Exploring the Digital Shift: Factors Influencing the Sustainable Adoption of e-Health Tools for Digital Mental Health Services during the COVID-19 Pandemic

Rhodrick Nyasha Musakuro
Cape Peninsula University of Technology
Cape Town, South Africa

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Abstract

The COVID-19 pandemic accelerated the global adoption of electronic health (e-health) tools for digital mental health services (DMHS) in South African higher education institutions (SA HEIs). However, the long-term sustainability of these innovations remains uncertain. This study employs an integrated Technology-Organisation-Environment (TOE) and Technology Acceptance Model (TAM) framework to investigate determinants of the sustainable adoption of e-health tools. A cross-sectional survey of 348 staff at a selected SA HEI was analysed using descriptive statistics and exploratory factor analysis. Three critical factors emerged: (1) University capacity to deliver DMHS, emphasising the significance of top management support, financial resources, and information and communications technology expertise; (2) Perceived benefits and importance of e-health tools, highlighting user perceptions of usefulness, ease of use, and behavioural intention; and (3) External support to enhance university capacity, including government policies, competitive pressures, and institutional partnerships. The study advances theory by synthesising TOE and TAM in a resource-constrained context, revealing how institutional readiness and user perceptions jointly influence the sustainable adoption of e-health tools for DMHS. Practical implications highlight the need for targeted investments in digital infrastructure, capacity-building, and policy alignment to

strengthen DMHS sustainability. The study results are consistent with Sustainable Development Goal 3 (SDG 3), offering a roadmap for SA HEIs to leverage e-health tools for mental health resilience post-pandemic.

Keywords: e-health tools; digital mental health services; technology adoption; COVID-19; sustainability.

1. Introduction

The World Health Organization (WHO) (2001) posits that mental health is fundamental to overall health, encompassing a state of well-being where individuals can recognise their abilities, manage everyday challenges, work productively, and contribute to their community. The comprehensive concept of health integrates physical, mental, and social well-being, noting that health is incomplete without mental health (WHO, 2013). Varga and Latham (2024) supported this by asserting that health should be viewed as a condition of positive well-being rather than merely the absence of disease. The United Nations (UN) (2020) states that the intrinsic value of mental health impacts how individuals engage, connect, learn, work, and experience life. This highlights the significance of overall health, considering both physical and mental health, and the importance of mental health to an individual's well-being.

It has been observed that mental health has a reciprocal link with the well-being and productivity in workplaces such as higher education institutions (WHO, 2013). This means employees with better mental health are more likely to be more productive, have increased job satisfaction, and show higher levels of engagement in the workplace. In South African higher education institutions (SA HEIs), increased mental health can lead to increased productivity, for example, more research outputs and improved teaching and learning, which can benefit the higher education sector as a whole (Dlamini, 2024). The UN (2020) stressed that during the recent coronavirus disease 2019 (COVID-19) pandemic, sustaining good mental health is crucial to each country's response to, and recovery from, COVID-19 and should thus be prioritised. Mental health issues, such as depression, anxiety, and post-traumatic stress disorder

(PTSD), can harm individuals, societies, and workplaces, such as SA HEIs (Van der Kolk, 2000; Meyer et al., 2019). It follows, therefore, that mental health issues can result in reduced productivity, strained healthcare systems, and an overall increase in social tensions and economic instability.

The COVID-19 pandemic catalysed the rapid emergence of the use of electronic health (e-health) tools, with SA HEIs actively implementing digital mental health services (DMHS) to ensure accessible, confidential, and convenient psychological support for their academic communities (Mbunge et al., 2022; Musakuro & Gie, 2024). Even though this digital shift expanded access during the pandemic, sustaining these tools in the long term remains uncertain, particularly in resource-constrained contexts. In the Global South, challenges extend beyond financial limitations and include persistent digital divides, such as unequal internet access, limited technological expertise, language and cultural barriers, as well as infrastructure instability, such as electricity supply disruptions (Agbeyangi & Lukose, 2025; van Stam, 2022; Zharima et al., 2023). These contextual factors, among others, complicate the sustainable use of DMHS compared to high-income countries. Therefore, this study investigates the factors influencing the sustainable adoption of e-health tools for DMHS in a SA HEI, to inform strategies that can strengthen their long-term implementation.

The significance of this study lies in its positioning of mental health as a strategic priority for SA HEIs, a claim supported by its established links to academic productivity, well-being, and institutional resilience, as demonstrated during the COVID-19 pandemic (UN, 2020; Mbunge et al., 2022; Musakuro & Gie, 2024). Moving beyond the initial pandemic-driven rollout of e-health tools, this study investigates the critical factors influencing their sustainable adoption. The study posits that the identification of these factors could provide a foundational basis for developing targeted institutional strategies and supportive policies that could inform both policy and practice. Consequently, this study contributes to the broader discourse on achieving Sustainable Development Goal (SDG) 3 by outlining a pathway toward equitable and effective long-term

digital mental health support. It aims to ensure these tools transition from emergency implementations to sustainably integrated DMHS within the South African higher education landscape. Furthermore, understanding the factors influencing the sustainability of e-health tools is a critical prerequisite for effectively using these e-health tools to evaluate and improve mental health outcomes within the academic community. This study, therefore, not only identifies the pathways to implementation but also lays the groundwork for future research to assess the impact of digitally-enabled mental health support on staff well-being and productivity.

2. Literature Review

E-health tools, defined in this study as information communication technologies (ICT)-based technologies that electronically process health-related data to support mental health care (Gooding, 2019), played a critical role in delivering DMHS during the COVID-19 pandemic. These tools encompass a wide spectrum, ranging from the use of devices such as computers, smartphones, tablets, to specific applications such as mental health applications, and broader innovations such as mobile health (m-health), telehealth, social media, and artificial intelligence (AI)-driven interventions. Their functions are equally varied, serving purposes such as remote therapy, cognitive behavioural therapy (CBT), mental health promotion, psychoeducation, and real-time monitoring (Asi & Williams, 2018; Schueller et al., 2016). Their rapid integration was particularly vital in the workplace contexts, including SA HEIs, where they became the primary means to ensure the availability, continuity, and accessibility of DMHS during the COVID-19 pandemic, which included lockdowns and social distancing protocols among other measures (Howarth et al., 2018; Musakuro & Gie, 2024).

This section details the implementation of e-health tools for DMHS at a SA HEI, hereafter referred to as University X for anonymity. The literature traces their evolution and implementation from their inception as an emergency response during the COVID-19 pandemic (2020-2022) up to their current state. The South African higher education sector provides a critical context for this study, as

it faces a substantial mental health burden that was exacerbated by the pandemic.

Prior to the COVID-19 pandemic, several factors contributed to mental health issues among university staff, including rising student enrolments, excessive workloads, research pressures, ineffective leadership, and administrative burdens (Kinman & Johnson, 2019; Gie et al., 2017; Barkhuizen et al., 2014; Bezuidenhout & Cilliers, 2010). Moreover, the national context is characterised by a high prevalence of depression, anxiety, and post-traumatic stress disorder (PTSD), which are linked to broader societal challenges such as socioeconomic inequality, violence, and a high prevalence of human immunodeficiency virus (HIV) (Meyer et al., 2019). University staff are not immune to this national burden; studies demonstrate high levels of burnout and stress, which directly impact productivity and institutional resilience (Dlamini, 2024). However, the COVID-19 pandemic acted as a catalyst, compelling a rapid digital transformation to address these severe and pre-existing needs during periods of strict lockdown and social distancing protocols. This abrupt shift necessitated an investigation into the sustainability of the e-health tools adopted during this period.

During the peak phase of the COVID-19 pandemic, University X, in collaboration with national agencies and non-governmental organisations (NGO), rapidly deployed a suite of digital services to support university staff mental health (Musakuro & Gie, 2024). This multi-stakeholder approach was essential to overcome internal resource constraints (Musakuro, 2025).

The main initiatives included tele-counselling and hotlines, which provided immediate, confidential crisis support and ongoing therapy through phone and video conferencing lines operated by mental health experts from the South African Depression and Anxiety Group (SADAG) (Musakuro & Gie, 2024). Furthermore, University X, in partnership with Higher Health (the national agency of the Department of Higher Education and Training for employee well-being), hosted virtual workshops and webinars on topics such as managing pandemic anxiety, remote work-life balance, and grief counselling.

Moreover, University X also established digital resource hubs, which were centralised online portals hosting a library of digital resources, including self-help guides, articles on mental wellness, recorded mindfulness and meditation sessions, and links to reputable external apps such as those providing CBT exercises (Musakuro & Gie, 2024). Supplementary services were provided through partnerships with private entities such as Momentum Wellness, which presented additional general mental health support, including trauma debriefing sessions and access to telemedicine services for general health concerns, thereby indirectly supporting overall mental well-being (Musakuro, 2025). This initial phase was characterised by its reactive nature, where the primary goal was to ensure accessibility and continuity of mental health care using readily available tools, many of which were repurposed from other uses, such as standard video conferencing software for therapeutic purposes (Musakuro & Gie, 2024).

In the post-pandemic period, the provision of DMHS through e-health tools at University X has transitioned from emergency implementation toward a more structured, yet still evolving, hybrid model (University X, 2025). This model blends tele-counselling and in-person DMHS, with a growing emphasis on asynchronous tools such as mental health apps and digital CBT to enhance flexibility (University X, 2025). Moreover, Momentum Wellness, SADAG, and Higher Health continue to play a leading role in the provision of DMHS to the university staff (University X, 2025).

However, literature shows that the sustainable integration of e-health tools faces significant challenges beyond financial constraints. The main barriers include low uptake due to uneven staff awareness and initiatives, as well as structural issues such as the digital divide. This divide manifests through inequitable access to reliable Internet, high data costs, varying levels of digital literacy, and a lack of culturally and linguistically adapted content for the South African context (Agbeyangi & Lukose, 2025; van Stam, 2022; Zharima et al., 2023). This transition accentuates the central research problem: identifying the factors that facilitate the shift from temporary adoption to the sustainable, equitable, and effective

integration of e-health tools within the unique socio-technical landscape of South African higher education.

3. Theoretical Framework for the Study

The study employed a combination of two theories: the Technology-Organisation-Environment (TOE) theoretical framework and the Technology Acceptance Model (TAM) to position the study within the existing body of knowledge. The next section discusses the TOE and TAM frameworks separately and explains how each contributes to the understanding of the research constructs.

4. Technology-Organisation-Environment Framework

The TOE framework offers a comprehensive analytical lens for examining technology adoption processes within organisational contexts (Tornatzky et al., 1990). The framework identifies three core contextual dimensions: technological, organisational, and environmental factors. As illustrated in Figure 1, these interconnected elements collectively shape an organisation's decision-making process regarding new technology implementation.

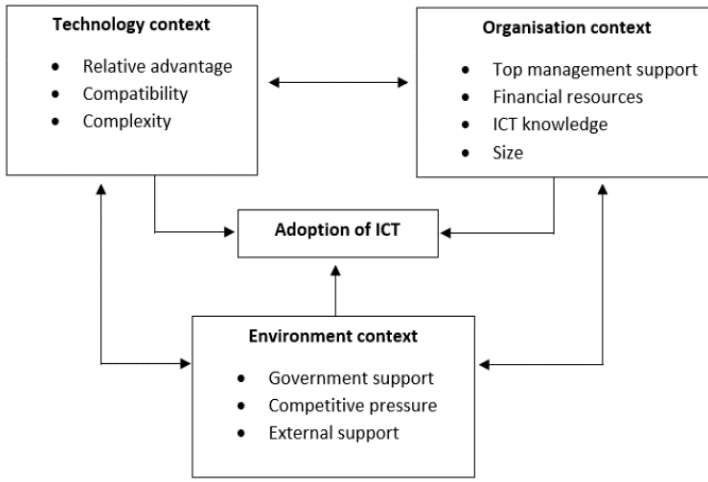

Figure 1: TOE framework. Source: (Tornatzky et al., 1990)

5. Relative Advantage

Relative advantage, a critical technological factor, denotes the perceived superiority of e-health tools over conventional approaches (Hiran & Henten, 2020). This study posits that SA HEIs should assess the potential benefits of e-health tools, including customisation, convenience, accessibility, and enhanced privacy (Bernecker et al., 2017). A thorough understanding and strategic utilisation of these advantages could facilitate the successful adoption of e-health tools in SA HEIs in the foreseeable future.

6. Compatibility

Compatibility refers to the extent to which technological innovations are perceived to align with an organisation's existing technologies, information systems, and prior experiences (Han et al., 2020). Consequently, if university administrators and main stakeholders perceive e-health tools as compatible with current ICT infrastructure, institutional systems, and operational processes, the adoption of such tools in SA HEIs becomes more feasible and streamlined (Jere & Ngidi, 2020). Hiran and Henten (2020) further contend that the Internet has emerged as the dominant medium for global communication. Given this trend, e-health tools, being inherently internet-based, can be leveraged to substantially enhance accessibility to DMHS.

7. Complexity

Jere and Ngidi (2020) assert that when organisations such as SA HEIs perceive ease of use, technology is much more likely to be accepted quickly, whereas complicated technologies are more likely to be adopted slowly. The complexity of technology influences the adoption or non-adoption of technology because stakeholders in organisations believe that complicated ICTs are too difficult to embrace and, if implemented, they would be abandoned quickly (Jere & Ngidi, 2020). The more complicated the technology, the less likely it is to be embraced by organisations such as SA HEIs (Han et al., 2020).

8. Top Management Support

Recent developments in the field of technology adoption have highlighted the critical role of top management support as a determining factor (Walker & Brown, 2020). This finding is consistent with the argument that top management possesses direct influence and authority over financial resource allocation (Johnson & Diman, 2017). Researchers further contend that top management serves as a key advocate for organisational change, implying their capacity to either facilitate or hinder technological implementation (Han et al., 2020). Consequently, the sustainable adoption of e-health tools in SA HEIs may face significant challenges in the absence of such support.

9. Financial Resources

Financial resources constitute a critical determinant in the adoption of technology (Hiran & Henten, 2020). In low-income economies, such as South Africa, inadequate funding presents a significant barrier to the implementation of e-health tools within higher education institutions (Fagherazzi et al., 2020). The substantial costs associated with developing, operating, and maintaining digital platforms, alongside telecommunications expenditures, may deter investment in e-health tools (Johnson & Diman, 2017). Given these financial constraints, it is imperative to assess economic implications and identify cost-effective strategies to facilitate the sustainable integration of e-health technologies.

10. ICT Knowledge

SA HEIs, as established public organisational entities, typically maintain dedicated ICT departments staffed by professionals with specialised technical expertise, a factor shown to significantly enable the adoption and implementation of e-health tools for SA HEIs (Jere & Ngidi, 2020; Johnson & Diman, 2017). Empirical evidence demonstrates a strong correlation between institutional ICT capacity and technology adoption rates, with larger organisations benefiting from in-house technical expertise while smaller entities often face adoption barriers due to limited technical resources (Walker & Brown, 2019; Johnson & Diman, 2017). This existing infrastructure,

combined with potential collaborative opportunities with DMHS providers, positions SA HEIs as particularly suitable environments for the successful integration of e-health solutions within their mental health service frameworks.

11. Size

Organisational size serves as a critical determinant in technology adoption processes (Ramdani et al., 2020), suggesting that institutional scale may significantly influence the sustainable implementation of e-health tools within higher education contexts. Empirical research consistently demonstrates that larger institutions possess distinct advantages in technological adoption when compared to their smaller counterparts (Awa & Ojiabo, 2016; Ramdani et al., 2013). This disparity stems from several institutional advantages: larger organisations typically benefit from greater financial capacity for technology acquisition, enhanced ability to recruit specialised talent, and more robust research and development infrastructure to support implementation efforts (Han et al., 2020). These factors collectively create an organisational ecosystem that is more conducive to successful technology adoption and integration.

12. Government Support

Government support represents a pivotal factor influencing the adoption of e-health technologies within SA HEIs. The policy framework established by governmental bodies, including the DHET and Higher Health, can serve as either an enabling or constraining force in the implementation of DMHS (Han et al., 2020; Fagherazzi et al., 2020). Given their status as public institutions, SA HEIs are particularly susceptible to shifts in government regulations and funding priorities. Consequently, progressive policy interventions can promote and foster an environment conducive to technological innovation, whereas restrictive measures may create substantial barriers to successful implementation.

13. Competitive Pressure

Competitive pressure represents a significant external factor shaping organisational technology adoption decisions. Empirical studies demonstrate that institutional responses to competitive dynamics substantially influence technological innovation uptake (El-Gohary, 2012). This phenomenon manifests particularly through the imperative to enhance operational efficiency, service innovation, and organisational effectiveness (Sligo et al., 2017). Within the South African higher education landscape, these competitive pressures assume particular relevance regarding workforce productivity and institutional performance. The growing emphasis on maintaining optimal staff and student well-being creates compelling incentives for SA HEIs to adopt e-health tools. In this context, the strategic implementation of e-health tools emerges as both a competitive necessity and an enabler of institutional resilience in an increasingly dynamic higher education environment.

14. External Support

External support constitutes a critical enabling factor in technological adoption processes, particularly for complex innovations such as e-health solutions. Empirical evidence suggests that the organisational capacity to implement technological innovations is often constrained without adequate external assistance (Han et al., 2020). Within the South African higher education context, institutional support from entities including the DHET, Higher Health, the SADAG, and Momentum Wellness emerges as particularly pivotal for the successful implementation of e-health tools for DMHS. Even though SA HEIs maintain strong competencies in their core academic functions, they frequently encounter limitations in the specialised technical expertise required for effective e-health deployment (Maphalala & Adigun, 2020). In this regard, strategic partnerships with external organisations thus serve as essential mechanisms for supplementing institutional capabilities, providing both technical knowledge and implementation resources necessary for the sustainable integration of e-health tools.

15. Technology Acceptance Model

TAM provides a theoretical framework for understanding user acceptance or rejection of technological innovations (Davis, 1989). As one of the most widely adopted theories in information systems studies, TAM examines the cognitive factors influencing technology adoption decisions. The primary objective of the model centres on promoting ICT utilisation by identifying and promoting the determinants of technology acceptance. The predictive capacity of the model is enhanced through empirical investigation of the variables shaping user perceptions, particularly when examined through the lens of user experiences and attitudes toward specific technologies. In this regard, this study applies this approach by examining the factors affecting the sustainable adoption of e-health tools in higher education contexts. TAM's foundational constructs, i.e., perceived usefulness and perceived ease of use, serve as key determinants of technology acceptance (Davis, 1989). The model further posits that individual attitudes toward technology mediate the relationship between these perceptions and behavioural intention to adopt. Notably, perceived usefulness exhibits a direct positive relationship with behavioural intention, as illustrated in Figure 2. This theoretical framework provides an additional robust foundation for investigating the factors for the sustainable adoption of e-health tools in SA HEIs.

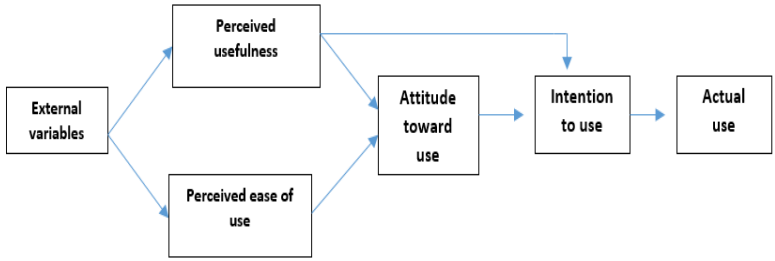

Figure 2: TAM. Source: Davis (1989)

16. Perceived Usefulness

When investigating the sustainable adoption of e-health tools, perceived usefulness emerges as a critical determinant requiring careful consideration. Grounded in Davis's (1989) TAM, this construct represents users' fundamental belief that adopting specific technologies will enhance their task performance. In the context of SA HEIs, perceived usefulness refers to the perception that e-health tools will enhance DMHS effectiveness, convenience, and accessibility. When institutional stakeholders (university staff included) recognise the potential benefits of these technologies, particularly their capacity to address mental health challenges and ensure sustainable service provision, they demonstrate more favourable attitudes and stronger behavioural intentions toward adoption. This positive correlation between perceived utility and adoption likelihood accentuates the importance of effectively communicating the advantages of e-health tools during the implementation phases.

17. Perceived Ease of Use

Perceived ease of use represents a fundamental determinant in the adoption of e-health technologies. As conceptualised by Davis (1989), this construct reflects users' assessment of the mental effort required to operate a particular system. This dimension of technology acceptance is intrinsically related to system usability, and when technologies demonstrate intuitive interfaces and require minimal cognitive load, they are more likely to be adopted (Melzner et al., 2014). Empirical research has consistently demonstrated the significant influence of perceived ease of use on the adoption patterns of e-health tools (Bamufleh et al., 2021). In the context of this study, perceived ease of use refers to the expectations of university staff regarding the ease of using e-health tools in delivering DMHS. When these tools are designed with user experience as a priority, requiring minimal training or technical expertise, adoption rates among academic staff tend to increase substantially. This relationship highlights the importance of human-centred design principles in developing e-health tools in higher education contexts.

18. Attitude Towards Use

The TAM posits that an individual's attitudinal disposition toward technology serves as a critical antecedent to the adoption intention (Davis, 1989). Building on established organisational behaviour theory, attitudes represent cognitive-affective evaluations that shape behavioural responses to specific stimuli (Robbins et al., 2019). Within SA HEIs, cultivating positive attitudinal orientations toward e-health tools emerges as a prerequisite for the successful implementation of e-health tools (Bamufleh et al., 2021). This attitudinal dimension specifically reflects stakeholders' evaluative judgments regarding the value and appropriateness of e-health tools in clinical contexts. Therefore, if institutional actors develop favourable perceptions of these technologies' utility, it is expected that they will demonstrate a greater willingness to integrate them into existing service frameworks. Consequently, strategic interventions targeting attitude formation, through demonstration of benefits, usability testing, and participatory design, may significantly enhance adoption rates. Such approaches can enable SA HEIs to create an organisational climate conducive to digital transformation in mental health service delivery through e-health tools.

19. Behavioural Intention to Use

Within the TAM framework (Davis, 1989), behavioural intention represents a pivotal construct that mediates between user perceptions and actual technology adoption behaviours. This study operationalises behavioural intention as university staff's propensity to utilise e-health tools for mental health support. As the immediate psychological precursor to technology usage behaviour, this construct serves as a critical indicator of adoption potential. Contemporary research substantiates strong behavioural intentions toward e-health adoption in mental health contexts, with recent findings reporting particularly high intention levels among professional user groups (Gbollie et al., 2023). These empirical observations suggest favourable conditions for technology integration in healthcare contexts. Building on this evidence, the current study considers behavioural intention as a fundamental determinant of sustainable

e-health adoption of e-health tools in SA HEIs. Specifically, the study contends that the strength of university staff's adoption intentions will significantly influence the long-term viability of e-health tools within the university ecosystems.

20. Materials and Methods

This study utilised a cross-sectional quantitative design to examine factors influencing the sustainable adoption of e-health tools for DMHS at University X, a public institution in Cape Town, South Africa. Consistent with Bryman and Bell's (2011) positivist epistemology, the research employed scientific methods to objectively measure relationships between theoretical constructs through statistical analysis to ensure methodological rigour.

The study population included all staff members at University X. Using non-probability sampling techniques, participants were recruited through voluntary response sampling via email invitation, where they were self-selected through an online survey (Murairwa, 2015). This approach ensured voluntary participation while adhering to institutional protocols for staff research participation.

The sampling frame consisted of three distinct groups: (1) top management, (2) academic, and (3) non-academic (administrative) staff members. Of the 2840 university staff invited to participate, 348 completed the online survey, resulting in a response rate of 12.3%, as shown in Table 1. The response rate constitutes a statistically robust sample size for quantitative data analysis. Table 1 demonstrates significant demographic heterogeneity across multiple dimensions, including gender, race, age, educational qualifications, occupational roles, employment categories, and years of service at University X.

Table 1: Sample characteristics (N = 348).

Item	Category	Frequency	Percentage
Gender	Male	156	44.8
	Female	192	55.2

Item	Category	Frequency	Percentage
Race	African	161	46.3
	White	44	12.6
	Coloured	89	25.6
	Indian	51	14.7
	Asian	3	0.8
Age group	20 - 29	10	2.9
	30 - 39	83	23.9
	40 - 49	149	42.8
	50 - 59	93	26.7
	60 or older	13	3.7
Highest level of qualification attained	National Senior Certificate	2	0.6
	Diploma	16	4.6
	Undergraduate Degree	47	13.5
	Honours Degree	39	11.2
	Master's Degree	180	51.7
	Doctoral Degree	63	18.1
	Other	1	0.3
Occupation	Academic staff	205	58.9
	Non-academic staff	124	35.6
	Management staff	19	5.5
Employment Category	Permanent employment	242	69.5
	Fixed-term contract employee	106	30.5

Item	Category	Frequency	Percentage
Length of service at the current institution	0 – 5 years	74	21.3
	6 – 10 years	103	29.6
	11 – 15 years	67	19.3
	16 – 20 years	76	21.8
	More than 21 years	28	8.0

21. Data Collection Instrument

The primary data collection method was an online survey administered through Microsoft Forms, which enabled real-time data capture from June to August 2023. The study employed a 5-point Likert scale (1 = strongly agree to 5 = strongly disagree) to measure TOE and TAM framework constructs. The survey instrument was developed through rigorous adaptation of validated items from prior e-health adoption studies (TOE and TAM framework) to ensure strong theoretical grounding and content validity (Tornatzky et al., 1990; Davis, 1989). A pilot study involving 18 non-respondents from University X was conducted to refine the design, clarity, and technical functionality of the measurement instrument. Feedback from this phase addressed issues such as layout, wording, and measurement scale consistency, eventually enhancing the face and construct validity of the research measurement instrument. Further rigour was achieved through a comprehensive review process involving the research supervisor, a statistician, and two academic experts, who evaluated the measurement instrument alignment with the study objectives and methodological soundness.

The survey comprised two distinct sections. The first section collected biographical data through seven items, capturing the demographic characteristics of the respondents. The second section focused on the factors influencing the sustainable adoption of e-health tools, featuring 17 items organised around technological, organisational, environmental, and social dimensions. Each section was preceded by clear instructions and a cover letter outlining the

study objective, ethical considerations, and the voluntary nature of participation.

Ethical compliance was a cornerstone of this research study. Ethical clearance was obtained from the Cape Peninsula University of Technology Faculty of Business and Management Sciences Research Ethics Committee (No. 2021_FBMSREC 083). All respondents provided informed consent before completing the online survey. Confidentiality was maintained through anonymised data collection. All collected data was kept strictly safe and secure through precautionary measures implemented during and after collection. During the online data collection phase, respondents were never compelled to provide their identities. Upon completion of the study, the dataset was stored on a password-protected computer at the researcher's private residence.

22. Data Analysis

The study utilised SPSS version 28 to conduct both descriptive statistics and exploratory factor analysis (EFA). Descriptive analyses included frequency distributions for demographic characterisation, alongside measures of central tendency (means) and dispersion (standard deviations). For EFA, principal axis factoring (PAF) was employed due to its focus on common variance, which was consistent with the objective of the study of identifying latent constructs underlying sustainable adoption of e-health tools. Promax rotation ($\kappa=4$) was applied to account for the anticipated factor correlations.

Data suitability was confirmed through the Kaiser-Meyer-Olkin (KMO=0.912) measure, indicating adequate sampling, and Bartlett's Test of Sphericity ($p<0.001$), confirming significant inter-item correlations for factor analysis (Hair et al., 2014). Factor retention criteria included eigenvalues >1, interpretability, and item loadings ≥0.4 (Ledesma et al., 2021).

Reliability and validity were robustly assessed: internal consistency via Cronbach's alpha ($\alpha\geq0.7$) and composite reliability (CR≥0.7), convergent validity through average variance extracted (AVE≥0.5) (Hair et al., 2021), and discriminant validity via item loadings (≥0.4) exclusively on designated factors without cross-

loadings. This multi-metric approach ensured rigorous evaluation of the factor structure's psychometric properties.

23. Results

Descriptive Statistics

Descriptive statistics (see Table 2) showed that respondents perceived the e-health tools as useful (mean = 1.67, SD = .982), ease of use (mean = 1.99, SD = 1.134), that it promotes positive attitudes towards their adoption (mean = 1.81, SD = 1.117) and that it is a relative advantage (mean = 1.82, SD = 1.087). In addition, the respondents signified a behavioural intention to use e-health tools in the future for DMHS (mean = 1.83, SD = 1.112). Ability to source financial resources (mean = 2.03, SD =1.294), compatibility with existing ICT infrastructure (mean = 1.92, SD = 1.172) and organisational size (mean = 2.00, SD = 1.318) were perceived as enablers by the respondents. However, complexity (mean = 2.61, SD = 1.449), availability of financial resources (mean = 2.24, SD =1.452) and ICT knowledge (mean = 2.29, SD = 1.475) received mixed perceptions and were noted as barriers to sustainable adoption of e-health tools. Government support (mean = 1.95, SD = 1.216) and government policies and regulations (mean = 2.03, SD = 1.214) were perceived positively by respondents. Apart from that, respondents also positively perceived the delivery of e-health tools and DMHS as strategically valuable for University X to remain competitive (mean = 1.77, SD = 1.126). Finally, external support was deemed essential for the sustainable adoption of e-health tools (mean = 1.60, SD = .965).

Table 2: Descriptive statistics results.

Descriptive Statistics	N	Min	Max	Mean	SD
Perceived usefulness	348	1	5	1.67	.982
Relative advantage	348	1	5	1.82	1.087
Perceived ease of use	348	1	5	1.99	1.134
Attitude towards use	348	1	5	1.81	1.117
Behavioural intention	348	1	5	1.83	1.112

Descriptive Statistics	N	Min	Max	Mean	SD
Compatibility	348	1	5	1.92	1.172
Complexity	348	1	5	2.61	1.449
Top management support	348	1	5	2.18	1.421
Availability of financial resources	348	1	5	2.24	1.452
Ability to source financial resources	348	1	5	2.03	1.294
ICT knowledge	348	1	5	2.29	1.475
Technical support	348	1	5	2.38	1.515
HEI size	348	1	5	2.00	1.318
Government support	348	1	5	1.95	1.216
Government policies and regulations	348	1	5	2.03	1.214
Competitive pressure	348	1	5	1.77	1.126
External support	348	1	5	1.60	.965
Valid N (listwise)	348				
Note: SD = Std. Deviation					

24. Data Suitability and Factor Extraction

The KMO measure (0.912) and significant Bartlett's Test of Sphericity (*p* < 0.001) confirmed the sampling adequacy and appropriateness of the data for factor analysis (see Table 3). All communalities exceeded 0.40 (see Table 5), indicating that each item shared substantial variance with its respective factor. These results collectively demonstrated that the extracted factors were both statistically robust and theoretically meaningful.

Table 3: KMO and Bartlett's Test results.

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.912
Bartlett's Test of Sphericity	Approx. Chi-Square	2974.603
	df	136
	Sig.	<.001

Principal axis factoring with Promax rotation extracted three distinct factors that collectively explained 52.215% of the total variance in the sustainable adoption of e-health tools (see Table 4). Each factor demonstrated robust psychometric properties, as evidenced by reliability and validity metrics, including CR, Cronbach's Alpha, and AVE (see Table 5).

Table 4: Total Variance Explained by extracted factors.

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Factor	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total
1	7.252	42.658	42.658	6.812	40.072	40.072	5.312
2	1.911	11.242	53.9	1.476	8.684	48.755	5.047
3	1.08	6.353	60.253	0.588	3.459	52.215	5.605
4	0.942	5.543	65.796				
5	0.773	4.548	70.344				
6	0.706	4,151	74.495				
7	0.603	3.546	78.04				
8	0.576	3.391	81.431				
9	0.494	2.906	84.338				
10	0.464	2.73	87.068				
11	0.428	2.519	89.587				
12	0.365	2.146	91.733				
13	0.336	1.975	93.708				
14	0.3	1.762	95.47				
15	0.285	1.674	97.145				
16	0.26	1.532	98.676				
17	0.225	1.324	100				
Extraction Method: Principal Axis Factoring.							
[a] When factors are correlated, sums of squared loadings cannot be added to obtain a total variance.							

The first factor, *University capacity to deliver DMHS*, accounted for 40.072% of the variance (see Table 4). This factor comprised five key elements: top management support (factor loading = 0.699), availability of financial resources (0.801), ability to source financial resources (0.735), ICT knowledge (0.791), and technical support (0.746) (see Table 5). The construct exhibited excellent internal consistency, with a Cronbach's Alpha of 0.875 and a strong CR of 0.850. The AVE of 0.534 confirmed acceptable convergent validity, indicating that the items collectively captured the latent construct of institutional readiness effectively.

The second factor, *Perceived benefits and importance of e-health tools*, explained an additional 8.684% of the variance (see Table 4). Rooted in the TAM, this factor included perceived usefulness (0.693), relative advantage (0.783), perceived ease of use (0.799), attitude toward use (0.586), and behavioural intention (0.601). The scale reliability was high (α = 0.853; CR = 0.864), and the AVE of 0.560 surpassed the threshold for convergent validity. These results highlight the centrality of user perceptions in driving the adoption of e-health tools, consistent with prior TAM (Davis, 1989).

The third factor, *External support to improve university capacity*, contributed 3.459% of the variance (see Table 4). It involved university size (0.612), government support (0.849), government policies and regulations (0.650), competitive pressure (0.580), and external support (0.573). The construct showed good reliability (α = 0.834; CR = 0.823) and strong convergent validity (AVE = 0.590), affirming the role of environmental enablers in the adoption of e-health tools. Government support emerged as the most influential item (loading = 0.849), showing the importance of policy frameworks in sustaining e-health initiatives.

Table 5: EFA with reliability and validity test results.

Factor solution	Factor loadings	Commu-nalities	Cronbach's Alpha	CR	AVE
Factor 1					
Top management support	0.699	0.540	0.875	0.850	0.534
Availability of financial resources	0.801	0.564			
Ability to source financial resources	0.735	0.640			
ICT knowledge	0.791	0.603			
Technical support	0.746	0.607			
Factor 2					
Perceived usefulness	0.693	0.463	0.853	0.864	0.560
Relative advantage	0.783	0.628			
Perceived ease of use	0.799	0.635			
Attitude toward use	0.586	0.493			
Behavioural intention	0.601	0.520			
Factor 3					
Size	0.612	0.517	0.834	0.823	0.590
Government support	0.849	0.695			
Government policies and regulations	0.650	0.598			
Competitive pressure	0.580	0.491			
External support	0.573	0.400			
Note: AVE = Average Variance Extracted; CR = Composite Reliability					

As depicted (see Table 5), all factors demonstrated strong reliability (CR > 0.7) and convergent validity (AVE > 0.5), supporting the internal consistency of the scales. Furthermore, the Promax-rotated factor solution demonstrated clear discriminant validity, with all items loading strongly (≥ 0.40) on their respective factors and no significant cross-loadings (i.e., no item loaded above 0.40 on more than one factor). This confirmed that the three extracted factors, namely

University capacity to deliver DMHS, *Perceived benefits and importance of e-health tools*, and *External support to improve university capacity,* are statistically and conceptually distinct, supporting their interpretation as independent constructs. This study elucidates the critical factors shaping the sustainable adoption of e-health tools. The following section contextualises these results within existing literature and further discusses their theoretical and practical implications.

25. Discussions

University Capacity to Deliver DMHS

The first and most substantial factor identified in this study was the *University's capacity to deliver DMHS*, which accounted for 40.072% of the total variance explained. This factor comprised five key elements: top management support, availability of financial resources, ability to source financial resources, ICT knowledge, and technical support. Each of these elements is consistent with established literature on organisational readiness for technology adoption.

Top management support emerged as a critical determinant, with a factor loading of 0.699. This result is consistent with prior research, which stresses the role of leadership in driving technological innovation (Walker & Brown, 2020). Top management not only allocates necessary resources but also promotes an organisational culture conducive to change. In the context of e-health tools for mental health support, leadership commitment is particularly vital, as mental health initiatives often require cross-departmental collaboration and sustained investment. The absence of such support, as noted in the literature, can significantly hinder the implementation of e-health tools, particularly in resource-constrained environments such as South Africa (Han et al., 2020).

Financial resources, both in terms of availability (factor loading = 0.801) and the ability to source them (factor loading = 0.735), were also pivotal. These results corroborate the recent literature, which identified funding as a major barrier to the adoption of e-health tools in low- and middle-income countries (Fagherazzi et al., 2020). The high costs associated with digital infrastructure, including software

development, maintenance, and staff training, pose significant challenges for SA HEIs. Therefore, the results of this study suggest that even though financial constraints are perceived as barriers (mean = 2.24 for the availability of financial resources), the ability to secure funding is seen as an enabler (mean = 2.03). This duality highlights the importance of financial planning and resource mobilisation strategies in ensuring the sustainability of e-health tools.

ICT knowledge (factor loading = 0.791) and technical support (factor loading = 0.746) further demonstrated the importance of institutional technical capacity. The presence of skilled ICT workers and robust support systems facilitates the seamless integration of e-health tools into existing workflows. This is consistent with Jere and Ngidi's (2020) assertion that organisations with strong ICT departments are better positioned to adopt and sustain new technologies. However, the study also revealed mixed perceptions regarding technical support (mean = 2.38), indicating potential gaps in service delivery or user training. In light of this, addressing these gaps through targeted capacity-building initiatives could improve the long-term adoption of e-health tools.

26. Perceived Benefits and Importance of E-Health Tools

The second factor, *Perceived benefits and importance of e-health tools*, explained 8.684% of the variance and was rooted in the TAM constructs of perceived usefulness, ease of use, and behavioural intention. This factor highlights the psychological and cognitive dimensions of technology adoption.

Perceived usefulness (factor loading = 0.693) was strongly endorsed by respondents (mean = 1.67), reflecting their belief that e-health tools enhance the efficiency and effectiveness of mental health services. This result is consistent with Davis's (1989) original TAM, which posits that users are more likely to adopt technologies they perceive as beneficial. In the context of e-health tools, the perceived utility of these tools likely stems from their ability to provide accessible, confidential, and convenient mental health support, particularly during crises such as the COVID-19 pandemic (Mbunge et al., 2022).

Perceived ease of use (factor loading = 0.799) also played a significant role, with respondents rating the tools as user-friendly (mean = 1.99). This is consistent with the argument that technologies requiring minimal cognitive effort are more readily adopted (Melzner et al., 2014). However, the relatively higher mean score for complexity (mean = 2.61) means that some users may still find certain aspects of e-health tools challenging. This divergence highlights the need for ongoing usability testing and iterative design improvements to ensure that these tools meet the diverse needs of university staff.

Attitude toward use (factor loading = 0.586) and behavioural intention (factor loading = 0.601) further reinforced the predictive power of the TAM framework. Positive attitudes (mean = 1.81) and strong behavioural intentions (mean = 1.83) indicate a favourable disposition toward e-health adoption, which is critical for long-term sustainability. These results mirror recent studies, which reported high intention levels among professionals using DMHS (Gbollie et al., 2023). Collectively, these results mean that although e-health tools are generally well-received, their sustained use depends on continuous engagement and support.

27. External Support to Improve University Capacity

The third factor, *External support to improve university capacity*, accounted for 3.459% of the variance and confirmed the role of environmental enablers in technology adoption. This factor included university size, government support, government policies and regulations, competitive pressure, and external support.

Government support (factor loading = 0.849) and policies (factor loading = 0.650) were perceived positively by respondents (means = 1.95 and 2.03, respectively). As previous studies indicate, policy frameworks have a significant impact on the adoption of e-health services (Han et al., 2020). In South Africa, government initiatives during the COVID-19 pandemic, such as those led by the DHET, facilitated the rapid deployment of DMHS. However, the slightly higher mean for policies (2.03) demonstrates that while supportive, regulatory frameworks may not be fully optimised for the integration of e-health tools.

Competitive pressure (factor loading = 0.580) also emerged as a significant driver, with respondents acknowledging the strategic value of DMHS for institutional competitiveness (mean = 1.77). This finding supports El-Gohary's (2012) contention that external pressures can incentivise innovation. In the competitive landscape of higher education, institutions that prioritise staff well-being through digital solutions may gain a reputational edge, further motivating the adoption of e-health tools.

External support (factor loading = 0.573) from entities such as Higher Health, SADAG and Momentum Wellness was deemed essential (mean = 1.60), echoing Maphalala and Adigun's (2020) emphasis on partnerships to overcome technical and resource limitations. These collaborations provide institutions with access to expertise and infrastructure that may otherwise be unavailable, thereby enhancing their capacity to deliver DMHS.

Interestingly, compatibility and complexity did not load significantly on the external support to improve the university capacity factor, diverging from some prior research (Han et al., 2020). This means that in this context, external enablers such as government policies and partnerships were more influential than the perceived alignment of e-health tools with existing ICT systems. This result reflects the unique technological landscape of University X, where external support mechanisms overshadowed compatibility concerns.

Similarly, complexity, though identified as a barrier in descriptive statistics (mean = 2.61), did not emerge as a significant factor in the EFA. This could indicate that while users recognise the challenges posed by complex technologies, these challenges are not decisive in their adoption decisions. Instead, factors such as perceived usefulness and external support may mitigate the impact of complexity.

28. Implications for Evaluating Mental Health Outcomes

In light of the research results, it is important to note that the adoption of e-health tools is not an end in itself but a means to achieve improved mental health outcomes. A number of implications can be drawn from the results of this study on how SA HEIs can

use these tools to evaluate and improve the well-being of their academic communities.

Firstly, the university's capacity to deliver DMHS (Factor 1) directly influences the quality and reliability of outcome data. Robust technical support and ICT knowledge ensure data is collected securely and accurately. Furthermore, strong financial resources and top management support are needed not only to adopt the e-health tools, but to fund the analytical expertise required to interpret the data and translate it into practical insights for policy and programme development. The capacity to deliver DMHS, therefore, includes the capacity to evaluate its effectiveness.

Secondly, it is important to note that user perceptions of the usefulness and ease of use of e-health tools (Factor 2) are prerequisites for sustained use, which in turn contributes to the creation of rich, real-time data. In contrast to traditional, episodic methods such as annual surveys, integrated e-health platforms could provide continuous, anonymised data on usage patterns, common concerns, for instance, anxiety, stress peaks during examination periods, and help-seeking behaviours. This allows university management and health professionals to move from reactive to proactive care, identifying trends and evaluating the impact of interventions with unprecedented granularity and speed.

Finally, external support (Factor 3) could extend the outcome evaluation. Partnerships with organisations such as SADAG or Momentum Wellness could provide access to validated assessment frameworks, benchmarking data against national standards, and expert analysis. This would help institutions answer critical questions: Are digital services actually reducing symptoms of depression or anxiety? How do outcomes compare to other institutions? This external validation is crucial for moving beyond simple usage metrics such as the number of logins to evaluating genuine clinical and well-being outcomes.

In essence, the sustainable adoption of e-health tools creates a feedback loop: the tools generate data that evaluates mental health outcomes, which informs better resource allocation (enhancing Factor 1), demonstrates the tools' utility (strengthening Factor 2),

and justifies further investment and partnerships (strengthening Factor 3). This positions SA HEIs to not only provide support but to become better institutions of higher learning that continuously improve their mental health services based on empirical evidence.

29. Theoretical and Practical Implications

The integration of the TOE and TAM frameworks in this study provides several theoretical contributions. First, it demonstrates the interdependence of organisational capacity (TOE) and user perceptions (TAM) in shaping the adoption of e-health tools. For instance, financial resources (an organisational factor) indirectly influence perceived usefulness (a user factor) by enabling the development of more effective tools. Second, it extends the TOE framework by highlighting competitive pressure as a unique environmental driver in higher learning institutions.

From a practical standpoint, the results of this study present several practical strategies for policymakers and institutional leaders. To enhance university capacity, institutions should prioritise leadership and top management commitment, expand funding for e-health initiatives by reaching out to NGOs and other private organisations, and also invest in ICT training. Furthermore, addressing user perceptions requires a focus on user-centric design optimisation to enhance perceived usefulness and usability. Finally, leveraging external support through government partnerships and collaborations with mental health organisations such as SADAG can provide the necessary technical and financial resources to sustain the adoption of e-health tools for DMHS.

30. Limitations and Suggestions for Future Research

This study has limitations that present opportunities for further research. The single-institution design may affect generalisability, warranting multi-institutional future studies and replications across diverse contexts. Self-selection bias in online survey participation could be mitigated through stratified random sampling in future studies. Even though the EFA employed in this study helped to identify the sustainable adoption factors for e-health tools, confirmatory

factor analysis (CFA) is needed to validate the structural model. Furthermore, the cross-sectional design limits causal inferences, suggesting longitudinal assessments of sustainability in future studies. Finally, emerging and continuously evolving technologies such as AI-enhanced tools warrant examination in the long-term adoption of e-health tools. These methodological and contextual extensions would strengthen both theoretical understanding and practical implementation of the sustainable adoption of e-health tools for mental health in higher education contexts.

31. Conclusions

This study advances the understanding of the sustainable adoption of e-health tools for DMHS in SA HEIs by integrating the TOE framework and TAM. Three critical factors emerged: institutional capacity, perceived benefits, and external support, which collectively drive long-term adoption. Theoretically, the study bridges TOE and TAM, demonstrating their synergistic utility in resource-constrained contexts. Critically, the sustainable adoption of these tools provides a foundation for data-driven evaluation of mental health outcomes, enabling institutions to measure the effectiveness of interventions, allocate resources strategically, and, in the end, demonstrate progress toward improved well-being for staff. Empirically, it contributes to the technology adoption literature in developing countries, while contributing a practical roadmap for SA HEIs to enhance post-pandemic DMHS resilience. The study recommends targeted investments in digital infrastructure, capacity-building, and policy alignment, consistent with SDG 3 to promote mental well-being and equitable care. Future research should validate study results through multi-institutional comparisons, CFA, longitudinal studies, and should specifically examine the link between e-health adoption metrics and quantitative mental health outcome data to further improve adoption strategies.

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Rhodrick Nyasha Musakuro, PhD., is a Lecturer in International Human Resource Management at the University of Sunderland, UK. This research was conducted as part of his doctoral studies at the Cape Peninsula University of Technology, South Africa. Dr. Musakuro has published peer-reviewed research in accredited South African and international publications. His research interests include e-health tools, technology adoption, digital mental health services, sustainability, and talent management. His email address is: rmusakuro@gmail.com ORCID: 0000-0002-3787-3580