

Curriculum Reform-Necessity for Emerging VUCA Worlds to Enhance Pre-service Teachers' Pedagogy

Tshepang Jacob Moloi^{1*} 

Tshele John Moloi² 

AFFILIATIONS

¹Faculty of Education, Cape Peninsula University of Technology, Cape Town, South Africa.

²Faculty of Education, Sol Plaatje University, Kimberly, South Africa.

CORRESPONDENCE

Email: moloits@cput.ac.za*

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Abstract: The economic meltdowns across countries are exacerbated by COVID-19 and its aftermath, which bear the brunt of perennial devastations characterised by abject poverty. Although somewhat peculiar, higher institutions of education (HIE) have modified learning and teaching strategies to accommodate the deleterious effects of COVID-19. Conversely, while adapting, the emergence of artificial intelligence (AI) necessitates that HIE reprioritises a plethora of factors, including pedagogies. This approach catalyses the comprehension of volatile, uncertain, complex, and ambiguous (VUCA) environments in economic sectors. Hence, this paper aims to evaluate the use of pre-service teachers' AI skills and digital pedagogy at universities to determine the need to reform the curriculum for the purposes of navigating the VUCA world. Likewise, critical theory is utilised to understand the necessity of digital skills for pre-service teachers to enable HIE's adaptation to VUCA environments. This mixed-method study involves purposively sampling 12 participants for interviews and randomly sampling 78 participants for surveys. Using critical discourse analysis, the data is analysed to postulate nuances of perspectives. The findings depict that, despite universities adapting to innovative methods, particularly AI, there is a paucity of AI

content and infrastructural development that enables pre-service teachers to acquire the digital competencies and skills needed to teach robotics, coding, and maritime studies. Overall, digital skills are below average; hence, the paper recommends that universities reform their curricula to stimulate digital skills that reflect the requisite capabilities of digitalisation and AI to withstand the VUCA world.

Keywords: VUCA worlds, artificial intelligence, digital skills, coding and robotics, high institutions.

1. Introduction

It is somewhat intriguing to notice the soaring levels of inequality, exacerbated by the onset of COVID-19, across economies, wreaking havoc on the stability and consistency of all sectors, including education (Dube, 2020; NICD, 2022; & WHO, 2022). These levels of inequality, evidenced by the adaptation of teaching methods and strategies to adjust to the pandemic, attest to the phenomenon of a VUCA world. This phenomenon refers to the emergence of digitalisation as a result of the fourth industrial revolution (Chama, 2023); it implies the use of computers, augmented reality, and virtual reality (AR and VR), which provide three and four dimensions of images (Proykova, 2021). Meanwhile, the emergence of digitalisation or the fourth industrial revolution does not imply that VUCA worlds never existed; rather, it suggests that COVID-19 acted as a catalyst for expediting awareness of VUCA worlds (Siegfried et al., 2021). The acronym VUCA stands for volatile, uncertain, complex, and ambiguous worlds; it is a concept proposed by the United States Army War College in 1987 (Johansen, 2015).

The turbulent and tumultuous events that tested human endeavours led Bob Johansen to conduct educational research pertinent to artificial intelligence and digitalisation post-Cold War (Johansen & Euchner, 2015). This undertaking navigated the frontiers of the educational sector in an attempt to comprehend and conceptualise the challenges and insights of artificial intelligence (Latha &

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Christopher, 2020). It is as a result of these educational research endeavours that the concept of VUCA worlds was discovered, in essence, to understand how the world operates and withstands its complexities through relevant and effective mechanisms such as artificial intelligence.

Artificial intelligence (AI) refers to systems structured to produce highly complex data using sophisticated algorithms (Mahato, 2022). In other words, AI encompasses programmed mechanisms or systems that mimic human cognitive processes to solve problems, make decisive decisions, and develop innovative strategies. Consequently, during COVID-19, higher institutions of education (HIE) were compelled to alter traditional methods of learning and teaching, particularly in pedagogy, by introducing blended and hybrid learning methods (Kaul et al., 2020). This necessity expedited the integration of AI in HIE, which aims to enhance the effectiveness of learning and teaching in an innovative, creative, and informative manner (Kinkel et al., 2021). As a result, a new level of relationship has emerged, requiring education practitioners to familiarise themselves with the requisite skills and expertise to utilise AI. Thus, the extensive attributes of AI present both numerous benefits and manageable challenges, requiring stakeholders to embrace the former and address the latter to adapt to the VUCA (Volatile, Uncertain, Complex, and Ambiguous) world.

Despite the rise of AI, teachers face the challenge of developing and enhancing their digital skills. Khanzode et al. (2020) argue that university curricula, particularly in sub-Saharan countries, struggle to balance the production of both digitally skilled and pedagogically competent graduates. This challenge necessitates a reform of university curricula to transform not only content-pedagogy programmes but also to incorporate AI content into these curricula. In doing so, universities can adequately equip pre-service teachers with the digital skills necessary for the modern era and essential for navigating the dynamics of AI and its challenges. Ding et al. (2020) contend that AI has positioned the art of learning and teaching at the fingertips of students, thereby making the learning and teaching process more convenient. This suggests that due to AI, learning and teaching are now cost-effective, accessible, and manageable.

Despite the benefits of AI, it is undeniable that it faces challenges, such as high levels of plagiarism and restricted human creativity and involvement (Mahato, 2022). Therefore, to mitigate the prevalence of these issues, understanding the use and application of AI tools, such as ChatGPT (Chat Generative Pre-trained Transformer), is critically important. The aim of this paper is to evaluate the digital skills required of pre-service teachers to navigate the challenges of the VUCA world. This aim is informed by two aspects: 1) teachers' pedagogy encompasses skills, knowledge, and attitudes pertinent to the subject matter, which does not adequately account for the necessity of digital skills at this particular juncture, and 2) teachers' curricular focus on content-pedagogy somewhat neglects the implications of digital skills required in the real world. With this in mind, the authors intend to evaluate the pre-service digital skills required for the VUCA world in order to develop digital pedagogy.

1.1 Contextualising the problem

It is fair to concede that inequality and the digital gap perpetuate the disadvantages of optimally equipping pre-service teachers, teachers, and learners with adequate digital skills (UNESCO, 2021). This assertion is endorsed by Ramsetty and Adams (2020), who state that the opportunity to be adequately capacitated with digital-technological skills is dependent on the presence of technology in a certain community. Equally, the oblique picture of African countries staggering behind in digital accessibility persists in perpetuating the digital divide, with only 40% of countries in Africa having access to the internet and technological devices (Makudza et al., 2022).

Similarly, the Global Digital Skills Report (2023) indicates the alarming figure that 36% of Nigerians have access to digital technology, with an indexing opportunity rate of 5%. In addition, Zambia portrayed a 23% usage and accessibility to digital technology in rural areas and 64% in urban areas

(Itu, 2021). These comparisons indicate a trend towards retrogression in respect to the development of digital skills compared to counterpart countries in Asia and Europe. To be precise, the former prides itself on a whopping 69% accessibility to digital technology, with Singapore (77%), Hong Kong (85%), and Japan (92%) leading, while the latter bears a 92% rate of accessibility, with Switzerland (99%), Germany (84%), and Spain (100%) leading globally (Global Digital Skills Report, 2023).

These statistical reports attest to the digital divide which persists in engulfing our nations and poses a risk notwithstanding the challenges of the VUCA world. Therefore, the ball is in the court of universities to reform the curricula to leverage the exposure of pre-service teachers to digital skills and expertise through accessibility. Thus, in summation, the paper aims to evaluate the pre-service teachers' digital skills pedagogy in order to tackle the challenges of the VUCA world. This is because the implementation of digital technologies at universities is steadily stagnating and gradually manoeuvring (DHET, 2023 & Marwala, 2024). Despite the pre-service teachers' curriculum or subject matter that entails introductory elements of information and computer technology (ICT), it does not entirely integrate digital pedagogy pertinent and required in their subject majors or disciplines (Ajani & Gamede, 2021). Thus, it is precisely this rationale that the paper aims to evaluate the pedagogy of pre-service teachers' digital skills.

1.2 Research questions

The paper aims to evaluate the use of pre-service teachers' AI skills and digital pedagogy at universities to determine the need to reform the curriculum for the purposes of VUCA worlds. The paper adopts the following research question as a guide: What factors of AI and digitalisation should be considered in a curriculum to enhance pre-service teachers' pedagogy?

In an attempt to respond to this question, the following objectives are outlined:

- To classify pre-service teachers' perspectives on AI to enhance digital pedagogy.
- To identify pre-service teachers' challenges in using AI tools such as ChatGPT.

1.3 Theorising Artificial Intelligence for Pre-service teachers' pedagogy

Artificial intelligence (AI) serves as a milestone in various aspects, including education. Its significance enhances several dimensions, such as learning and teaching tools like interactive whiteboards, blended and hybrid learning approaches, ChatGPT, and many others, which have advanced the methods and strategies of learning and teaching (Keim & Shadnam, 2020). The emergence of AI in the educational sector, particularly its tools like ChatGPT and DALL-E 2, has had and continues to have liberating effects across the spectrum of education (Ramsetty & Adams, 2020). The liberating implications of AI align with the emancipatory framework of critical theory (CT), which intends to empower and liberate individuals within society for the purposes of equality and freedom (Hove & Dube, 2022).

Overall, AI embodies principles of empowerment and emancipation aimed at advancing ideologies and intellectual capacities in a free and fair manner. Therefore, CT is a transformative approach that intellectualises concepts and conjures ideas within the framework of independence and freedom (Hur, 2019). As a result, the aim of achieving independence and freedom interfaces with the goal of enhancing learning and teaching to realise this aim. AI expedites the process of achieving this objective; consequently, the quest to learn and teach using AI tools requires relevant and foundational digital skills (Davies et al., 2021). At this rate, to accomplish the imparting of fundamental digital skills in AI, universities must alter their environments and curricula to align with the demands of the VUCA world by empowering pre-service teachers with AI and/or digital skills.

Similarly, CT is based on the premise of social empowerment and mutual respect, which sustain and advance social practices and educational dialogues that target transformation (Smith & Seal, 2021).

In the same vein, pre-service teachers engage in a social quest to unravel the mysteries of AI and its tools by capacitating themselves to withstand the VUCA world. Hence, CT is suitable for this study because it posits relevant principles similar to those of participatory action research (PAR), such as independence, emancipation, transformation, and empowerment.

In summary, CT and PAR possess features that empower pre-service teachers and not only emancipate and alter traditional methods of learning and teaching but also equip pre-service teachers, in the context of AI, with the sophisticated digital skills required for critical subjects such as robotics, coding, maritime studies, physical sciences, and mathematics.

2. Research Methods

This is a mixed method of qualitative and quantitative methods relying on the principles of participatory action (PAR) research, whereby planning, observations, and reflections are conducted on the auspices of empowering and emancipating co-researchers (participants). Overall, semi-structured interviews are administered with focus groups, with questionnaires, as a form of survey, disseminated on Google Drive to generate and collate worthy data comprising diverse perspectives. This survey is used to solicit detailed descriptive responses in relation to AI and digital skills for pre-service teachers; furthermore, the descriptive responses aid the analysis of both textual and discursive data in respect to the social practice, insomuch as solving the social phenomenon is concerned.

PAR encapsulates three phases, whereby in the first phase—planning—the principal researchers meet with the co-researchers to prepare and plan the process under which interviews shall be conducted. The outlining of this process includes stages of co-researchers conducting interviews among themselves while the principal researchers facilitate the process. In the second phase of observations, principal researchers observe the actual interviews being conducted by co-researchers, who are clustered according to different groups, each group with a coordinator or leader.

In the final phase of reflections, the entire research team, i.e. principal researchers and co-researchers, converges to determine whether the aims and objectives of the study are achieved by reflecting on each single item, process, and phase.

2.1 Participants

Purposive sampling is utilised to select twelve (12) participants (co-researchers) from one of the universities in South Africa, specifically in the district of Dr Kenneth Kaunda in the North-West. Additionally, random probability sampling is conducted to collect data from surveys administered via Google Forms, resulting in seventy-eight (78) randomised respondents. The purposive sample comprises diverse variables related to gender, qualifications, and level of study, including five (5) final-year female students, two (2) final-year male pre-service teachers, and two (2) male students in their third year of study enrolled in a Bachelor of Education (BEd) programme. Finally, three (3) qualified teachers with a maximum of two years' experience are sampled to contrast and compare the perspectives of pre-service teachers and qualified teachers. In contrast, random sampling is applied across the population of teachers and student teachers within the district. Concisely, the demographics of the co-researchers in terms of age, race, gender, and economic class are schematically presented in Table A.

2.2 Data analysis

Critical discourse analysis is the technique employed to analyse empirical data on the basis of written and spoken words. To begin with, the context that predicates the phenomenon in the social inquiry is analysed and assessed to gauge its effects on society (Van Dyk, 2001). In this inquiry, the digital skills of pre-service teachers, which constitute the context, are analysed. In addition, the implications

of context on socio-political dynamics are analysed to determine the discursive effects of context on influencing the discourse that pursues the impediments (lack of digital skills).

Meanwhile, textual analysis extrapolated from the analysis of the context is interpreted into five themes that influence discursive analysis, which fixates on the obstacles of inadequate digital skills for pre-service teachers. These themes are categorised according to semiotics and sociolinguistic factors that affect the social practices compounding the challenges of digital skills for pre-service teachers. The themes are classified into job curriculum design, AI and digital teachers' pedagogy, and critical subjects such as coding and robotics, and maritime studies.

In a nutshell, schematic presentations of themes in the form of tables and graphs are adopted to exhibit explicit analysis of textual interpretations of overt and covert data that impact on the social phenomenon of digital skills for pre-service teachers. Codes in the form of letters for the concealment of identities are adopted for each respondent, and responses with similar meanings are merged to itemise the central theme.

3. Presentation of Results

The paper comprises data generated from both interviews and surveys, and critical discourse analysis is employed to examine the themes developed from textual and discursive analysis. The following table depicts the demographic data about the co-researchers (participants) who took part in the various phases of PAR, i.e. planning, observation, and reflection:

Table A: Demographic data

N-Participants	Race	Gender	Age	Levels
2	White	Females	21-25	Third and final year of study
4	Black	Males	21-26	Final year of study
3	Black	Females	20-24	Third year and final year of study
1	Indian	Female	22	Third year of study
3	Black	Males	24-27	Two years' experience as a qualified teacher.

The above table presents the demographic data wherein co-researchers responded to a variety of interview questions. The following excerpts are the reflections of interview questions that foregrounded the study and influenced the formation of coined themes from the findings. The questions, together with relevant responses, are captured as follows:

What are the key factors of digital skills being taught at university? And at which level?

MK: Actually there is no critical skills dispensed in terms of AI except basic skills related to ICT and we learn these computer stuff from first year until final year.

AA: At university we do not necessarily focus on AI related content and curriculum, rather we focus on computer issues like excel, power point presentation and etc.

YY: We normally learn about computer technology particularly content about Microsoft word, excel and power point presentation. Nothing about AI and how it can impact the teaching and learning of various subjects.

The most critical themes nuanced from these responses relate to Information and Communication Technology (ICT), subject content, and curriculum dissemination. The participants who replied to this set of questions are pre-service teachers, and a profound assertion deduced from this analysis is that ICT has a significant impact on aspects of instructional design, learning strategies, and instructional content or subject matter. Consequently, the curriculum and subject content of different

subjects must reflect an explicit integration of ICT that fosters the implementation of artificial intelligence tools and digital technologies.

What are your views about AI at universities? Do students know how to use AI tools such as ChatGPT?

TT: AI has captured the landscape of academia; we are now writing assignments using AI tools such as ChatGPT. No stress about thinking hard and students know different tools of AI for text production.

MK: Nowadays it is easy and convenient to write an assignment, you just type the topic or title of the assignment into AI's tool like otter.ai and it produces fully completed responses.

ZZ: Students of today learn very fast and simple, it is because AI assist all of us with complex subject matters using applications like open-AI and tutor-AI.

In respect to this excerpt, the intriguing themes derived from this data are that students are extremely acquiescent towards AI tools. However, AI tools categorise a form of antithesis to proper and absolute ethical issues. Simply stated, students enlist the use of AI tools for the purposes of convenience and thus, by extension, defeat the purposes of epistemic and pedagogical philosophies. Withstanding the fact that participants who responded to this question are both qualified teachers and pre-service teachers, it is contrarily amazing to note that the majority who opined in respect to this question are student teachers who are, tacitly, digital enthusiasts. In brief, this data highlights the fundamental sense of urgency to integrate digital content, issues of ethical considerations and protocols that filter malpractices in relation to plagiarism. In spite of the contingency measures in place to mitigate plagiarism, such as the Turnitin tool, universities must infuse scholastic content in various subject matters and disciplines to formulate such content as part and parcel of requisite skills and knowledge. This approach shall aid the pedagogical and epistemic challenges interfacing with the use of AI tools and fortify the ethical practices anticipated of teachers.

As a pre-service teacher, do you think you have adequate AI skills to adopt and apply in your subject major, particularly critical subjects such as Robotics, Maritime Studies, Mathematics and Physical Sciences?

AA: My brother, it is not easy to confidently pronounce on my skills about AI, it is because we are still using traditional method. I major in Life Sciences and microscopes we are using, are still old. Now we have 4 Dimensions microscopic versions, so my skills are still at basic levels.

MK: Last year I had a chance to take my Physical sciences' learners on excursion to Sasol plant where they learned about AI emissions. It was my first time as well learning about these types of emissions relating AI together with my learners. So I don't think I have adequate skills about AI.

DD: Challenges as final year student is that I have never been exposed to the content and practical lessons which inspire confidence about the use of AI in various critical subjects such as Life Sciences and Mathematics. For instance, we now have robotic for dissections, but when we go for practical lessons in a laboratory, we still dissect animals and organs using traditional method.

The aforementioned excerpt is constituted by the responses of both qualified teachers and student teachers who ventured a peculiar but fascinating ideological stance. They argued that their digital skills and degree of exposure to opportunities that foster ethical use of AI tools and harness digital etiquette are not on par with their professional objectives. As a result, the data postulate a new dynamic that seeks primary attention, which is that digital skills at universities should not only be prioritised in the mainstream of disciplines such as software engineering, information technology engineering, and the like, but also taken into account as the rudimentary skills of eligibility for teachers. In summary, the themes classified from this data are moderate skills, insufficient exposure, and lack of procurement.

What are the main challenges encountered during your tenure as student about the use of AI and its tools?

ZZ: One of the challenges is the issue of plagiarism and lack of human element in our writings. Lecturers can detect that we have copied and pasted from AI tools.

YY: Because we do not have to do a lot of reading and writing, AI tools affect our levels of writing.

KK: To be frank, I have become very indolent to read and write because tutor.ai just produce for me a grammatically correct academic assignment without my involvement.

The enticing element of this question is that the majority of respondents are student teachers who asserted that it is incredibly amazing to have realised how vigilant lecturers are in respect to detecting plagiarism. Furthermore, student teachers presuppose that their writing and reading proficiencies are adversely affected; therefore, it is certainly amazing to deduce that AI will never replace humans and that the critical skills of writing and reading are intricately irresistible. Despite the forms and types of learning one is utilising, human development shall, invariably, remain fundamental. In that regard, the core themes inferred are the human element, human perspective, and academic writing skills.

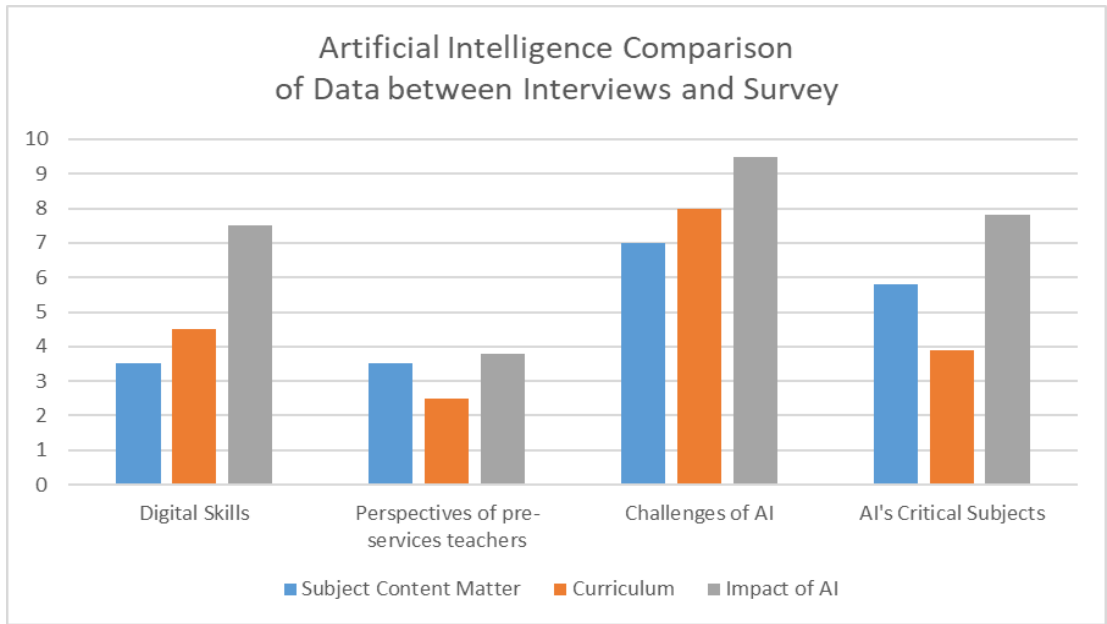
The data between these excerpts and Table B have resemblances and variances of themes, which infer different interpretations pertinent to the main research question. The following table is a schematic presentation of responses from the survey, which depicts the percentiles in terms of participants, gender, age, and similar and divergent responses that attribute to a category of a theme. For the survey, we had 78 participants within a 60-minute interval to determine the frequency or recurrence of participation in this notion. We tallied the numbers of recurrence to determine the percentiles on the basis of the number of 60-minute intervals.

Table B: Responses from the Google drive-survey

Variable	Category	Recurrence	Percentage	General Themes
Gender	Females	45	75%	<ul style="list-style-type: none"> • Plagiarism • Human capacity/involvement
	Males	33	55%	
Age	Females: 20-26yrs	47	78%	<ul style="list-style-type: none"> • Informational Communication Technology • Inadequate AI skills in critical subjects
	Males: 21-28yrs	32	53%	
Race	Black: 46, whites: 13, mixed race: 20 and Indians: 9	40	66%	<ul style="list-style-type: none"> • Teacher pedagogy of ICT • Writing and Reading Proficiencies • Insufficient detecting mechanisms
Level of study and/or experience as a qualified teacher	Second-final year of study Two-three years of experience as a qualified teacher	-	-	
Totals:	78 participants	60 Repetitio	100%	

The following graph represents data on AI and digital skills from both interviews and surveys for comparison purposes of general themes deduced from generated data: Critical themes range from subject content matter and curriculum, which are adversely impacted by AI and digital skills.

Graph A: Data Comparison from Interviews and Survey



4. Discussion of Findings

The paper aimed to evaluate the use of AI and digital skills among pre-service teachers to determine the necessity of reforming the universities' curricula to enable adaptation to a VUCA world. The results analysis characterises interesting elements of the effects of AI and digital skills possessed by pre-service teachers. In this case, Table A depicts the demographic data pertinent to the degrees of participation and variance levels of representation; a very versatile cohort of young people was interviewed between the ages of 20-27 with different margins of racial representation. Although 83% of the cohort consisted of people of African descent in general and Black individuals in particular, 17% consisted of other racial groups such as White individuals and Indians, which implies that the aspects of AI and digital skills are prevalent across the spectrum.

It further synthesises that digital skills have ripple effects inasmuch as universities track the intense processes of implementing AI structures and utilities. Amid the cohort of participants, the majority of teachers concurred that digital skills are crucial for adaptation to VUCA worlds, and this attrition, as a matter of urgency, purports an imperative dimension of agency and urgency towards reforming university curricula. Summarily, the precise insights drawn from this analysis are that there appears to be no sense of ownership, action plan, and realistic goals set towards implementing AI and its tools. As a result, these loopholes characterise threats associated with adaptation to VUCA; thus, it is essential to reform the curricula to reflect the intensity of content that addresses the pedagogical and epistemic challenges pertinent to digital skills.

There is a constant inclination to endorse or oppose the reforming of universities' curricula to reflect the integration of digital skills. The former is attributed to participants who are committed to embracing digital skills and, therefore, support changing the curriculum to cater to such skills. Meanwhile, the latter aspect is attributed to a voice of dissonance expressed by some of the teachers with long service; they opined that, for them, digital technologies are not that paramount. This highlights the insight that, to a certain extent, the issues of age and seniority within the profession serve as 1) a deterrent to reforming universities' curricula and 2) discouragement to the most senior and ageing teachers within the profession, which might result in resistance to change.

In these cohorts, a handful of co-researchers from interviews are qualified teachers with a maximum of two years' experience. This served as the credence to the generated data and provision of empirical interpretation thereof; hence, the data demonstrate, factually, the increasing trends of techniques involved in using AI tools, moderate skills acquired, and other factors such as convenience and cost-effectiveness. Furthermore, excerpts postulate themes that are deduced and interpreted from interviews and juxtaposed with themes from Table C developed from surveys. Finally, the contrast and comparison of the themes and implications thereof are schematically graphed to indicate the effects of AI and digital skills on subject content matter and curriculum.

In relation to demographics, it is established that 58% of co-researchers (participants) reiterated the significance of AI, its tools and relevant digital skills required for academic writing purposes. In addition, 75% of female co-researchers participated in the survey, while 50% of female co-researchers from interviews participated, which means that the majority of pre-service teachers are female and that the direct impact of AI and the digital skills required to be acquired from university have a ripple negative impact if not accorded sufficient attention and urgency.

In contrast, 58% of male co-researchers participated in interviews, while 55% participated in the survey. This disparity is indicative of two dimensions: 1) currently, the fact that female students consider teaching as their first choice of study, as such, AI and digital skills preparations in the curriculum ought to be on par with the demands of the modern era; 2) both female and male pre-service teachers deem content-pedagogy competencies and expertise crucial for a qualitative level of education; however, their pedigree of using AI and digital skills in an equitable and responsible manner is sketchy and vague. This aspect will be adduced further in the subsequent discussion of data.

Both teachers and student teachers intimated varying views; however, the dominating sentiment from this segment is that student teachers, particularly females, value and consider teaching as the profession of their first choice of study. By implication, this posits that curriculum reform that encapsulates digital skills will contribute immensely to women's empowerment and emancipation. In contrast, male student teachers do not consider teaching as a profession as the first choice of their study; albeit this exigency, infusing digital content and complex technological subject matter shall entice male student teachers to consider teaching as the first choice of their study. In a nutshell, teachers opined that digital skills have a pivotal role in shaping and reforming the profession, particularly in relation to pedagogical content skills and matters of epistemic philosophies.

There is relatively imaginable acceptance of a cohort of young people, which is critical to pay due diligence to, as 78% (females) are aged between 20 and 26, and 53% (males) are aged between 21 and 28. The variable of age is of critical importance in the sense that the reform of the curriculum is urgent to infuse AI and digital skills into the current Generation Z in order to forecast skills deficits for the next generation at university level.

4.1 Core themes about AI and digital skills

In a quest to accomplish the aim of the paper, the data in line with the core objectives underpinning the study and guiding its process towards the research question are discernibly interpreted. First and foremost, the data about pre-service teachers' perspectives depict both an explicit stance and an opaque picture of AI and digital skills. The themes detected from these perspectives range from plagiarism, the relevance of teacher pedagogy in ICT, writing and reading proficiencies, and insufficient detection mechanisms, to curriculum dissemination and subject content matter. In addition to these themes, digital skills, the challenges of AI, and critical subjects (coding and robotics) are identified as other themes that impact curriculum and subject content matter, as well as the effects of AI. Subsequently, these themes are coined into main concepts, i.e. a) curriculum design, b) teacher pedagogy, and c) gatekeepers' subjects to summarise the entire themes identified from the data.

Equally, teachers and student teachers are intrigued by developing and acquiring appropriate digital skills for the primary purpose of effective teaching and learning. Especially, students indicated that if universities can integrate content that addresses the appropriate and ethical use of AI tools to ensure quality, then the majority of student teachers will enhance both their academic writing and digital skills. Conversely, teachers opined that new developments in the Department of Basic Education, such as coding and robotics, require the introduction of such disciplines at university levels so that there is adequate exposure to content and pedagogy for teaching this subject. Therefore, a predominant view from this analysis is that synergy between the Department of Basic Education and higher education and training must be reinforced to assimilate instructional designs, strategies, and development that are in line with current trends.

4.1.1 Curriculum design

Pertinent to the research aim of evaluating pre-service teachers' perspectives about the use and application of AI and digital skills, the discovery of the extent to which universities' curricula are designed is indicative of defects and deficiencies that require urgent intervention. Issues of ethical and responsible use of AI tools such as ChatGPT and DALLA-2 are a great concern. Co-researchers opined that they use these tools for the purposes of producing academic texts without the sheer involvement of human activity. The indication of robotically produced academic texts asserts that human capacity is compromised as students rely solely on these tools to produce these academic texts without going the extra mile in the preparatory process of writing, such as conducting research (intense reading), drafting, editing, and proofreading. Hence, there is an intimation earlier in my supra discussion that the digital skills of pre-service teachers are vague and skewed.

Furthermore, with respect to the perspectives of pre-service teachers, there is a significant decline in curriculum issues or in designing subject content that caters to factors of AI and digital skills. According to Graph A of the comparison of data between interviews and surveys, 20.8% of co-researchers presuppose that the curriculum at university focuses only on aspects of ICT content and does not give due attention, rather priority, to AI and digital skills. In contrast, 29.1% of co-researchers posit that subject content matters endeavour to include aspects of AI and digital skills. These projections evidentially attest to the significance of reforming the university curriculum to accommodate the essential aspects of AI and digital skills (Davies et al., 2021).

In conclusion, pre-service teachers' perspectives on the use and application of AI and digital skills regarding the curriculum are below the margin of anticipation (Makudza et al., 2022). This means that the curriculum must be reformed to be inclusive, holistic, and advanced concerning factors of AI and digital skills in order to produce competent teachers who are immersed in vast digital skills and AI repertoires.

4.1.2 AI and digital teachers' pedagogy

The significant number of co-researchers categorised an exponential impact on their teachers' pedagogy as 62.5% premised that pre-service teachers' AI and digital skills are adversely impacted. Therefore, there are ripple negative impacts on both curriculum and subject content matters, as the former bears a 37.5% rate of AI and digital skills possessed by pre-service teachers. Alarming, this is a very low rate anticipated in terms of teacher capacitation and skills development; thus, an urgent requirement for universities' curricular reform to cater to these essential and rudimentary skills to capacitate the teachers to withstand the VUCA world.

This attrition confirms the argument of the Digital Skills Report (2023), cited in section 1.1 of this paper (contextualising the problem), that the challenge of digital accessibility has a direct ripple negative impact on digital skills development. In contrast, Galal (2022) concurs with the notion of prioritising the availability and accessibility of artificial intelligence subject matter to promote the acquisition of digital skills and development. Dialectically, there is a proportional relationship

between digital skills development and accessibility to digitalisation for pre-service teachers' development. As accurately contended by Makudza et al. (2024) in section 1.1 of this paper, the demise of digital accessibility in global south countries poses a tangible risk for digital skills development. In a nutshell, the urgency to prioritise AI and digital teachers' pedagogy extends to all sovereign states of global south countries.

Despite these margins in respect to digital skills, there are significant increases in terms of AI challenges encountered by pre-service teachers during their tenure at universities. Again, 79.1% of co-researchers indicated that the level of AI and digital skills affects their propensity to dispense curriculum and subject content matters aptly and competently. This is because 66.6% of co-researchers demonstrated that the curriculum does not entail instructional designs which address issues of AI and digital skills (Kinkel et al., 2021). In the same fashion, 58.3% suggested that content subject matters are void of AI and digital skills, which renders their teachers' pedagogy at sustained risk of qualitative measures of teaching and learning.

Since 40% of global south countries have accessibility to digital technologies, the rate at which the development and advancement of pre-service teachers' digital pedagogy is adversely lower than expected. Kinkel et al. (2021) advocated for digital programmes which are developmentally goal-oriented, meaning that the programmes need not only to address the scarcity of digital skills but also to prioritise expediting the availability and accessibility of digital technology across the global south. This surmises the idea that AI and digital teachers' pedagogy must be equally developed in line with availability and accessibility. In respect to the purview of institutions of higher education in general, but universities in particular, enormous investment in both development, accessibility, and availability is fundamentally required.

Amid these status quos, it is imperative that universities commence to re-evaluate their curricula to determine the risks involved in relation to digital and AI skills, to enable these universities to prioritise skills development around digitalisation and AI. Such endorsement shall satisfy the postulation articulated by Khanzode et al. (2020). It is significant to reiterate that AI and digitalisation are here to stay, and it is within our remit as universities to prepare and introduce mechanisms which enable the stakeholders to adopt and adapt to the arena of VUCA worlds.

4.1.3 Critical and/or gatekeepers' subjects

The data presentation highlighted profound areas of concern which require urgent prioritisation in order to reform the universities' curriculum. Issues of teaching and learning Maritime Studies, and Coding and Robotics using AI and digitalisation are at the forefront of curriculum design and content-subject matter concerns. To begin with, 32.5% of co-researchers asserted that curriculum design does not reflect an adequate mechanism that entertains and embraces aspects of digital and AI skills. Therefore, dimensions such as lack of exposure to materials and equipment that leverage and promote AI and digital skills contribute to the adverse impact on competently teaching Maritime Studies, and Coding and Robotics subjects.

Mhlongo and Nkomo (2024) opined about the scarcity of professional content development for teachers and the lack of support in respect to the availability of materials and infrastructure at schools. It is within this context that the aforementioned findings enunciate the prevailing status quo from schools regarding insufficient structure and infrastructure to dispense subject matter in coding and robotics. In addition, Kim and Quigley (2020) posit that the lack of relevant content for teacher training at universities exposes the potential for acquiring qualitative digital skills to be at risk. This empirical data substantiates the findings about critical or gatekeeper subjects as the stumbling block towards embracing the VUCA world, thus, the necessity to reform universities' curricula to be compatible with these trends.

Additionally, 45.8% of co-researchers alluded to the fact that content-subject matters reflect, to a certain extent, aspects of AI and digital skills, particularly in subjects such as Life Sciences and Physical Sciences. This implies that there is a reasonable beacon of hope if necessary contingencies can be executed, such as the procurement of relevant materials and equipment. Arguably, these procurements will address the digital skills deficit, as postulated by 65.8% of co-researchers, who state that the impact of AI on skills development is dire and profound. At this rate, it is crucial to prioritise the procurement of relevant AI tools or equipment at universities' laboratories and workshop centres to assuage challenges in teaching critical subjects such as Maritime Studies, Coding and Robotics, Mathematics, and other subjects using AI tools and advanced digital platforms.

In brief, the paper established that curriculum design, AI and digital teachers' pedagogy, and critical or gatekeeper subjects represent the core findings of the study, which encountered several attributes indicative of the fact that universities' curricula are slightly behind in terms of digital skills prioritisation and AI content development (Ramsetty & Adams, 2020). Therefore, the study recommends that curricula be reformed to accommodate AI content and digital skills, as well as enforcing mechanisms for advancing teachers' pedagogy regarding AI and digitalisation.

5. Conclusions

The paper evaluated pre-service teachers' perspectives on AI and digital pedagogy at universities to determine whether their pedagogy can withstand the phenomenon of VUCA worlds. It is, however, surprising that the data confirmed the literature review's assertions that digital divides persist, perpetuating inequalities, delaying the development of digital skills and accessibility, and hindering efforts to withstand VUCA worlds. Therefore, curriculum design, AI and digital teachers' pedagogy, and critical subjects are the core findings that attest to the necessity of reforming university curricula to position these institutions favourably for embracing VUCA worlds.

Succinctly, this paper discovered that university curricula are not compatible with AI and digital skills, as content-subject matters and curriculum design are overwhelmed by the effects of AI, placing universities in a precarious position. Consequently, high levels of moderate digital skills, a lack of AI equipment procurement, plagiarism, a decline in writing and reading proficiencies, and reduced human capacity or involvement are core themes highlighting the need to reform university curricula. Ultimately, 40% and 36% of inadequate digital skills and accessibility, as entrenched by the literature, affirm the findings of 71.1% regarding the adverse consequences of AI and digital skills on both curriculum and content-subject matters. Thus, it is crucial to prioritise reforming curricula to reflect and incorporate these aspects of AI and digital skills, which will enable our graduates to acquire the insights, expertise, and competencies necessary to navigate the realm of VUCA worlds.

5.1 Recommendations

On the premise of elucidated findings, the paper hereby recommends the following approaches to the expediency of AI and digital skills in the context of teacher pedagogy:

- The paper focused on the dynamics of AI and digital skills in relation to teacher pedagogy; as a result, further studies are required to assess the costs and expenditures incurred by universities in infusing AI and digitalisation into their curricula. This recommendation is informed by the significant austerity measures implemented against state government subsidies to universities.
- The paper further recommends conducting studies on lecturers' and academics' attitudes towards the use and application of AI and its tools in the university curriculum, particularly in relation to the ethics and principles of academic research
- The paper recommends that universities begin planning reforms to their curricula concerning subject content, which should largely reflect digital skills and the convenient and ethical use of AI tools, such as ChatGPT and DALL-E 2, without compromising essential skills such as writing and reading proficiency.

- The paper also recommends that universities assess their capacity to employ AI and digitalisation in content assessments and instructional designs, where online invigilation mechanisms, such as AI invigilator tools, can be utilised to facilitate online assessments.

6. Declarations

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