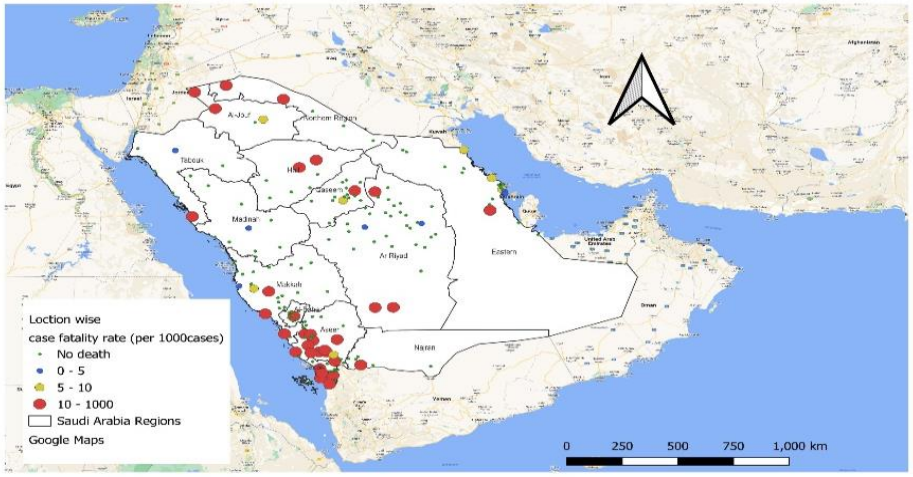


Figure 5C: Case fatality rate (per 1000 cases) in the time period 2022-23 in the Kingdom of Saudi Arabia by locations



In the analysis of location-specific data, it is noteworthy that Riyadh city consistently recorded the highest number of deaths in a single month during 2020-2021 and 2021-2022 (Panel 6). However, when considering population size and number of infections, this number is relatively low compared to other locations. Overall, during the 2020-2021 period, more than 10 deaths were reported as the highest monthly count in 27 locations, while in 2021-2022, this occurred in 15 locations. Notably, no location reported a highest monthly death toll exceeding 10 during the subsiding period of 2022-2023. In the Eastern Province, five locations reported a highest monthly death toll beyond 10 during 2020-2021 marking it as a highly affected administrative area. Likewise, both Aseer and Jazan administrative areas reported 4 locations each reporting the highest monthly death toll exceeding 10. Both these areas have rapidly expanding urban areas with massive infrastructure development.

Panel 6: Highest number of deaths in a month, various periods, in Saudi Arabia by locations

Figure 6A: Highest number of deaths reported in a month in the time period 2020-21 in the Kingdom of Saudi Arabia by locations

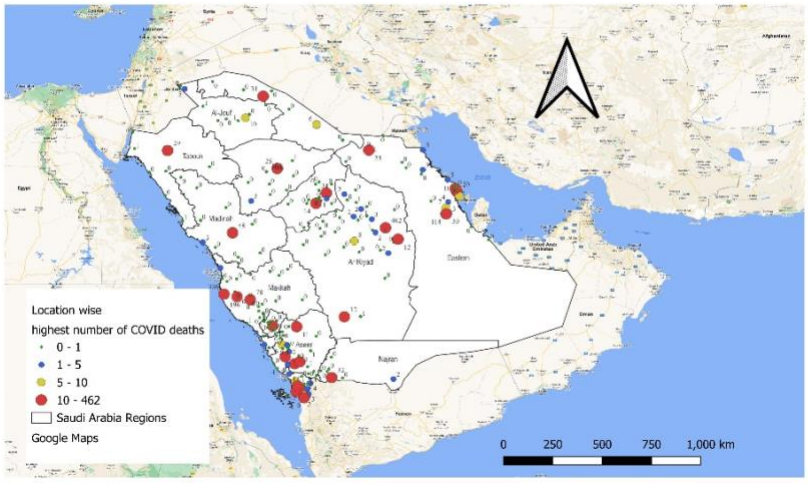


Figure 6B: Highest number of detahs reported in a month in the time period 2021-22 in the Kingdom of Saudi Arabia by locations

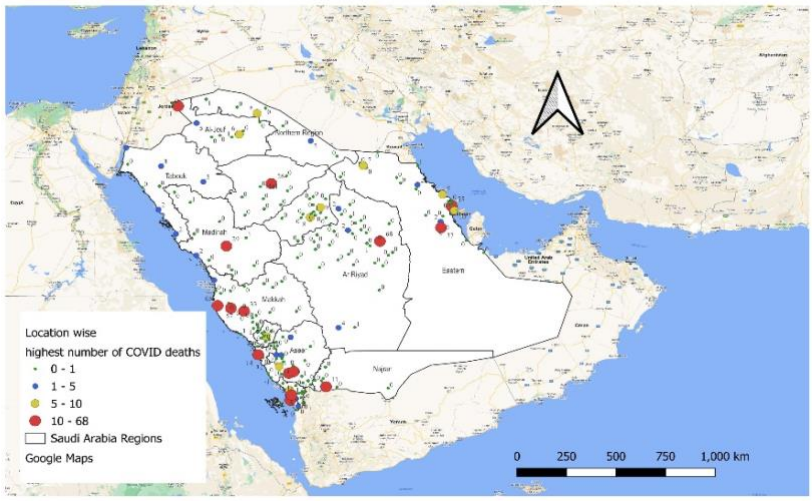
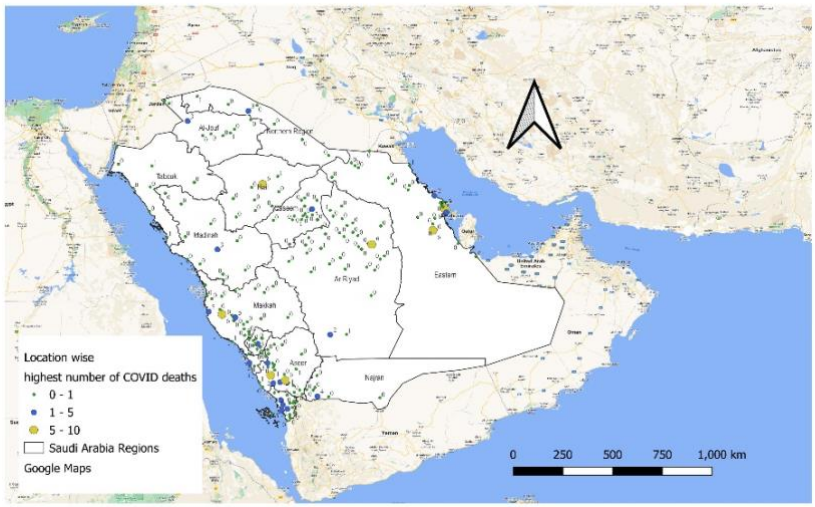


Figure 6C: Highest number of deaths reported in a month in the time period 2022-23 in the Kingdom of Saudi Arabia by locations



Conclusions:

Mapping holds significant importance not only in geo-social applications but also in health programs and policies. Its sophisticated technology facilitates epidemic identification, the emergence of new localities, social strata, and clusters, changing vulnerabilities and at risk, and understanding trends and patterns. This analysis of Saudi Arabia's COVID-19 experience clearly illustrates variations – raises and falls - by location for the periods considered. Maps were created to depict both the spread and subsidence of infections and cause-specific fatalities, demonstrating regional scales across major, medium-sized, and smaller locations. The data reveals a higher burden at smaller, rapidly developing locations, especially in the southwestern part of Saudi Arabia, not only during the two waves but also in the post epidemic period. Fatalities were also mapped by locations showing infection density across various time periods and waves. However, this research is limited by lack of data access to explore socio-demographic characteristics of reported cases and deaths. A number of maps could be produced to depict a clear picture of these variations over different time periods and locations.

References:

Aburas, R. (2020). Work environment during the COVID-19 pandemic in Saudi Arabia. *Journal of Public Health Research*; 9(s1), 69-74. https://doi.org.10.4081/jphr.2020.1968

Alabdulkarim, N., Alsultan, F., Bashir, S. (2020). Gulf Countries Responding to COVID-19. *Dubai Medical Journal* 3(2), 58–60. https://doi.org/10.1159/000508662

Aldossari H.M. and Salam A.A. (2024) COVID-19 infections, recoveries, and mortality: an ANOVA model of locations and administrative areas in Saudi Arabia. *Frontiers in Public Health* 12(1281289). https://doi.org10.3389/fpubh.2024.1281289

Aldossari, H.M. (2023). Exploring interrelationships of COVID-19 dimensions in Saudi Arabia: a systematic review. *Bulletin of National Research Center,* 47(1), 73. https://doi.org/10.1186/s42269-023-01041-w

Ali, M.A., Al-Khani, A.M. Sidahmed, L.A. (2020). Migrant health in Saudi Arabia during the COVID-19 pandemic. *Eastern Mediterrannean Health Jo*urnal. 26(8), 879–880. https://doi.org/10.26719/ emhj.20.094

Al-Khraif, R. M., Elsegaey, I., Al-Mogarry, M., & Abdul Salam, A. (2022). Saudi Arabia's City-Ranking Index (SACRI) methodology executed: Preliminary findings. *Journal of Economics & Management*, 44, 376-392. https://doi.org/10.22367/jem.2022.44.15 and doi.org/10.22367/jem.2023.45.03

Al-Knawy, B., Adil, M., Crooks, G., Rhee, K., et al. (2020). The Riyadh Declaration: the role of digital health in fighting pandemics. *Lancet*. 14;396(10262), 1537-1539. https://doi.org/10.1016/S0140-6736(20)31978-4

Asdaq S.M.B., Rabbani S.I., Alshammari, M.K., et al., (2022). Burden of COVID-19: a preliminary analysis in the population of Saudi Arabia. *PeerJ* 10:e13219. http://doi.org/10.7717/peerj.13219

Banjar, W.M., Alfaleh, A. (2021). Saudi Arabia experience in implementing telemental health during COVID-19 pandemic. *Saudi Journal of Health System Research*. https://doi.org.10.1159/000519637

Ebrahim, S.H., Memish, Z.A. (2020). COVID-19: preparing for superspreader potential among Umrah pilgrims to Saudi Arabia. *Lancet*. 395(10227):e48. https://doi.org.10.1016/S0140-6736(20) 30466-9

Elawad, M., Al-Thubyani, D., Almhdawi, A., et al. (2021). An Epidemiological study of COVID-19 cases in Al-Leith, Saudi Arabia. *Cureus* 13(12), e20457. https://doi.org.10.7759/cureus.20457

Khraif, R.M., Salam, A,A., Nair, P.S., Elsegaey. I. (2019). Migration in Saudi Arabia: Present and Prospects. In Rajan S. I. and Saxena, P. (Eds.) *India's Low-Skilled Migration to the Middle East: Policies, Politics and Challenges*. Palgrave Macmillan, 99–123. https://doi.org/10.1007/978-981-13-9224-5_5

Khraif, R., Salam, A.A., Potty, R.S., Aldosari, A., Elsegaey, I. and AlMutairi, A. (2016). Variations in basic demographics consequential to population size of governorate in Saudi Arabia *SpringerPlus* **Volume:** 5(**Article Number:** 1431). https://doi.org/10.1186/s40064-016-3126-0

Meo, S.A. (2020). COVID-19 pandemic: Saudi Arabia's role at national and international levels. Journ*al of Diabetes Science and Technology*; 14(4), 758–759. http://.doi.org.10.1177/ 1932296820930068

Robert, A.A., and Al-Dawish, M.A. (2021). COVID-19 in people with diabetes: perspectives from Saudi Arabia *Current Diabetes Reviews*, 17(6):e111020187810. http://doi.org.10.2174/1573399 816999201110195222

Salam, A.A., Khraif, R.M., Elsegaey, I. (2022[1]). COVID-19 in Saudi Arabia: an overview. *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2021.736942

Salam, A.A., Al-Khraif, R.M., Dilip T.R., Elsegaey I.(2022[2]). Coronavirus disease 2019 in proportion to population: a historical analysis of Saudi Arabia. *Bulletin of the National Research Centre*; 46(Article number: 198). https://doi.org/10.1186/s42269-022-00876-z

Salam, A.A., Elsegaey, I., Khraif R., and Al-Mutairi, A. (2014). Population distribution and household conditions in Saudi Arabia: reflections from the 2010 Census. *SpringerPlus*. 3 (Article Number: 530). http://www.springerplus.com/content/pdf/2193-1801-3-530.pdf

Salam, A.A. (2013). Population and household census, Kingdom of Saudi Arabia 2010: facts and figures. *International Journal of Humanities and Social Science*; 3(6 Special Issue), 258-263. http://www.ijhssnet.com/journals/Vol_3_No_16_Special_Issue_August_2013/31.pdf

Yezli, S. and Khan, A. (2020). COVID-19 social distancing in the Kingdom of Saudi Arabia: bold measures in the face of political, economic, social and religious challenges. *Travel Medicine and Infectious Disease*; 37(101692). https://doi.org/10.1016/j.tmaid.2020.101692

AI &ML Implications on Cyber Security-Data and Privacy Protection

Kiran Kumar Goud
Digital & Analytics, HCL America, Orlando, USA

Abstract

The goal of this paper is to present Generative AI (Gen AI) impacts on Cyber security & Data Privacy protection, on one side AI can help to detect and prevent Cyber-attacks on the other side it can aid Hackers /Cyber criminals to use ML models to bypass Security controls and capture critical Business information of Organizations leading financial loss and cause havoc in society. Hence its very significant when adapting Gen AI Technology, Organizations to analyze threats to security and risk to harm to human society and act ethically and morally responsible.

Keywords: Data Science, Analytics, Cyber security, Privacy

Introduction

In the past 2 decades, Artificial intelligence (AI) and Machine learning (ML) has revolutionized our society, organizations and people's lives in multifaceted ways. AI and ML are embedded into our day-to-day decision making, impacting our well-being and security. AI has been forefront of C-level executives in this decade and expected to multiply its applications in almost all areas in organizations and government sectors from data generation to prediction models to make decisions on hiring, profitability and legal aspects. In other words, Data becomes the commodity everybody would like to acquire, and this already led many C-level Executives consider GenAI, Cyber Security and Privacy Protection as top 3 items of their Agenda(Gartner 2023 Data) Ease of Use generative AI use in cyber security

Cyber Security core area & use of AI : 'Having AI would provide cybersecurity organizations with a significant edge in preventing future attacks. Stopping breaches before they occur would not only help protect the data of individuals and companies, but also lower IT costs for businesses' (AI and Cybersecurity: A New Era | Morgan Stanley)

Threat Management (Detection and Prevention).

Automated Incident response (Auto Tron)

Vulnerability Scanning and Automated Patch ManagementAI can help faster in vulnerability scanning

Penetration testing & SIEM Monitoring

Security Findings — Critical and High Remediation

Antivirus (AV) & Anti Malware (AM) Detection

Risk Assessment

Cyber Security risk factors for GenAI & Large Language Models in Organizations

Social engineering schemes: AI Models are helping in Social Engineering for attackers and defenders. As we have observed it AI can empower attackers with creative ways of phishing.

Password hacking: Cybercriminals exploit AI to improve the algorithms they use for deciphering passwords. 'The concern regarding potential oversights or vulnerabilities in AI models, along with the risk of adversaries using AI to manipulate models to evade detection, presents a key challenge in Threat management for organizations — Brock Bell

Deepfakes: This type of deception leverages AI's ability to easily manipulate visual or audio content and make it seem legitimate.

Data poisoning: Hacker's "poison" or alter the training data used by an AI algorithm to influence the decisions it ultimately makes.".

Generative AI Impacts & Ethical Concerns in Enterprise Cyber Security

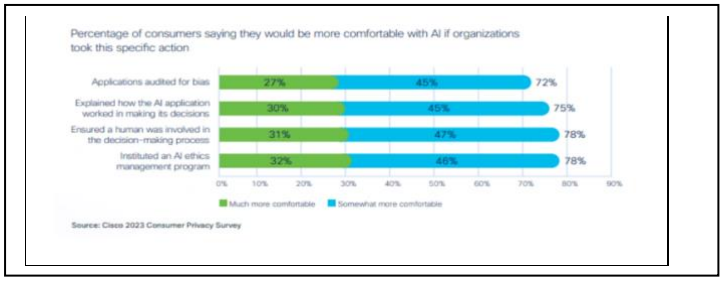
Bio-Ethics Framework	GenAI and Cyber Security concerns
Beneficience	Data Security, Privacy
Non-maleficence	Data anonymization
Justice	Data Bias-Fairness
Explicability	AI Model Transparency
Autonomy	Data Protection

Bio-ethics framework applied to GenAI in Cyber Security

Beneficence &non- maleficence

Data Security, Privacy Protection

Adopt Data Ethics Farmwork (Cyber security risks to artificial intelligence — GOV.UK (www.gov.uk)



Data Regulation : EU GDPR/ UK Data Protection Act

Data Integrity

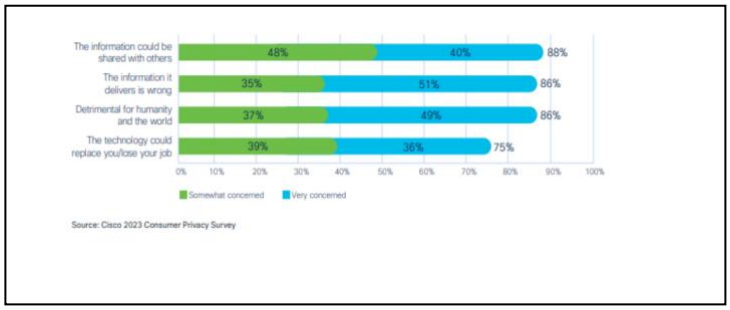
Data Governance & Security Policy checklists

Data anonymization : Use the minimum data necessary to achieve desired outcome

AI & ML- Data Privacy & User Consent

Justice: Bias in Data and its impacts — Model data is free from bias and is it generating nonbiased output .

Explicability : AI Model transparency — Is model prediction explainable in simple terms



Accountability Who is responsible if an AI system makes a decision that leads to a bad outcome !

Model Design & Societal considerations : Did model consider societal benefits in its design. Authors and Affiliations

AI & Data Privacy protection laws — Who controls them? (Autonomy)

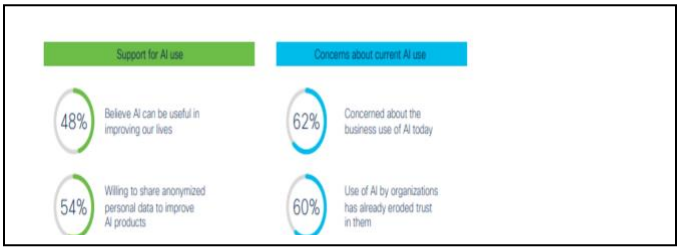
50% favored Government and 21% Organizations and 19% inclined for individuals. Overall, it seems majority of people look for government to regulate Privacy laws instead of Private companies.

Support of AI use of Privacy data Vs Concern about AI use of Privacy data Figures and Tables

Cisco Survey

Support of AI audited for Bias and Data Transparency of the model:

'Seventy-two percent respondents indicated that having AI products and solutions audited for bias and explain their working model and institute AI ethics management would really make them comfortable with the AI'



User concerns about Risks with Gen AI :

Cisco survey, its observed almost 80% of consumers are concerned that the information/data can be shared and results from Gen AI could be wrong and could be detrimental to humanity and world

Concluding Remarks

With tremendous growth of AI &ML, and its applications in today's world, as outlined in this paper, it presents a lot of excitement for technology improvement as well peril to ethical and human integrity and critical thinking. It was well established the ethical risks of GenAI applications in Cyber Security to Data Privacy for both individuals and corporations. This calls for high quality, comprehensive regulations from both enterprise and governments to protect Privacy and Human integrity.

Currently, there is no complete AI federal legislations in United States. There should be AI ethical standards and oversight bodies to ensure ethical use of AI while also protecting people's privacy. This means collaboration and communication across stakeholders, governments, Corporate and civil society. By working together, build comprehensive methodology that promotes Privacy and Security, to harness AI benefits in a manner this is ethical, sustainable and respects Human dignity and integrity

References

Fabian, D., Crisp, J.: Why Red Teams Play a Central Role in Helping Organizations Secure AI Systems. Google (2023)
Cisco 2023 Consumer Privacy Survey Report

Pramukh Ganeshamurthy Block COVID-19 Phishing Emails at Machine Speed (paloaltonetworks.com)

Ben-Sasson, H., Greenberg, R.: 38 TB of data accidentally exposed by Microsoft AI researchers (2023). https://www.wiz.io/blog/38-terabytes-of-private-data-accidentally-exposed-by-microsoft-airesearchers..

Data Ethics Framework (publishing.service.gov.uk)

Pope Francis (Pope Francis warns of AI in first-ever G-7 papal address, urges 'safegua

Park, K.: Samsung bans use of generative AI tools like ChatGPT after April internal data leak https://techcrunch.com/2023/05/02/samsung-bans-use-of-generative-ai-tools-like-chatgptafter-april-internal-data-leak/

OpenAI: Introducing GPTs: (2023). https://openai.com/blog/introducing-gpts)

AI and Cybersecurity: A New Era | Morgan Stanley)

Consumer perspectives of Privacy and Artifical Intelligence(iapp.org)

Kiran Gundrai completed Bachelor of Electrical and Electronics in 2002 from Nagarjuna University, India and Master of Science In Data Science from Eastern University, Philadelphia USA in 2024. Kiran has over 20 year experience in Digital & Analytics Product Implementations at multiple Fortune 500 companies. Currently he works full time at HCL America for Walt Disney Parks and Resort technology.

GenAI enabled Supply Chain optimization

Kiran Kumar Goud, Certified PMI ACP, MS DS, PMPO SAFe 5.0
Sr Technical Manager, Digital & Analytics, HCL America/Walt Disney Parks & Resorts Technology, Orlando, USA

Abstract :

Generative AI (GenAI) applications shaping every aspect of an organization and highly impacting key supply chain areas for an organization. Many Fortune 500 companies have started embedding AI and ML some or other form into their supply chain aspects. The paper discusses end to end supply chain optimization enabled by AI and ML and its impacts on the industry.

Introduction :

Organizations are adaptoing emerging technologies as enablers for above listed Supply chain capabilities. With respect to demand planning, AI and ML driven forecastingand replenishment helping supply chain to have accurate levels of forecasting and fulfill orders timely.

Supply Chain Capabilities:

Plan - Demand Planning, Sales Forecasting, Replenishment, Supply Planning, Supplier Order Recommendations

Source – Supplier/vendor management, Supplier Orders, Cross-dock orders, Transfer order, Receive product, Supplier Payments

Deliver – Dynamic slotting, Cycle counting, Yard management, Picking Optimization, Storage, Order Management

Return – Warehouse Returns, Vendor Returns, Supplier Credits

Enable- Labour Management, Integration Plantform, Cloud Migration, Mobile, Security, Data Warehousing, Analytics, Robotic Hub

Forecasting Analytics as Retail Solution :

AI and ML models, both supervised and unsuprvised being utilized to generate dialy basis forecasting as retail solution. Business users can view forecasting key performance indicators (KPIs) aka performance measures such as Accuracy, precision of forecasting model generates to help manage future demand for the organization. These forecasting driven by analytics, provides in depth information at product and item level for a given time period and also provides capability to review key factors that influence the forecasting prediction.

Why to use AI and ML models in Supply chain optimizations : Modernization of technology :

Replace end of life systems/ outdated platforms Update and standardize supply chain systems and processes across enterprise representing substantial annual revenue by replacing using SAAS (softyware As A Solution) solution enabled by AI and ML models.

Leverage off-the-shelf SaaS solutions with limited customizations to support business growth while gaining the benefits of a SaaS platform

Drive Efficiency of Supply chain Systems :

Drive a reduction in overtime labor costs through reduced daily inventory counting and integrated daily sales data,.

Drive a reduction in cost of sales through more effective production planning, recipe tracking, and visibility to safety stock

Order Optimization :

Drive a reduction in working capital through optimized demand and supply forecasting.

Drive a reduction in cost of sales through more effective production planning, recipe tracking, and visibility to safety stock

AI and ML Usecases for various domains (Refer to Databricks Big book for AI)

INDUSTRY	USE CASE
Retail	▪ Product Recommendations / Search Ranking using user preferences, search history, location . . . etc. ▪ Image and metadata based product search ▪ Inventory management and forecasting using sales data, seasonal trends and market/competitive analysis
Education	▪ Personalized learning plans based on past mistakes, historical trends and cohorts ▪ Automated grading, feedback, follow-ups and progress reporting ▪ Content filtering for issued devices
Financial Services	▪ Natural language apps for analysts and investors to correlate earning calls and reports with market intelligence and historical trends ▪ Fraud and risk analysis ▪ Personalized wealth management, retirement planning, what-if analysis and next-best actions
Travel and Hospitality	▪ Chatbots for personalized customer interactions and tailored travel recommendations ▪ Dynamic route planning using weather, live traffic patterns, and historical data ▪ Dynamic price optimization using competitive analysis and demand-based pricing
Healthcare and Life Sciences	▪ Patient/member engagement and health summaries ▪ Support apps for personalized care, clinical decisions and care coordination ▪ R&D report summarization, clinical trial analysis, drug repurposing
Insurance	▪ Risk assessment for mortgage underwriting using text and structured data about properties and neighborhoods ▪ User chatbots for questions about policies, risk and what-if analysis ▪ Claim processing automation
Technology and Manufacturing	▪ Prescriptive maintenance and diagnostics for equipment using guided instruction ▪ Anomaly detection on live data stream against historical statistics ▪ Automated analysis for daily production / shift analysis and future planning
Media and Entertainment	▪ In-app content discovery and recommendations, personalized email and digital marketing ▪ Content localization ▪ Personalized gaming experiences and game review

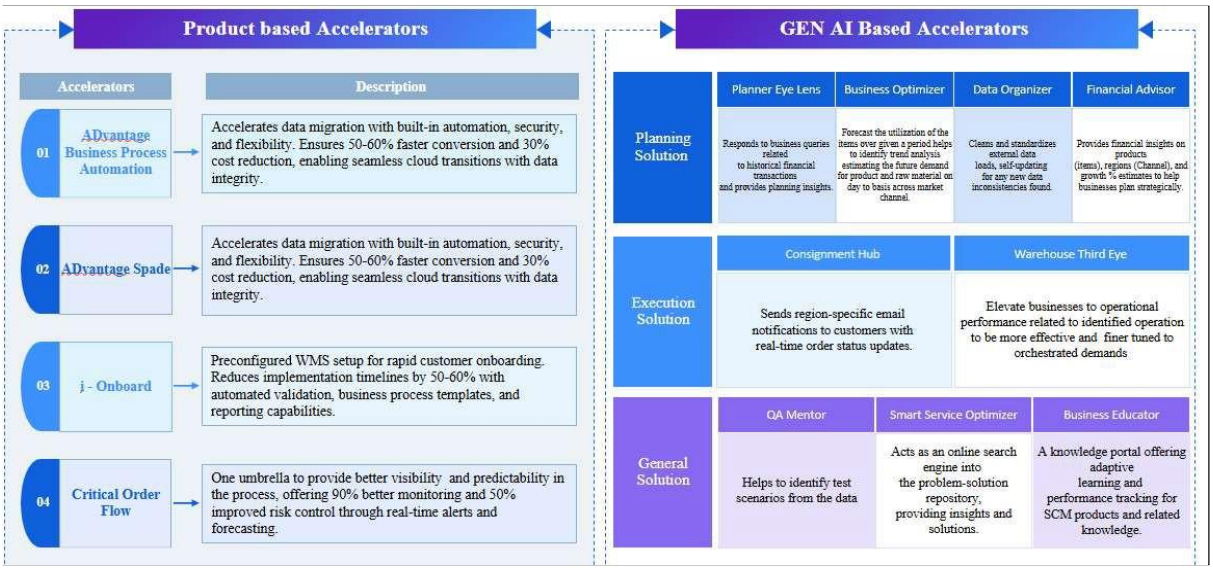
AI and ML driven retail solutions – what are key challenges ?

One of key requirment for Analytics forecasting solutions is to have all required data should be loaded, and the prediction engine should have predictions generated for review, this means if there is erroneous data and insufficient data the predictions will be resulted in poor accuracy leading to impact Business revenues.

Business capability: Onboarding challenges with engagement – Identity Access management, Secure File transfer and Data transfers (Enable Data doctor and data insights)c, Analytics solution environment set up – multiple environments help reduce risk of failures.

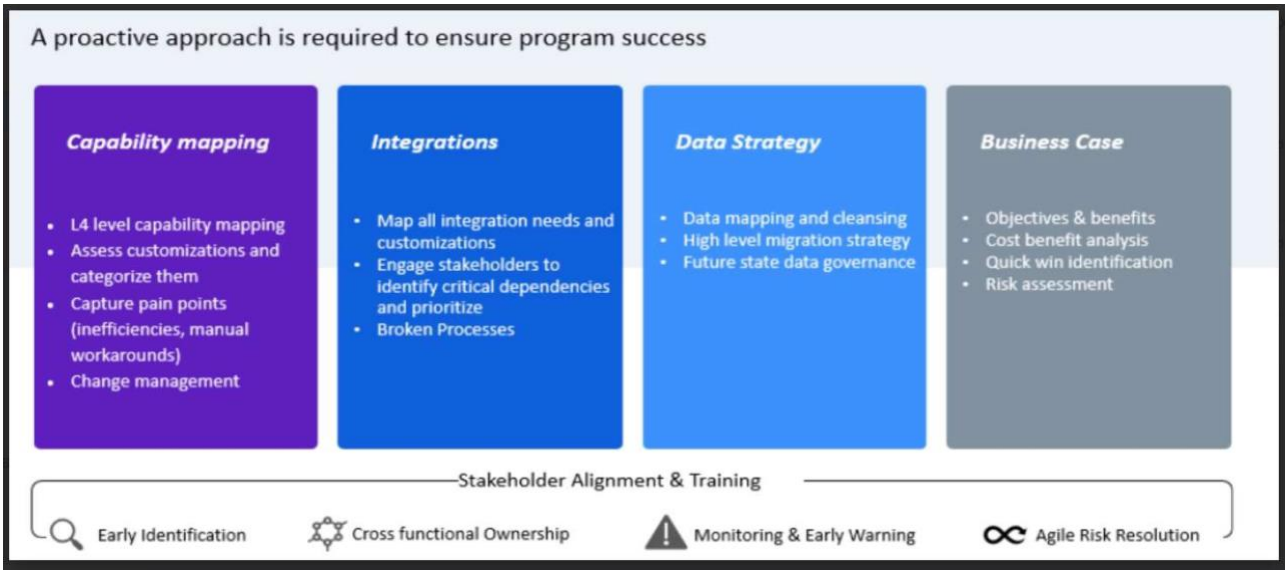
Integrations: Setting multiple Integrations for supply chain service platform – Building new integrations interacting with multiple systems. Batch and real time processing for Replenishment

Data Management: Pallet stacking issues as legacy system requirement may not match with AI enabled solution,



Perishable item management/ expiration date management for shelf life (supersession), Date sensitive inventory management

Business constraints: Item Substitution. Most companies do not want older item to use for forecasting.



Key factors means the features that are influencing the predictions for that given day level predictions and the model gradually ignores other features in the future for better prediction, this introduces bias into model as all the time forecasting solutions try to look for key factors and ignore other spikes which may have impact on accuracy of prediction, hence Business users must take proactive measures and manually intervene to assess the model accuracy and tune the system for the best use.

Supply Chain Accelerator products and Gen AI Based Solutions

Historical Data requirements for Forecasting :

The Retail Aanlytics solution generates day-level demand predictions for store-level SKUs/Items, for a specific horizon based on historical and current master, transaction, price, and promotion data

Business user can review the predictions user interface.The demand prediction process is batch-triggered at a specific time for predictions to be available for users to review. This batch process will have impacts for Business users depending on if Business needs realtime predictions compared to batch processing. Businesses expect to have ability to receive updated inventory and totals to generate multiple outbound files to processes.

Converting data from legacy supply chain systems; someof them have been in use for many, many years(more than 20+ years) . Its not just the technical work of data conversion, a big part is understanding the business use of the data and how to troubleshoot when data doesn't align in the new system.

Big Bang Approach	Phased Approach	Modular Approach	Hybrid approach (Pilot + Phased)
The entire legacy system is replaced with new system across all locations and functions in a single switchover at a defined cutover point	Transformation is rolled out incrementally across different phases, locations or functions over time, allowing gradual adoption	The transformation is broken into independent modules or components (function/system etc), implemented separately and integrated over time	This is a hybrid approach where we first pilot solution within a very limited scope and further expand it using Phased approach
Pros • Quick transition • Uniform adoption **Cons:** • High risk **Best for:** Small, simple systems with low complexity	**Pros** • Lower risk • Allowing learning and refining **Cons:** • Longer timelines • Requires temporary interoperability between legacy and new systems **Best for:** Large complex organizations	**Pros** • Focuses on high value areas first, delivering early wins • Reduces complexity by tackling at module level **Cons:** • Dependencies between modules can delay benefits • Integration challenges **Best for:**	**Pros** • Minimizes risk • Uniform adoption **Cons:** • Longer timelines • Requires temporary interoperability between legacy and new systems **Best for:** Large complex organizations

Retails Analytics challenges – Sensitive data for organization can prevent forecasting capabilities of not shared.

Data challenges:

Provision of multiyear Historical data – Item data, Item Location data, Item Hierarchy (build Bill of Materials) from multiple systems as organizations have to collate all the information from legacy systems which may not be available, and data can be sensitive to company revenue which will be limited to share with Analytics solution.

Execute On Boarding Data Analysis /package can be complex if data volumes increase than capacity defined by AI engine.

Review and address data issues involves huge time consumption from both tech and business teams.

Forecasting Model assessment and tuning /Train the Model with data –

Time intensive process that goes through multiple iterations and model performance explainability for Business users becomes critical.

Data being used is sensitive can put organizations at risk due to usage of such data by Analytical models.

Business Applications

Review suggested orders for vendor direct deliveries and manage product transition

Set up vendor order and transportation constraints, Ability to review order exceptions, adjust quantities

Approval process flow: manually approve orders, Ability to set auto-approval for a vendor

Vendor and product management: Ability to define maximums on vendor order to respect the shelf life of products/Ability to manage product transitions

Conclusion:

Most of AI and ML driven forecasting models present forecasting in the form of Key performance Indicators, Accuracy scores and Exceptions. Therefore, organizations should interpretation these model scores in Business context as that will be highly value add. Also AI models can evaluate and perform based on trained data so the output of model may be erroneous hence Business needs to continuously monitor and understand the scores to help drive Business value. It becomes extremely vital for enterprise when adapting to AI and ML driven platforms to ensure Business context is well understood and security of system is intact when implemented.

References:

The Big Book of Generative AI | Databricks

D& A Case study – HCL - HCLTech: Supercharging Progress | Digital, Engineering and Cloud

Supply chain solution – Blue Yonder Supply Chain Planning Software | Blue Yonder

Leading technology and services company re-energizes its business | HCLTech

AI in Supply Chain Processes | SAP Business AI

Secondary School Students' Attitudes Toward the Teaching Profession

Milosh Raykov, Colin Calleja, Joseph Gravina, Lucianne Zammit

Abstract

The global shortage of teachers has raised questions about the declining attractiveness of the teaching profession among young people and in-service teachers. Teacher shortages are also evident in Malta, and an increasing number of studies document the difficulties of attracting new students for the teaching profession as well as retaining the current in-service teachers (Attard Tonna & Calleja, 2023; Fenech & Formosa, 2024). Previous international studies demonstrate that perceptions of the teaching profession, financial considerations, and job satisfaction are decisive factors influencing students' career choices (Kyriacou & Coulthard, 2000; Watt & Richardson, 2007). However, such studies are scarce in Malta, and this study aimed to examine how secondary school students, potential entrants to teaching programs, compare teaching to their preferred professions.

Method

This study explores the attitudes of secondary school students toward the teaching profession in comparison to their preferred occupations. Data were collected from 220 students through an online survey by using a semantic differential scale consisting of 12 bipolar pairs of adjectives rated on a 7-point scale (e.g., 1 = Boring, 7 = Exciting). The sample of participants included students from 19 secondary schools in Malta who attended state, church, and independent schools. Items measured perceptions related to interest, innovation, pay, excitement, safety, respect, creativity, pleasantness, desirability, activity level, societal usefulness, and difficulty.

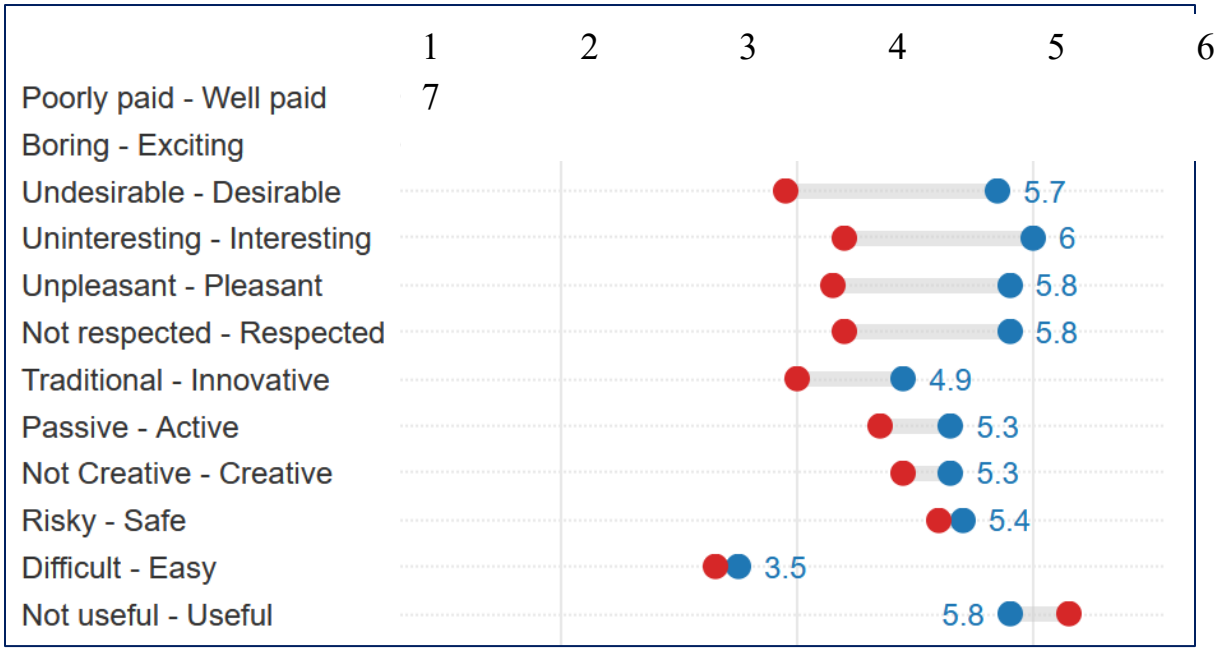
Results

The preliminary results of this study demonstrate how secondary school students view the teaching profession in comparison to their desired career choices. As Figure 1 shows, in all 12 aspects examined in this study, students had more positive attitudes towards their preferred jobs, and significant differences were identified in most scales that described their attitudes toward a preferred profession compared to the teaching profession.

One of the most evident differences is the perception of financial reward. Teaching is regarded as significantly less lucrative compared to the careers students aspire to (significant, at $p < .001$, $d = 0.98$). This result is consistent with studies that emphasize salary as a factor discouraging students from pursuing the teaching profession (OECD, 2019). Similarly, significant differences and effect sizes on attributes such as "Boring - Exciting" ($p < .001$, $d = 0.89$) and "Undesirable - Desirable " ($p < .001$, $d = 0.79$) indicate that students perceive teaching as less dynamic and attractive than their preferred occupation.

Respect and prestige are also perceived as significantly less favourable for teaching than for students' preferred profession. Teaching was ranked significantly lower in terms of perceived respect ($p < .001$ and effect size $d = 0.63$) as well as prestige (at $p < .001$, $d = 0.70$), indicating that the social prestige of the teaching profession plays a significant role in students' career decisions. These findings are consistent with studies suggesting that individuals are less inclined to choose teaching as a profession since the teaching profession is perceived as less socially esteemed (Heinz, 2015).

Figure 1: Students' ratings of teaching and their preferred professions



Legend: ● Teaching Profession, ● Prefered Profession

Less significant differences with smaller effect sizes were observed in dimensions related to creativity ($p = 0.008$, $d = 0.18$) and dynamic ($p = 0.002$, $d = 0.23$), indicating that some students perceive teaching less passive or uncreative and consequently less attractive when compared to their prefered professions.

Our study also found that students did not perceive teaching as more risky ($p = 0.208$) or more difficult ($p = 0.245$) than their preferred profession. The perception of teaching, in comparison to their preferred profession, was perceived as equally safe and similarly difficult, suggesting that it is likely that other non-intrinsic factors, such as external rewards and status, probably play a more decisive role in discouraging students from choosing teaching as a career.

The only dimension where attitudes toward teaching occupation were more positive than students' preferred profession was perceived usefulness for society ("Useful for Society - Not Useful for Society") ($p = 0.004$, $d = 0.22$). This result indicates that, despite most students perceiving teaching as a less desirable profession, they still recognize the importance of teaching to society. The recognition of teaching as a significant profession to society is consistent with prior studies that emphasize intrinsic motivations for entering the teaching profession (Watt & Richardson, 2007).

Secondary school students' perceptions of unattractive salaries and social prestige of the teaching profession explain why they have a relatively low interest in pursuing a teaching career despite the fact that they recognize the importance of the teaching profession to society. Identified attitudes toward the teaching profession could explain the difficulties in attracting youth to choose the teaching profession as well as retaining educators, particularly in fields which are in high demand.

Concluding remarks

In summary, the teaching profession is highly valued in terms of its usefulness for society, but secondary school students perceive it as less well-paid, less respected, and less interesting. Also, secondary school students in Malta consistently rate their preferred professions higher on factors like material rewards and respect, with most differences demonstrating high statistical significance and medium to large effect sizes.

To address the identified negative attitudes toward the teaching profession, policymakers and education leaders need to implement targeted strategies and interventions to improve public opinions and students' attitudes toward teaching. Such interventions could include the enhancement of financial incentives and working conditions, promotion of the diverse and dynamic aspects of the teaching profession, and increased public recognition of teachers' contributions to society, including overall social and economic prosperity. Additionally, career guidance programs, particularly for younger students, should be designed to restructure students' perceptions of teaching by emphasizing the societal importance, personal fulfilment and non-material rewards of the teaching profession. Our research findings indicate that reversing the declining interest in the teaching profession will require systemic efforts that extend beyond individual schools into broader societal and policy contexts.

References:

Attard Tonna, M., & Calleja, J. (2023). An investigation of the professional behaviour, status, career and identities of teachers in Malta. *European Journal of Teacher Education*, *46*(1), 95-113.

Fenech, C., & Formosa, G. (2024). Characteristics of Teacher Trainee Students in Malta and Their Readiness for the Labour Market. *Malta Journal of Education*, *4*(1), 25-44.

Heinz, M. (2015). Why choose teaching? An international review of empirical studies exploring student teachers' career motivations and levels of commitment to teaching. *Educational research and evaluation*, *21*(3), 258-297.

Kyriacou, C., & Coulthard, M. (2000). Undergraduates' views of teaching as a career choice. *Journal of Education for Teaching, 26*(2), 117-126.

OECD. (2019). *Education at a glance 2019: OECD indicators.* OECD Publishing.

Watt, H. M., & Richardson, P. W. (2007). Motivational factors influencing teaching as a career choice: Development and validation of the FIT-Choice scale. *The Journal of experimental education*, *75*(3), 167-202.

EDUCATION & HUMANITIES

BY THE WEI

ISSN 2167-3179 (ONLINE) USA