Western Cape Government

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Measuring regional innovation systems in the Western Cape: ICT and Digital Innovation (4IR)

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List of Abbreviations

EduTech	-	Educartion Technology
FinTech	-	Financial Technology
HealthTech	-	Health Technology
ICT	-	Information Communications Technology
G4J	-	Growth for Jobs Strategic Framework
RIS	-	Regional Innovation System
WC	-	Western Cape
WCG	-	Western Cape Government

1) Introduction

The present desktop research is part of the systemic inter-institutional cooperation and academic programme collaboration between CHEC and the Western Cape Government (WCG) to fulfil their mandate of supporting the development of the Western Cape (WC) Regional Innovation System (RIS). The outcome expected from this collaboration is the development of an integrated view of the RIS and its inclusive and sustainable functioning to encourage the medium-term development goals of the WCG.

RIS has two essential traits (Komninos, 2018). Firstly, RIS is a combination of public policies, and secondly, it constitutes a development of skills in the market. These two traits have made the RIS approach strongly oriented towards economic development and competitiveness at the regional level (Komninos, 2018). The observable results of this traditional approach have been heterogenous in such a way that although this approach has played an important role in reducing absolute poverty, there are growing concerns that it has also contributed to exclusion and inequality (Botha et al., 2016). For instance, in South Africa, a large portion of the population remains either excluded from economic systems or are included on terms that perpetuate inequalities and poverty as a result of inter alia mismatches in the skills available and skills demand from industry, a lack of employment opportunities, and a lack of education opportunities (Toit, 2004; Phiri et al., 2016). An alternative approach to solve these problems is to disseminate and develop RIS by creating adequate conditions that promote economic development, at the same time, improve the quality of life and levels of well-being of the excluded groups. This would lead to achieving a more inclusive innovation system (Alexander, 2021). Hence, in this research, we focus on the concept of RIS as an innovation system that includes social innovation and economic development, fostered by key stakeholders in the WC RIS.

According to a Harvard Business Review, there is a strong correlation between socio-economic development and the emergence of digital technologies and Information Communications Technology (ICT) (Chakravorti & Chaturvedi, 2019). Specifically, the notion of the fourth industrial revolution (4IR) which is a new era of technological innovation– one that is unlocking new market opportunities, fuelling growth across the global economy, and contributing to job creation (getsmarter, 2021). In South Africa, the 4IR has entered the public and policy domain over the last five years. President Ramaphosa acknowledges the 4IR's place in driving new solutions and potential development. Upon his assumption of the chairpersonship of the African Union in February 2020, he made a rousing call for advancing 4IR on the continent: "the 4IR presents our continent with great opportunities. The uptake of digital technologies will lead to improved competitiveness and provide fresh opportunities for inclusive growth. Millions of our continent's young citizens are digital natives, and we must drive a skills revolution to enable Africa to take a quantum leap into the economy of the future". (Ramaphosa, 2020, n.p.). Ramaphosa aims to have by 2030 a nation that has fully harnessed the potential of technological innovation to uplift people and grow the South African economy.

The 4IR is disrupting every industry. From agriculture to education, medicine to law, finance to health, the impact of technology can be felt everywhere. Hence, we see a growing trend of names of existing industries with the word "tech" attached towards the end, such as HealthTech, RegTech, FinTech, AgriTech, RealTech, EduTech, and more. The present research focuses on the use of innovative technologies for socio-economic innovation in the WC. It focuses particularly on Educational Technology (EduTech), Financial Technology (FinTech) and Heath Technology (HealthTech) industries led by the triple helix network - public, private, and academic organisations in the WC.

The triple helix was chosen because RIS is a collection of interconnected private, semi-private and public organisations that operate together under an institutional framework (Samara et al., 2022). Additionally, the helix is of importance in this research as the strategic goals of a RIS cannot be determined in isolation. The term "system" implies that the various stakeholders, leadership structures, and components work together in achieving RIS objectives. Each of these 'components' plays vital roles and have functions within the innovation system, which is essential for building and guiding the economic system (van Heyningen, 2011).

In the WC, the partnership between the triple helix is fostering economic and social development. For instance, the Digital Economy unit at the Department of Economic Development and Tourism collaborates with Wesgro, the Western Cape Government, the City of Cape Town, and different ecosystem organisations such as LaunchLab, CiTi, StartupbootCamp, Silicon Cape to launch initiatives aimed at positioning Cape Town as Africa's Tech Capital (Startup Genome, 2021). The University of Western Cape, the University of Cape Town, CPUT, and Stellenbosch university, in addition to six Technical and Vocational Education and Training (TVET) in the region, supply growing organisations with a talent pipeline. Cape Town is home to over thirty venture capital firms, including Naspers, a $100 million fund to support South African start-ups and one of the top tech investors in the world (Startup Genome, 2021). The WC region also has an active community of angel investors. There are more than 500 tech organisations in the Western Cape, including e-commerce giants such as Takealot and Amazon.

Tech organisations have the potential to address many of South Africa's endemic challenges and form an integral pillar within the small and medium enterprise sector. Collectively they employ more than 40 000 people, a number which grows daily (Cover, 2022; Wesgro, 2022). These tech organisations contribute to GDP, play a massive role in decreasing unemployment, and can put the country on the global stage (Cover, 2022). As a result of the triple helix partnership, many studies have recognised the WC, particularly Cape Town, as a leading African DigiTech hub and a driver of innovation (Startup Genome, 2021; WESGRO, 2022).

2) Aims and Objectives

The aims of this chapter are the following: the first is to inform the concept of RIS as an innovation system involving social and economic development fostered by the triple helix network - public, private, and academic organisations in the WC. The second aim is to provide the areas of focus for digital innovation in the WC in the 4IR sectors that are more flourishing. These sectors are EduTech, FinTech, and HealthTech. Data was collected from various sources to bring together knowledge on the state of innovation of the three sectors.

The chapter, therefore, takes on an informative and explanatory style. The third aim is to discuss key players in the different sectors as well as barriers and promoters of innovation in these three industries. The fourth aim is to describe the maturity level of each sector using the CHEC RIS innovation maturity framework. This framework provides insight into the level of the Western Cape's innovation capabilities. It can also serve as a roadmap for future improvement. Finally, the chapter concludes by proposing directions for the province regarding steps forward.

3) Methodology

The following methodology was used in this chapter:

- Desktop-based research: it is a methodology that comprises a document and database review of available information, statistics, and other data from private, provincial, regional, and local sources.

  For this chapter, the desktop research was conducted by completing a bibliographic search to identify, extract, and compile available information to fulfil the research objective presented in the above section. Key sources include reports from WESGRO, StartupGenome, DEDAT, data from the Western Cape Government, information from Stellenbosch University, University of the Western Cape, University of Cape Town, GetSmarter, NACI, G4J, and reports from Provincial Ministries of Education and Health.

- The maturity framework: The maturity level is a measurement tool for auditing and benchmarking. This report adopts the maturity framework developed by (Grobbelaar et al., 2016) Grobbelaar et al. (2016), which involves four maturity levels or indicators, from the lowest to the highest, Birth, Growth, Maturity, and Decline. The maturity framework is of great importance as it can serve as a measurement tool for progress assessment against objectives. It is also essential to understand strengths, weaknesses and opportunities, which can support decision-making concerning strategy.

4) Framework

The maturity framework developed as part of the study by Grobbelaar et al. (2016) is adopted in this chapter as it is a valuable instrument to structure the baseline information on existing areas of innovation in the WC. Their conceptual framework is illustrated in Figure 1 below.

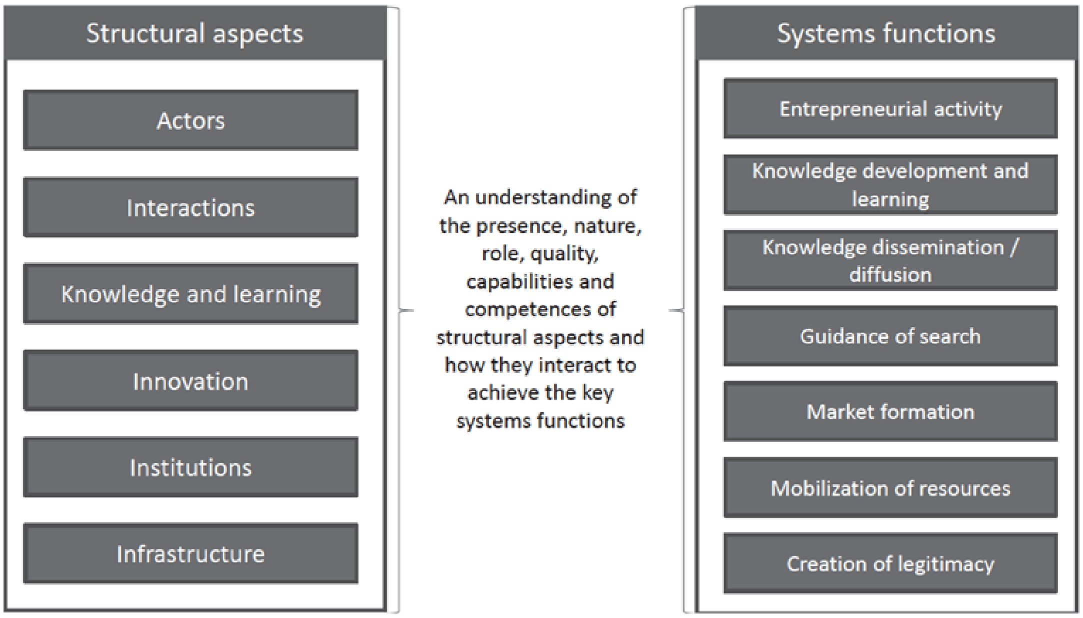

Figure 1: Analytic framework for an inclusive innovation system (Grobbelaar et al., 2016)

The above maturity framework is divided into the structural aspects and the systems functions. The structural aspects or components-based approach allows *"the analyst to acknowledge that the economy is a system with various actors and linkages between them"* (Grobbelaar et al., 2016). While the systems functions or function-based approach helps *"to understand the activities and functions that need to be performed in a system to ensure that the system achieves its goals, i.e., innovations are developed and diffused"* (Grobbelaar et al., 2016). In this chapter, emphasis is placed on the "systems functions". The different functions along with their respective definitions are presented in the Table 1 below.

Table 1: Systems Functions

Systems Functions	Definition

F1: Entrepreneurial activity:	Functions through which the region could create businesses opportunities to capitalise on ideas - possibly through business-level or sector-level interventions (Grobbelaar et al., 2016).
F2: Knowledge development and learning:	This function defines the processes of knowledge learning and development through formal R&D or informal knowledge production activities (Grobbelaar et al., 2016).
F3: Knowledge dissemination/ diffusion:	The role of supporting the dissemination of innovations and ideas - possibly through demand-side, supply-side and support mechanisms (Grobbelaar et al., 2016).
F4: Guidance of Search:	Guidance on relevant investment in technology or projects.
F5: Market formation:	The process through which the region can create a space in which innovations can be developed and introduced to markets – e.g. access to markets (Grobbelaar et al., 2016).
F6: Mobilisation of resources:	Support access to financial and human and resources available for innovation (Grobbelaar et al., 2016).
F7: Creation of legitimacy:	It aims to ensure that enough support is in place to legitimise commitment and resources from the private sector and government to support innovation (Grobbelaar et al., 2016).

5) The Digital Innovation Landscape

Digital innovation is defined as a "business model, process or product perceived as new embodied in or enabled by IT, and which necessitates some considerable changes on the part of adopters." (Barroso & Laborda, 2022). According to the World Bank, digital innovation influences the ability of countries to benefit from the social, economic, and environmental impact of ICT ecosystems (TheWorldBank, 2021). The National Advisory Council on Innovation (NACI) also recognised digital innovation as a key driver for long-term economic growth, competitiveness, and a better quality of life (NACI, 2020).

Digital innovation can boost inclusive and sustainable growth by enhancing services and generating efficiencies. It is changing today's society by giving new opportunities for businesses, governments, and citizens in various sectors, including industry, health, social media, e-services, data and more.

Digital innovation also impacts the society and thus contributes to national well-being (Barroso & Laborda, 2022). This makes it easier for citizens to access public services and contribute to higher economic growth and employment. However, the positive influence of digital innovation on national well-being occurs only if some criteria are met such as a good educational system, a philanthropic financial system, and adequate governance, because digital innovation by itself is not the only fix. Instead, it is a social learning process, sustained over time, comprising diverse stakeholders. The fundamental objective of digital innovation is to harness the global digital revolution to meet a country's specific socio-economic priorities. This process is a marathon, not a sprint. It is driven by leadership, vision, learning, innovation, and partnerships among government, business, and civil society (TheWorldBank, 2017).

It thus results in greater diversity in the form of new business models in the provision of financial, health, and education services. The outcome is the emergence of a new set of organisations entering the market to take advantage of this digitisation. Hence, South Africa has adopted digital innovation as one of its strategies to promote inclusive growth, the transformation of government, business, and society among other things (Manda & Backhouse, 2018).

The South African government is considered among the growing numbers of African countries that have embraced the use of innovative technologies to stimulate growth and development. Innovative technologies are increasingly being used in diverse sectors such as health care, financial and educational sector (Manda & Backhouse, 2018).

The WC particularly is the home of many of South Africa's growing companies. Thus, it is a natural choice for innovative tech firms. Most of the industry, or some 47% of tech start-ups, is based in the WC, where Cape Town is located, with Gauteng, where Johannesburg is, coming in second place at 44%. Additionally, 75% of the venture capital transactions in the nation take place in Cape Town. The 2021 Global Startup Ecosystem Report (GSER) published by Startup Genome saw Cape Town ranked first in Regional Ecosystem Knowledge and Regional Ecosystem Talent and Experience and third in Regional Ecosystem Performance (Wesgro, 2021). The report confirms the city's value and the tremendous prospects for innovation it offers.

6) Regulatory Framework

As South Africa has adopted digital innovation to promote economic and social development, adequate regulations are required to shape business practices in every sector of the economy and protect citizens.

The key pathway to achieve social and economic growth by adopting digital technologies will require collaboration and partnership between the government, and the private sectors as well as the knowledge development institutions. Thus, it is important to have regulations that enable for a proper functioning of the economy (G4J, 2022). According to the Growth for Jobs Strategic Framework (G4J), a foundation for the development of the new Growth for Jobs Strategy and Implementation Plan for the Western Cape, regulations should level the playing field, promote the level and vibrant markets that can be responsive to altering public interests (G4J, 2022). Nevertheless, regulations can also restrict or constrain the economy, and thus, reform, awareness, and advocacy are required to bring about adequate and enabling regulatory evolution and ease of doing business. The vision of the G4J involves three pillars that underpin the Western Cape’s approach to realising break-out economic growth. The first pillar is to enable the business environment. The second one is to support growth opportunities. The final pillar is to stimulate market growth (G4J, 2022).

As in other countries, the financial, educational, and healthcare sectors in South Africa are subject to high levels of regulation and intervention. Key regulatory bodies and legislation are discussed below:

6.1) FinTech

In 2018, South Africa's financial regulatory system underwent a significant change, as new Twin Peaks regulators came into operation − the Financial Sector Conduct Authority and Prudential Authority. The prudential regulation aimed to maintain the stability of the financial system. In contrast, the Financial Sector Conduct Authority is responsible for market conduct, which the South African authorities have termed the "good conduct" peak (Malinga, 2022).

The Financial Sector Regulation Act was signed into law on August 21st, 2017, marking a significant milestone towards a safer and fairer financial system that could serve citizens. As part of the second aspect of the Twin Peaks, the COFI Bill, which aims to consolidate the conduct standards of financial institutions, is the next step in legislative reform that is expected to strengthen the regulation of the financial sector and general market conduct (Malinga, 2022).

The COFI Bill aims to protect financial customers, promote the protection and fair treatment of financial customers by financial institutions, and support transparent, efficient and fair financial markets, among other goals. The COFI will also result in major amendments to Regulation 28 of the Pension Funds Act, which deals with the infrastructure used to conduct services and with credential restrictions to pension funds. This can result in big institutional investors climbing into the fintech space and pension funds being invested in the fintech space (Malinga, 2022)

Money laundering in South Africa is regulated by the Prevention of Organised Crime Act, 1998 ("POCA"), and FICA and the regulations promulgated thereunder. FICA provides the administrative framework for regulating anti-money laundering, while The POCA sets out the money laundering offences (GlobalLegalGroup, 2019).

FICA was recently amended by the FICA Amendment Act, which introduced a risk-based approach to client due diligence. "Accountable institutions", as defined in FICA, include money remitters, banks, investment advisers, insurers, and the like. Accountable institutions are subject to onerous compliance obligations, including identifying and verifying customers and record-keeping and registering with the Financial Intelligence Centre ("FIC") (GlobalLegalGroup, 2019).

Fintech companies that do not fall within the definition of an accountable institution are exempt from these obligations, and the monitoring and screening of transactions become increasingly difficult where transactions are conducted cross-border using financial technology. It is interesting to note in passing that mobile phone operators are not accountable institutions for purposes of FICA (GlobalLegalGroup, 2019).

Regarding cryptocurrency, the SARB and the FIC have recommended that cryptocurrency asset service providers must comply with FICA. Among other things, this would require South African cryptocurrency asset providers to do the following (GlobalLegalGroup, 2019):

- Adopt a risk-based approach to customer due diligence.
- Ensure complete compliance with FICA or risk facing remedial action, which would include administrative sanctions.

- Register with the FIC as an accountable institution, conduct due diligence of clients and keep records. This also comprises monitoring transactions, compiling, and filing reports on any unusual or suspicious crypto transactions, and reporting cash transactions of R24,999 and above.

6.2) HealthTech

Below is a list of some of the most relevant pieces of legislature pertaining to the health industry.

- The National Health Act (61 of 2003), involving the amendment dealing with fundamental standards, regulates public and private healthcare providers to promote the best health services available resources can afford. It emphasises the need for cost-effective health technologies (FTIConsulting, 2019).
- As amended, the Medicines and Related Substances Control Act (101 of 1965) regulates the distribution and sale of medicines, technologies, and medical devices, which are broadly defined in the Act to include simple and complex devices (FTIConsulting, 2019).
- Prior to 2015, South Africa had no specific regulations for health technology, barring electronic medical devices which were regulated by the Medicines Control Council (MCC) under the Medicines and Related Substances Control Act (discussed above). The passing into law of the Medicines and Related Substances Amendment Act 14 of 2015 introduced a new and more complete, regulatory regime into the sector (FTIConsulting, 2019).

  The amendment established the South African Health Products Regulatory Authority (SAHPRA), whose mandate was expanded from that of the Medicines Control Council (MCC) which preceded it. The new legislation entails that all medical technologies and devices are registered and regulated prior to sale in the local market (FTIConsulting, 2019).

  All technologies, from syringes to software, must now be distributed by a licensed provider, and demonstrate their compliance with the "Essential Principles" laid out by SAHPRA.
- The Medical Schemes Act (131 of 1998) regulates, the value that reserves schemes should hold, how schemes operate, and the cover provided by schemes, involving setting Prescribed Minimum Benefits (PMBs), the set of diagnosis-treatment combinations that schemes must reimburse. The Medical Schemes Amendment Bill introduced in June 2018 seeks to fundamentally alter the role of schemes considering the government's plans for

a National Health Insurance (NHI) programme. This is dealt with in more depth in the discussion of NHI in the next subsection (FTIConsulting, 2019).

6.3) EduTech

The education policy goal in South Africa is to have ICT capable citizens by 2073 - to help develop the skills and knowledge they need as lifelong learners to achieve personal goals and to be full participants in the global community. Entrepreneurs are encouraged to visit the National Department of Basic Education to ensure that they are better prepared and equipped to successfully operate in the education industry (Morobe, 2022).

Some of the most relevant regulations relating to the education industry in South Africa are discussed below.

- The Higher Education Act 101 of 1997, which intends "to regulate higher education; provide for the establishment, composition and functions of a Council on Higher Education; provide for the appointment and functions of an independent assessor; provide for the establishment, governance and funding of public higher education institutions; provide for the registration of private higher education institutions; provide for quality assurance and quality promotion in higher education; provide for transitional arrangements and the repeal of certain laws; and provide for matters connected therewith" (GovernmentSA, 2022).
- The South African Schools Act 84 of 1996, which promotes access to education, promotes democratic and quality governance in the schooling system, and makes schooling compulsory for children aged seven to 15 to ensure that all learners have access to quality education without discrimination (GovernmentSA, 2022).
- The Basic Education Laws Amendment Act 15 of 2011, aims to amend; the National Education Policy Act, 1996, so as to amend or delete certain definitions; the South African Schools Act, 1996, the Employment of Educators Act, 1998, the South African Council for Educators Act, 2000, and the General and Further Education and Training Quality Assurance Act, 2001 (GovernmentSA, 2022).
- The National Education Policy Act 27 of 1996, which inscribes into law the policies, legislative and monitoring responsibilities of the Minister of Basic Education, and the formal relations between national and provincial authorities (GovernmentSA, 2022).

- The National Qualifications Framework Act 67 of 2008, is the system that records the credits assigned to each level of learning achievement in a formal way to ensure that the skills and knowledge that have been learnt are recognised throughout the country (GovernmentSA, 2022).
- The Further Education and Training Colleges Act 16 of 2006, aims to provide for the regulation of further education and training; to provide for the establishment, governance and funding of public further education and training colleges; and to provide for the employment of staff at public further education and training colleges.

Other Regulatory Regimes that concern all the three industries are:

POPI which regulates the collection, use and transmission of personal data. In other terms, POPI is defined as "a public or private body or any other person which, alone or in conjunction with others, determines the purpose of and means for processing personal information".
Fintech, healthtech, and edutech businesses have to comply with the eight conditions for lawful processing of personal information set out in Chapter 3 of POPI when collecting, using, transmitting, or otherwise processing personal information.

Another law is the Broad-Based Black Economic Empowerment (B-BBEE), which is a legislative framework. Its primary goal is to address the legacy of apartheid and promote the economic participation of previously disadvantaged groups in the South African economy.Thus, all companies wishing to supply products or services to the public sector must consider B-BBEE certification. Further, new amendments to the B-BBEE scorecard incentivise companies to use suppliers that are B-BBEE compliant, making B-BBEE a significant consideration even for companies supplying only to private sector clients.

7) Key Role-Players

This section discusses the key players that operate in the FinTech, EduTech and HealthTech environment in the WC according to the triple Helix network - public, private, and academic organisations.

7.1) FinTech

There are at least 125 FinTech companies in Cape Town in March 2021 according to a report by KPMG. Some of these FinTech organisations are illustrated in the Figure below. This section will then discuss some of the big FinTech players operating in the EduTech private, public, and academic environment in the WC.

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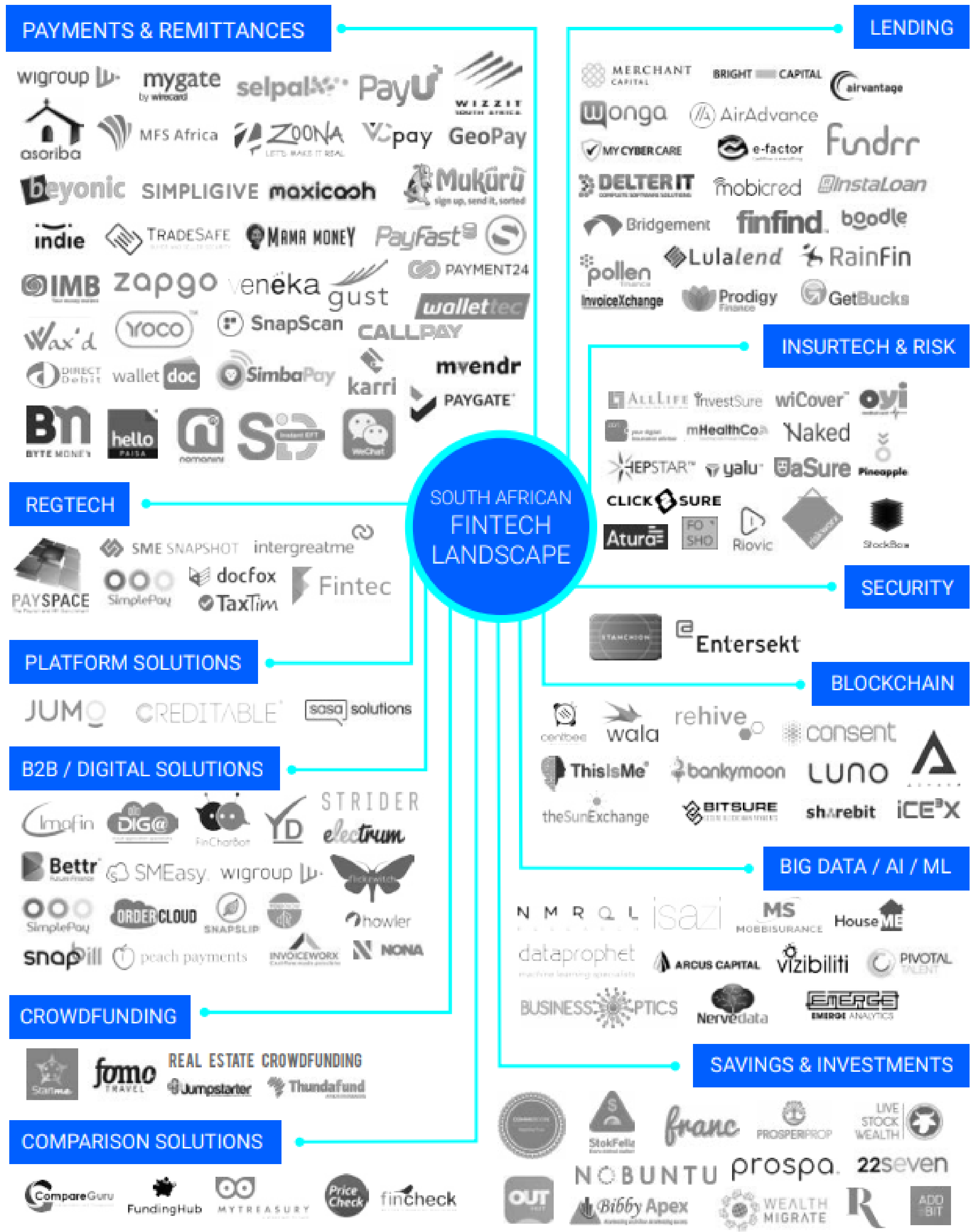

Figure 2: South African FinTech Landscape

7.1.1) Academic Institutions

- **The Algorand-UCT Financial Innovation Hub**

The University of Cape Town and the Algorand Foundation collaborated On October 27th, 2021, to launch the UCT-Algorand Fintech Innovation Hub (the Hub).

The three pillars of the innovation hub are:

1. Rigorous academic investigation on blockchain, central bank digital currencies, privacy, cyber security, and digital inclusion to make meaningful contributions on the forefront of current knowledge.
2. Hands-on support for student-led startups with a distinctively African perspective will help translate the latest academic research into non-commercial, open-source projects and commercially viable startups contributing to the overall Algorand and fintech ecosystem.
3. Multidisciplinary collaboration will be accelerated by a thought leadership platform for continuing communication with policy- and lawmakers and the financial services sector.

7.1.2) Private Organisations

Fintech firms in South Africa can be broadly divided into eight industry market segments based on the functions the specific Fintech organisation performs, as shown in Table 1 below (GenesisAnalytics, 2019). These market segments are payments, lending, savings and deposits, insurtech, investments, financial planning and advisory, capital raising, and B2B Tech providers. Some FinTechs can operate across more than one segment. The table below provides a description of each industry segment and sub-segments to understand the particular products and services offered within each fintech segment.

Table 2: FinTech Market Segments (GenesisAnalytics, 2019).

Segment	**Description**	**Products Offered**
Payment	Entities that perform part or all of the functions required to **send and/or receive value from one party to another** via any digital channel. This includes parties in the value chain that	mPOS, Crypto Payments, payments aggregators, Third party payment providers, closed loop mobile wallets.

	facilitate or enable clearing and settlement processes.	
Lending	Entities that facilitate the **borrowing of money or financing assets** for individual consumers and/or small businesses with traditional and non-traditional financiers through internet, cloud or app-based platforms.	Online lenders, asset financing, alternative scoring, lending marketplaces.
Savings & Deposits	Entities that are **deposit-taking and provide digital banking services as well as savings products and layby** arrangements using mobile technology	Layby, digital banking, digital community savings, savings products.
Investments	Entities that provide digital platforms for **investment and/or trading activity (including cryptocurrency)** or enable individuals to trade on traditional exchanges/platforms from their own device(s).	Retail trading, crypto currency trading, alternative exchange.
Financial Planning & Advisory	Entities that use **artificial intelligence and/or robotics to provide financial advice** to individuals or small businesses by recommending suitable savings, investment or credit products and managing financial wellness.	Robo advisory, small business finance management, personal finance management.
Capital Raising	Equity or debt funding platforms that allow businesses or individuals to raise funds for investment purposes or charitable causes. This segment also	Crowd investing, due diligence.

	includes digital due diligence service providers.	
B2B Tech providers	Entities that create or support white label platforms and/or products provided by other financial services providers, for use by other fintechs but do not provide financial services to the general public through their own brand name.	Aggregators, open infrastructure, security and ID, process automation, white label platforms(solutions), RegTech & risk management.

a) Lending Segment

Online lender, **Pollen Finance** in the Western Cape, is one of the biggest online lending platforms established in 2015. This fintech serves a growing need for SME funding to support business growth. The lender managed to provide firms with up to R20 million in short-term loans in 2017. The company offers short-term loans which are applied for over the internet.

In the personal lending space, **Mobicred**, established in Cape Town offers a differentiated business model that allows consumers to apply for loans while shopping online. Mobicred targets consumers who do not want to use a credit card and are looking for a centralised credit facility for their online purchases (GenesisAnalytics, 2019).

Currently, innovation in the lending space does not include alternative datasets for credit scoring, which has been successful in other African markets. For example, some mobile network operators calculate eligibility using telco-usage inputs such as tenure, airtime or data top-up for micro and "nano" loans. These models have allowed credit extension to previously underserved markets (GenesisAnalytics, 2019).

b) Insuretch

The insurtech segment is characterised by numerous fintech entrants, however, incumbents are responding to these entrants by digitising their processes in line with technological advancements in the sector (GenesisAnalytics, 2019). The insurtech market in the WC contains a diverse set of players ranging from traditional providers using digital distribution channels to new players with innovative business models. Digital distribution refers to offering traditional insurance products through digital channels, such as mobile, web or app (GenesisAnalytics, 2019).

With backing from traditional financial institutions, this segment seems more established than other segments, with many incumbents embracing digital distribution. The digital distribution sub-segment, however, includes relatively young players such as **Lulalend**, **Click2Sure,** etc..

Click2Sure was launched in 2016 and allows customers to purchase high-value consumer items via an online e-commerce provider. During the checkout process, the customer is offered an insurance policy on the item they have just purchased. This allows retailers to promote insurance on their products and enables consumers to easily claim against their insurance policies using an online platform, with easy access to all relevant records (GenesisAnalytics, 2019).

Peer-to-peer (or social) insurance represents a new innovative business model in South Africa's established insurance industry. Peer-to-peer insurance players are mostly located in Gauteng such as **Pineapple Insurance** and **FoSho Insurance** (GenesisAnalytics, 2019).

c) Financial Planning and Advisory

In South Africa, there are a total of 16 fintechs under the Investment segment, four being small business finance management, five personal finance management and seven robo-advisory.

Finance management segments include fintechs that help consumers manage their finance, through financial advice or aggregating financial information. In the micro, small and medium enterprise (MSMEs) space in Cape Town, most fintechs focus on assisting with financial management, accounting, and working capital, for example **SMEasy**. In the personal finance management space, fintechs like **22seven** aggregate account information. **Pocketslip** has software that is integrated with point-of-sale devices so cashiers can send the receipts directly to a client (GenesisAnalytics, 2019).

d) Payments

The growth of fintechs in South Africa (SA) has mainly been in the payments segment. Fintechs have been able to disrupt a core "banking" service and offer simpler, faster solutions. Increased access to the internet and the growth of e-commerce created the opportunity to facilitate and process digital payments. As a result, a large majority of payment fintechs are third-party payment providers or payment services providers (PSPs). These fintechs offer retailers the ability to accept electronic payments via a number of payment rails (e.g. credit card, direct debit, bank transfer, and real-time bank transfer). The third party sub-segment is relatively mature and can even be described as saturated with very few new entrants in the market in 2017 or 2018 (GenesisAnalytics, 2019).

WiGroup, whose head office is in Cape Town is one of the oldest PSPs; it launched in 2008 as a mobile wallet, and evolved into a facilitator of mobile transaction services. To date, the company has facilitated over R7 billion of transactions. Some of their customers include big retail brands such as Pick n Pay, Vodacom, and Woolworths. This fintech has grown from processing an average of R650 million in value (between the years 2008 to 2016), to processing R1.8 billion of transactions in 2017.

The crypto payments sub-segment in contrast is very immature. While a platform such as **Luno** provids crypto wallets, this fintech is mainly considered a currency trading platform. Luno has focused on the buying and selling of crypto currencies for investment purposes with very low payment transaction values and volume.

Mama Money -located in Cape Town is a peer-to-peer (P2P) money transfer service that tackles the high cost of international money transfer to and within Africa. It currently operates in ten countries by using retail cash points to send money to customers' mobile wallets. Mama Money has a network of around 1,000 agents in local communities who distribute the company's products and sign-up and onboard customers

e) Savings & Deposits

New digital banks are disrupting the market and are already recording increasing consumer numbers. For instance, **Tyme Bank**, an exclusively digital retail bank that is digitally smart, is reportedly onboarding 5,000 new customers each day, with a reported total of 3 million customer milestones in March 2021, following its soft-launch in November 2018.

Hello Paisa provides payment solutions that enable people to send money from South Africa and receive money from overseas.

Early indications show that incumbent banks are taking the threat of fintechs seriously with a number of banks focusing on product innovation and lowering fees. **Fomo Travel**, and **Lay Up** are two fintechs in Cape Town that provide layby services online, allowing consumers to pay a deposit toward a good while the retailer in turn holds the good until the customer can pay the balance.

The savings product sub-segment includes fintechs such as **Jumo** and **Prospa.** Prospa provides a mobile savings wallet for low-income earning South Africans that makes it easy to save small amounts infrequently using prepaid vouchers. Prospa then pools all savings on its platform, taking advantage of banks' higher interest rates for larger savings balances. The sub-segment is still young with only one fintech operating purely as a savings platform.

f) Investments

Similar to insurance, investments are considered secondary financial services. As a result, investment products have been more attractive for middle to high-income earners who had the means and the intention to increase their wealth (GenesisAnalytics, 2019).

The entrance of fintechs in the investment space is changing this landscape, making it more accessible for retail consumers to gain access to the equity trading and investment sector by providing investment services on a smartphone with a lower fee structure.

There are a total of 22 fintechs in South Africa under the Investment segment, 10 being cryptocurrency trading platforms and eight retail trading platforms. The cryptocurrency market has offered investors a new asset class. Domestic cryptocurrency trading platforms such as **Luno** make it easy and simple to trade cryptocurrency by buying and selling the currency on your mobile phone.

g) Capital Raising

Although South Africa has a number of crowdfunding platforms, almost all of these support reward-based crowdfunding. Unlike equity-based crowdfunding where the investor receives equity, e.g. shares in the business, investors contribute small amounts of money to projects in return for some kind of reward, usually the product being produced. This includes platforms such as FundFind, Jumpstart, and Thundafund.

Equity-based crowdfunding has been slow to develop in South Africa due to the regulatory uncertainty in this space. Crowdfunding is not specifically regulated, however, if an entity raises funds through equity, that entity may be required to register as an exchange under the Financial Market Act 2012. This has deterred the growth of equity-based crowdfunding models.

Currently, there is only one true equity crowdfunding platform in the market, **UpriseAfrica**, and a handful of other fintechs that facilitate collective investments in alternative assets such as property or livestock, such as Live Stock Wealth, Wealth Migrate, or Realty Africa. Uprise.Africa was launched in 2017 and managed to raise R3.9 million in that year, higher than its R1 million target. This only amounts to 0.03% of the value venture capital firms managed to raise in the same period, indicating that the segment is still in its infancy.

In addition to equity crowdfunding platforms, there are fintechs that support capital raising through automated due diligence tools. There is only one due diligence platform in South Africa to date, **YueDiligence**, which is an interactive web-based tool that increases due diligence efficiency for entrepreneurs, investors and service providers through process automation. The platform enables users to identify growth gaps in their business and prepare a pitch to potential investors and business partners.

7.1.3) Public Organisations

- DashTech program

The DashTech program consists of a series of events that focuses on five specialised sub-sectors of the tech ecosystem to provide a venue for different stakeholders to interact, encourage collaboration,strengthen alliances, and foster innovation, improve local product development, and open new markets and supply-chains for local tech businesses. Additionally, this strategy aims to solve structural gaps in the ecosystem, such as those in funding sources, start-up quality and quantity, and incubator and accelerator efficiency.

The fourth industrial revolution and FinTechare are of the five ecosystems highlighted in the 2022 year's DashTech program.

DEDAT organise the DashTech events in forms designed to meet the demands of the industry along with their partners Silicon Cape Initiative & Loudhailer, IESA (Interactive Entertainment South Africa), CiTi (Cape Innovation and Technology Initiative), and KPMG.

7.2) HealthTech

A report published by Wesgro in 2022 identified 22 start-ups in the WC which are pioneers in the HealthTech industries. Below key players are discussed:

7.2.1) Private Organisations

The three large hospital groups (Life Healthcare, Netcare and Mediclinic) constitute 66% of the private hospital sector and are the most prominent potential purchasers of EHR technologies (FTIConsulting, 2019).

However, they are at different stages of the EHR procurement process. Other players in the hospital market include the National Hospital Network (NHN), a network of private hospitals that has been granted permission to bargain and procure goods and services collectively and represents 25% of the private hospital beds in South Africa. There are also other smaller hospital groups including Lenmed Health and Clinix Health Group. The larger administrators (Discovery, MMI, Medscheme and Universal) would also theoretically present possible markets for EHR and RHMI programmes, as they have, or aspire to have, their own systems which they require health professionals and facilities to use or connect with. However, many of these companies, such as Discovery Health and Universal Healthcare, have built their own software in-house. Many established global technology companies are active in the South African market, including Philips, GE, Altron (and their subsidiary Med-e-Mass), Accenture and EOH (FTIConsulting, 2019).

There are many South African startups currently operating in this space, including Signapps (mobile app-based case management software), Vula (mobile app-based referral software), MomConnect (SMS-based health maternal and child health promotion) and Hello Doctor (mobile app-based health information and telephone doctor access). Some other startups are presented below:

- **AzarGen**

AzarGen is the first private plant-made pharmaceutical company in South Africa. It is a biotechnology firm focused on developing human therapeutic proteins using advanced synthetic biology and genetic engineering techniques in plants. The company's lead therapeutic candidates are a biosimilar version of an anti-cancer monoclonal antibody and a recombinant human surfactant protein targeted for diverse respiratory disease conditions. AzarGen has developed proprietary synthetic DNA tools (promoters) for different expression platform applications in synthetic biology, plant-made pharmaceuticals and GM-crop improvement (Wesgro, 2022).

- **Digihealth based in Woodstock**

Digi health helps high-growth, high-social impact businesses succeed and supports established enterprises at risk of being disrupted. DHCT draw on the latest thinking and tools for innovation and can offer digital health education to clients wherever they are on their innovation journey.

- **iKineo Ventures**

It is an investment firm and venture builder. It has made waves in the South African Health tech sector by facilitating the formation of venture portfolio firm Kena Health. The Kena Health App aims to be Africa's largest digital healthcare provider, offering real-world, cost-effective healthcare to millions of South Africans (Cover, 2022).

7.2.2) Public Organisations

- **The Cape Health Technology Park**

The Cape Health Technology Park is a collaborative venture between the national Department of Science and Technology, the Western Cape Government, business and academia. It aims to be a world-class facility where pharmaceutical companies, research institutes, clinical trial facilities and health-related academic and government programmes are strategically housed in one location (wesgro, 2022)

The economic impact of the proposed health tech park, during its construction phase, could be transformational with R1.5-billion contribution to the economy; 2 000 direct jobs; and 4 165 indirect and induced jobs added to the national economy, based on a construction investment of R757-million. The Cape Health Technology Park is set to contribute more than 13 000 jobs to the economy during its 10-year operational phase (wesgro, 2022).

7.2.3) Academic Institutions

Many academic institutions in WC promote HealthTech by ensuring cutting-edge research and highly skilled engineers and scientists. Some of these institutions are presented below:

- **Stellenbosch Biomedical Research Institute**

Stellenbosch University is launching a billion-rand state-of-the-art Biomedical Research Institute (BMRI) at its Faculty of Medicine and Health Sciences. The goal of the BMRI is to create a fully integrated, organised, and future-focused research complex that will outperform current standards (Stellenbosch University, 2022)

It aims to investigate diseases with the most significant impact in South Africa and Africa and to strengthen research, and improve diagnosis, treatment, and prevention of illnesses such as HIV, tuberculosis, heart disease, and diabetes, among others. Furthermore, it targets the improvement of teaching capacity in the fields of genomics, bioinformatics, anatomy, surgery, and neurology (Stellenbosch University, 2022).

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- **University of Cape Town (UCT) Biotech and Pharmaceutical**

UCT's Department of Medicine in the Faculty of Health Sciences is the largest department in the university, housing 18 divisions with international collaborating teams and 10 specialised research units. The biotechnology and microbiology faculties of the university have contributed to the further development of The Centre of Genomic and Proteomic Research (InvestCapeTown, 2022).

The UCT Biotech and Pharmaceutical centre has partnered with global pharmaceutical bodies to ensure and accelerate medicinal drug research and discovery in South Africa and Africa (Martin Wendyl, 2021). The chemistry department has also established a footprint with tropical disease drug discovery and development (InvestCapeTown, 2022).

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- **StellenboschTechnology Transfer Office**

The Technology Transfer Office of Stellenbosch University, better known as Innovus, has succeeded in establishing many health products and spin-out companies from the university. They are responsible for producing the most innovations in South Africa, with 20 spin-out companies with a combined turnover of US$22,68 million in 2018 and 300 employees (InvestCapeTown, 2022).

- **African Genomics Centre - Data Centre for Genomics based in Bellville**

The African Genomics Centre is a partnership between the South African Medical Research Council and the Beijing Genomics Institute, which aims to build the capacity for whole human genome sequencing. The potential impact of better understanding the factors of diseases specific to South Africa and developing informed strategies are essential assets. Two entities driving further development in genetic knowledge with a focus on the African population are Artisan Biomed and Gknomix (InvestCapeTown, 2022).

- **University of Western Cape (UWC) and Cape Peninsula University of Technology (CPUT)**

UWC's faculty of natural sciences is a significant centre of research in South Africa, with a spin-out organisation now marrying information with digital sequencing to better identify treatment resistance in HIV and TB patients.

The CPUT Applied Sciences Faculty is leading the way with indigenous medicine research in the region. Food supplements, developments in nanotechnology, and nutraceuticals such as omega 3/fatty acid and a rooibos extract capsule are exciting contributors worldwide.

7.3) EduTech

The latest statistics shows that there are over 75 Edutech start-ups in Cape Town, and the list is still growing (Tracxn, 2022). This section discusses key players operating in the EduTech private, public, and academic environment.

7.3.1) Private Organisations

- **iXperience**

In 2013, Rafi Khan and Aaron Fuchs established iXperience, an edutech company that collaborates with businesses, colleges, and high schools to offer innovative education programs and services that equip students with industry-focused skills.

iXperience, which started as a coding bootcamp, has advanced to become the leading provider of career-focused skills training. The EduTech company asserts to have over 2500 alumni and partners with organizations and individuals to close the skills gap between traditional education and what businesses need. The firm uses its in-house developed technology platform to guarantee students' success during the educational process. Their key differentiator is their capacity to quickly develop new programs, largely due to their innovative technology. The success of the EduTech company may be linked to the calibre of students it recruits and the teachers hired. According to iXperience, its students come from prestigious worldwide universities, including Harvard, Princeton, Stanford, Oxford, and others.iX works with other organizations to ensure they remain relevant in the quickly changing domains of business and education. iXperience has recently forged successful relationships with many schools, including the University of Virginia, WorldStrides, and Bar Ilan University. iXperience possesses the market position and leadership necessary to alter its industry and positively impact the lives of thousands of students and other educational stakeholders.

- **The Student Hub**

The Student Hub was founded by an innovative education firm with its headquarters Western Cape. It strives to provide a learner-centric educational system in which every student is prepared and achieves to discover their purpose. The Student Hub digitises TVET course content to present it personalised for learners on its 100% online distance learning model. The platform offers tools for lecturers and instructors to monitor student performance. Additionally, it has crowdsourcing tools to assist students in financing their studies.

- **Snapplify**

Snapplify is a media and technology company specialising in selling and distributing digital material to businesses and individual users. The platform includes prescribed eTextbooks, videos, audiobooks, and applications from more than 270 partnered publishers. The business provides these services to more than 1400 educational institutions, including colleges, universities, and schools. The firm was established in 2011 and has its headquarters in Cape Town

- **Siyavula education**

Siyavula is a startup that develops educational software that helps students do better in science and math classes in high school. Their goal is to develop and make available engaging, integrated, high-quality learning opportunities in mathematics and the sciences. Siyavula also want to have a lasting, enriching impact on learners and teachers in South Africa and around the world. They constantly look for and develop the most cutting-edge technology while staying grounded in the principles of learning and instruction.

- **Codespace**

Codespace is a Cape Town-based EduTech firm that teaches young adults how to code to address economic injustice, concentrating on creating employment opportunities and closing the racial and gender wage gaps that still exist in South Africa.

- **Karri School Payments**

This startup is a hybrid of EduTech and fintech in the sector, with its first test having been run in November 2021. The financial app allows parents to pay small amounts to the school and teachers, such as for civvies days. The Karri school app is backed by Nedbank, who has concluded a partnership with it.

- **Sea Monster**

Sea Monster is a Cape Town-based 2D animation and game development studio. It is one of the first EduTech participants in the EduTech Open Innovation Cluster. According to CEO Glenn Gillis, two of the company's products, Old Mutual's Moneyversity and PnP's Super Animal AR game, have yielded positive results in the EduTech space.

Sea Monster was one of five startups chosen to participate in the Cocreate2Accelerate programme, received R6.5-million from the Western Cape government, was one of Grindstone's 13 tech startups of 2015, and was featured on 702/Cape Talk Radio's Nedbank Business Accelerator programme.

- **SeeBox**

SeeBox focuses on electronic engineering. More specifically, the startup has a game console that teaches kids about the subject through practical use.

SeeBox won the education category at the African Entrepreneurship Awards and delivered its first units to Manenberg High School in September2021.

- **Paper Video**

Paper Video, a self-described social venture, uses QR codes on previous exam papers. Students that scan the QR code are shown a movie that will assist them in understanding the subject. It currently offers videos on accounting, life sciences, mathematics, natural sciences, physical sciences, and unimaths, across grades eight to 12 and post matric, depending on the subject. One of its recent innovations is is the Paper Video center, which enables students to access 700 hours of instructional videos without an internet connection.

- **Daptio**

Daptio is a SaaS EduTech firm established in Cape Town in 2013 by Tabitha Bailey. Daptio is an adaptive online learning platform that is optimised for integration into current LMS's and 3rd World environments. It employs adaptive technology to evaluate students' competence levels with the appropriate content for publishers and content developers.

The startup won the Telkom Open Innovation Mega Challenge's highest honor in 2013. Daptio was a finalist in the Get in the Ring 2014 competition, one of Fast Company's top 10 most innovative firms in Africa, and a participant in the Edupreneurship Program in 2014.

- **Clock Education**

Clock Education, founded by CEO Kolawole Olajide, aims to solve the education crisis through adaptive technology that enables personalised and self-paced learning. It creates these systems for a range of institutions across all sectors.

7.3.2) Public Organisations

- **Injini**

Injini is a non-profit organisation founded in part by the Cape Innovation & Technology Initiative (CiTi). It launched its research division as an avenue to produce and distribute research and insights about education and innovation that is for Africa and by Africa. The division's objectives are to assist EduTech entrepreneurs through pertinent market research, assist corporate initiatives in fulfilling their commitments to educational outcomes, and promote educational reform by engaging with policymakers in targeted African nations and conducting evidence-based research.

7.3.3) Academic Institutions

- **Heavy chef**

Heavy Chef is an EduTech that specialises in developing learning experiences for entrepreneurs. They organise masterclasses featuring ‘Heavy Chefs’ and then disseminate the information to their network of more than 20,000 entrepreneurs, intrapreneurs, and graduates.

- **Nasper labs**

Naspers Labs is a social impact initiative within the Naspers Group of companies designed to open the closed doors between young unemployed people and their first employment opportunity.

It aims to reduce youth unemployment through digital skills development, access to technology careers, tech-enabled microbusinesses and youth-led.

- **GetSmarter**

GetSmarter, an edX partner, offers online learning from prestigious universities and organisations to change the lives of thousands of students across the world. The online certificate programs from GetSmarter are created to help you enhance your profession while still fitting into people's busy lifestyle. Each course is expert-led, fully supported, and community-based, assisting people in developing skills that are essential for their profession.

- **UCT Online High School, in collaboration with Valenture Institute**

The University of Cape Town (UCT) has partnered with Valenture Institute to launch the UCT Online High School on the 21st of June 2021. UCT Online High School is an innovative, affordable online school offering the South African National Senior Certificate (CAPS) curriculum in grades 8-12 and the Cambridge International Curriculum in years 8-13. UCT online high school not only expertly prepares learners for tertiary education but offers every student with a highly engaging, social, and individualised learning experience at a competitive price.

Valenture Institute is a global private online education platform offering a high school curriculum recognised by leading universities worldwide. It was founded in 2019 and had its headquarters in the UK. It empowers students with the knowledge and abilities they need to thrive in a world that is becoming increasingly digital by providing educators and parents with cutting-edge technology.

8) Innovation Maturity Functions

The innovation maturity is used in this chapter to identify where FinTech, EduTech and HealthTech currently are in terms of their adoption by companies in the WC. The proposed model consists of five maturity indicators which are Birth, Growth, Maturity, and Decline. The definition of each maturity indicator is further explained below:

- **Birth**: This is the first phase of the maturity framework. It refers to introduction of new product to the market, in the case of this paper it refers to the introduction of FinTech, EduTech and HealthTech to the market. During this stage, companies release their innovative technologies into the market for the very first time. The company at this stage is at high stake but does not decide whether their disruptive technologies will be successful or not. Furthermore, a lot of capital is needed and is pooled so that the companies' technologies reach the consumers. Thus, many firms need a lot of promotional and marketing activities to be undertaken.
- **Growth:** In this stage, consumers start to take action. The market for the innovative technologies expands and it may also be tweaked at this stage to ensure some features or functionalities are improved. The knowledge on the technologies is easily accessible. They become popular and results in increased sales. Thus, many investment organisations are growing and ready to provide finances. Other companies also notice these disruptive technologies.
- **Maturity:** It is the stage the market has begun to reach saturation. This is also one of the stages when the competition increases.
- **Decline:** When a disruptive technology is in the decline stage, the sales of companies that offer them drop due to a change in consumer behaviour and demand. This stage is a turnaround stage where companies go back to their survival mode and they make the transition to new business models.

8.1) FinTech

The Table 3 below shows that FinTech in the WC is mainly in its growth stage. According to Startup Genome, Cape Town has a growing Fintech ecosystem compared to other provinces in the country (StartupGenome, 2021). The country has produced some of the most cutting-edge FinTech solutions for South Africa that are also exported across Africa and around the world.

This growth is primarily driven by readily available venture capital funding, an increasing knowledge development and diffusion by institutions, the rising creation of spaces in which innovations can be developed. FinTech businesses are attracting enormous levels of investment especially in the WC. Furthermore, many fundamental regulations are being developed or amended in support of FinTech companies. Also, regulators are reacting to and supporting the continued growth of fintech in various ways, and how ambitious companies are adapting to the regulatory landscape.

Table 3: Fintech Maturity Framework

	Functions	Indicator	Birth	Growth	Maturity	Decline
		Number of new entrepreneurs/ entrants	A low number of new enterprises. Enterprises are not innovation-focused.	A rapid increase of new enterprises. Few established innovation-focused enterprises.	Continuous introduction of new enterprises. Most enterprises are innovation focused.	It is difficult for newer enterprises to compete due to too many large corporations. Enterprises do not focus on innovation.
		Private vs public sector enterprises	The sector is made up of a small number of private enterprises and is majorly made up of public enterprises.	The sector has a growing number of private enterprises that build healthy relationships with public enterprises.	The sector is majorly made up of private enterprises but works in synergy with the public enterprises present.	The relationship between private and public enterprises deteriorates. A large number of enterprises leave the system in a shake-out event.
		Number of entrepreneurs/enterprises	A low number of enterprises. Enterprises are not innovation-focused.	An increased number of enterprises. Few established innovation focus enterprises.	Many enterprises. Most enterprises are innovation-focused.	Multiple large corporations dominate the market. Enterprises do not focus on innovation.
		The entrance vs churn rate of entrepreneurs	There is a slightly higher entrance ratio than the churn rate of entrepreneurs.	There is a continuous increase in the entrepreneur entrance ratio compared to the churn rate of entrepreneurs.	There is little to no difference in the entrepreneur entrance ratio and the churn rate of entrepreneurs.	There is a continuous increase in the churn rate of entrepreneurs compared to the entrepreneur entrance ratio.
F1	Entrepreneurial activity	The intensity of the competition	There is no or minimal competition in the IS. There is a small number of actors that compete.	There is increasing competition among a growing actor base. The marketplace is competitive.	There is a large amount of competition in the IS. The market is moderately concentrated.	The market is highly concentrated or is dominated by few market leaders decreasing the intensity of competition.

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		Sources and intensity of knowledge development	Minimal or no knowledge creation occurs from sector participants. No clear R&D efforts from enterprises.	Continuous increase of knowledge created. An academic institution in the sector's region has an increasing amount of knowledge production. A small number of enterprises are involved in producing R&D contributions.	A large amount of knowledge is constantly generated. Academic institutes produce large volumes of multi-topic knowledge. Enterprises are aiding in knowledge creation through published R&D efforts.	There is a decreasing amount of knowledge generation. The academic institute associated with the sector has a much lower output than usual. Enterprises have shifted their focus away from performing R&D.
		Who finances the knowledge development?	There is minimal or no funding for knowledge development.	There is an increasing number of well-known funding sources for knowledge development.	It is clear where to obtain finances, private or public, for knowledge development.	There is a decrease in the number of sources of funding for knowledge development.
		Who leads research and development?	There are no leaders in research and development.	There is an increasing number of prominent leaders in research and development	There is a large number of prominent leaders in research and development	Leaders start decreasing their contributions and/ or start leaving the system.
		Relevance of knowledge produced	A small amount of academic knowledge produced is relevant to the sector's priorities.	There is a growing level of activity of academic knowledge produced relevant to the sector's priorities.	More sector-relevant knowledge is produced from academia and the private sector.	The knowledge produced has shifted focus away from the sector and is developed more for other sectors.
F2	Knowledge development	Who collaborates to produce published knowledge?	There is no to minimal collaboration among actors of published knowledge.	Actors collaborating to produce published knowledge	There is clear evidence of who collaborates when producing	Collaboration efforts, among actors, to produce published

				increases rapidly.	published knowledge.	knowledge decrease.
		Who collaborates to produce knowledge from R&D?	There is no to minimal collaboration among actors of R&D knowledge.	Actors collaborate to produce R&D knowledge increases rapidly.	There is clear evidence of who collaborates when producing R&D knowledge.	Collaboration efforts, among actors, to produce R&D knowledge decrease.
		Are there partnerships or collaborations?	No clear partnerships between enterprises.	There are some collaborations among enterprises and between academic institutes.	Clear collaboration among enterprises and between academic institutes.	A decreasing number of collaborations among enterprises and academic institutes.
		How is knowledge shared?	Minimal or no knowledge diffusion attempts, or events occur in the sector.	Knowledge is mostly shared unintentionally, intentional knowledge events, and sharing are increasing in the sector.	Continuous formal events occur between various innovation-related parties related to the sector.	A decreasing number of formal events focused on previous innovations occur in the sector.
		Is the knowledge diffused relevant to the IS?	The knowledge diffused in the area has small relevance to the main sectors in the IS.	There is an increase in the efforts to diffuse sector-relevant knowledge.	There is a high level of activity to diffuse new and sector-relevant knowledge.	Participants in the sector have shifted their focus, from the currently diffused knowledge, decreasing its relevance.
		Who shares more knowledge?	There are no leaders in knowledge-sharing efforts.	There is an increasing number of prominent leaders in knowledge-sharing efforts.	There is a large number of prominent leaders in knowledge-sharing efforts.	Leaders start decreasing their contributions and refocusing their efforts on other innovations or sectors.
F3	Knowledge diffusion	The absorptive capacity of the IS's actors	IS actors struggle to absorb and utilise the	IS actors' ability to absorb and utilise the diffused	IS actors absorb and utilise the diffused	IS actors reject the diffused knowledge as they have shifted their focus and

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			diffused knowledge.	knowledge improves.	knowledge effectively.	don’t absorb it anymore.
F4	Guidance of search	Do clear targets/goals exist?	No innovation-orientated sector-focused targets and goals are set.	Innovation-orientated sector-focused targets and goals are being set and achieved.	Innovation-orientated sector-focused targets and goals have been achieved in the region.	Innovation-orientated sector-focused targets or goals are not revised when met or failed to be achieved.
		Do the goals cause government involvement?	The government is not or is minimally involved with goal setting or contributing to achieving the sector-focused goals.	The government is increasingly involved with goal setting or contributing to achieving sector-focused goals.	The government is steadily involved with goal setting or contributing to achieving the sector-focused goals.	The government decreases its support for goal setting or contributing to achieving the sector- focused goals.
		Does existing or new legislation/ regulation act as a barrier or an enabler?	Current legislation acts as a strong barrier to innovation in the IS.	Impeding legislation is relaxed and/ or new legislation is introduced to aid innovation in the IS.	Impeding legislation is minimal and/ or new legislation strongly aids innovation in the IS.	Current legislation is outdated and hinders innovation, it needs to be updated again.
		Articulation of interest by leading customers	There is minimal to no interest articulated by leading customers in the innovation system. The IS actor’s demand is not clear.	Leading customers increasingly articulate their interests showing the IS participant’s demand.	It is clear what the IS’s interest is and it is well articulated. All actors understand each other’s demands.	The interest is not articulated well and the customer’s interest has shifted to other innovations or sectors.
F5	Market formation	Are their policies, or incentives for the market?	No policies or incentives exist to promote innovation or innovative related solutions.	Policies or incentives to support innovation are introduced and utilised by various entities.	The market is well- formed and self-sufficient. Policies or incentives do not have a large effect on	The policies or incentives in place don’t have any impact and the market is beginning to decrease in size

					the market's growth.	due to other markets.
		The market size of a specific sector	The sector’s market is non-existent/tiny and would require work to develop.	The sector’s market is growing rapidly and receives increasing growth.	The sector’s market has slowed, but it is receiving a sustaining amount of support.	The sector’s market is decreasing in size and needs to pivot to accept newer innovations.
		Who are the sector's market leaders?	It is not easy to identify the sector leaders. The market is still for new entrants to succeed.	Clear sector leader(s) emerge and can be easily identified. There is still space in the market for new entrants.	Sector leaders are easily identifiable, they dominate the market making it difficult for new entrants to succeed.	The sector’s market starts to lose its relevance and the sector leaders withdraw or shift their focus from the sector.
		What lifecycle stage is the market in?	The market is a niche market and has limited structural elements.	The market is bridging and welcomes more elements. The elements find it easy to grow.	The market is mature, it is large and well-established. Structural elements are comfortable and there is minimal change.	The market is declining and is either left to phase out or renewed by aiming to grow again.
F6	Resource mobilisation	Nature of financial resources	There are few funding resources or mechanisms available.	There is an increasing number of different funding resources or mechanisms available.	There is a large variety of types of funding resources or mechanisms available.	There is a limited number of types of funding resources or mechanisms available.
		Accessibility of financial resources	Financial resources are not available or are difficult to obtain.	Financial resource access is increasingly easier and investors are showing increased interest.	Established financial resources exist (i.e. established banks, venture capital firms and angel investors).	Financial resources are withdrawing their support from the sector.

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		Accessibility of seed and venture capital (VC)	Seed and venture capital are not available or are difficult to obtain.	Seed and venture capital access is increasingly easier and investors are showing increased interest.	Established access to seed and venture capital exists (i.e. established venture capital firms and angel investors).	Financial resources are withdrawing their support and leaving the system.
		Accessibility of infrastructure to provide basic needs (business-facing as well)	The infrastructure to meet basic needs is mediocre or non- existent.	The infrastructure to meet basic needs is improving and is accessible.	The infrastructure to meet basic needs is well developed and stable.	No further investments into the infrastructure to meet basic needs are made, and they start to deteriorate.
		Availability of appropriately skilled workforce	There are minimal or no appropriately skilled workers available.	There is a large increase of appropriately skilled workers to employ.	There are plenty of appropriately skilled workers in the region.	There is a decreasing number of appropriately skilled workers
		Availability of a high- skill workforce	There are minimal or no high skilled workers available.	There is a large increase of high skilled workers to employ.	There are plenty of high-skill workers in the region.	There is a decreasing number of high-skill workers
F7	Creation of legitimacy	Strength of resistance to change for a specific sector?	The sector's participants are resistant to change and are not open to innovative ideologies or influences.	The sector's participants are opening up to different innovations and are starting to welcome them into their everyday lives	The sector's participants are accepting of innovative solutions and continuous change. There are plenty of examples of what innovation does for the sector. A clear buy-in can be seen by prominent entities.	The sector's participants are starting to lose trust in new innovations and what innovation does for the sector.

		Is there recognised actor support?	There are no recognisable brands or enterprises supporting innovation.	Large enterprises are starting to support and fund innovation activities and actors within an area.	There is consistent and committed support from recognised enterprises for innovation activities and actors within an area.	Large enterprises are withdrawing their funds and support for innovative activities.
		Are there mechanisms to engage with the community?	There is no to little way for innovation driving actors to engage with the community.	There is an ever- growing number of ways to engage with the community on innovation topics.	There are established mechanisms to engage with the community.	Current engagement mechanisms are overused and the communities focus shifts while participation decreases.
		Do actors lobby for sector support? (Are there resources or formal structures to empower lobbying for actor support?)	Actors do not or barely lobby for support from the appropriate support actors in the IS. There are no formal processes to follow to lobby.	Actors are increasingly lobbying for their required resources, changes to legislation, and implementation of goals.	There is a continuous group lobbying for required resources, changes to legislation, and implementation of goals.	Lobbying groups' presence is diminished and there is decreased lobbying activity. Formal processes become difficult to navigate.
		Are the benefits of innovation marketed effectively?	No to minimal effort to market innovation is performed.	The benefits of innovation are increasingly marketed more and made clearer to actors in the IS.	The benefits of innovation are marketed effectively and are understood by actors in the IS.	There is confusion regarding the benefits of innovation, some of the benefits expressed are outdated and should be revised.

8.2) HealthTech

The Table 4 below shows that HealthTech in the WC is in its growth stage. According to a report commissioned by the Netherlands Enterprise Agency, the current market for medical technology in South Africa is dominated by traditional devices (FTIConsulting, 2019). It is said that, globally, the healthcare sector is thought to lag behind other industries in its use of technology by at least 10 years13, while South Africa is also behind the curve in terms of technology adoption in general. These facts combined indicate that the South African healthcare technology market presents major opportunities for growth (FTIConsulting, 2019).

Table 4: HealthTech Maturity Framework

	Functions	Indicator	Birth	Growth	Maturity	Decline
F1	Entrepreneurial activity	Number of new entrepreneurs/ entrants	A low number of new enterprises. Enterprises are not innovation-focused.	A rapid increase of new enterprises. Few established innovation-focused enterprises.	Continuous introduction of new enterprises. Most enterprises are innovation-focused.	It is difficult for newer enterprises to compete due to too many large corporations. Enterprises do not focus on innovation.
		Private vs public sector enterprises	The sector is made up of a small number of private enterprises and is majorly made up of public enterprises.	The sector has a growing number of private enterprises that build healthy relationships with public enterprises.	The sector is majorly made up of private enterprises but works in synergy with the public enterprises present.	The relationship between private and public enterprises deteriorates. A large number of enterprises leave the system in a shake-out event.
		Number of entrepreneurs/enterprises	A low number of enterprises. Enterprises are not innovation-focused.	An increased number of enterprises. Few established innovation focus enterprises.	A large number of enterprises. Most enterprises are innovation-focused.	Multiple large corporations dominate the market. Enterprises do not focus on innovation.

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		The entrance vs churn rate of entrepreneurs	There is a slightly higher entrance ratio than the churn rate of entrepreneurs.	There is a continuous increase in the entrepreneur entrance ratio compared to the churn rate of entrepreneurs.	There is little to no difference in the entrepreneur entrance ratio and the churn rate of entrepreneurs.	There is a continuous increase in the churn rate of entrepreneurs compared to the entrepreneur entrance ratio.
		The intensity of the competition	There is no or minimal competition in the IS. There is a small number of actors that compete.	There is increasing competition among a growing actor base. The marketplace is competitive.	There is a large amount of competition in the IS. The market is moderately concentrated.	The market is highly concentrated or is dominated by few market leaders decreasing the intensity of competition.
F2	Knowledge development	Sources and intensity of knowledge development	Minimal or no knowledge creation occurs from sector participants. No clear R&D efforts from enterprises.	Continuous increase of knowledge created. An academic institution in the sector's region has an increasing amount of knowledge production. A small number of enterprises are involved in producing R&D contributions.	A large amount of knowledge is constantly generated. Academic institutes produce large volumes of multi-topic knowledge. Enterprises are aiding in knowledge creation through published R&D efforts.	There is a decreasing amount of knowledge generation. The academic institute associated with the sector has a much lower output than usual. Enterprises have shifted their focus away from performing R&D.
		Who finances the knowledge development?	There is minimal or no funding for knowledge development.	There is an increasing number of well-known funding sources for knowledge development.	It is clear where to obtain finances, private or public, for knowledge development.	There is a decrease in the number of sources of funding for knowledge development.
		Who leads research and development?	There are no leaders in research and development.	There is an increasing number of prominent leaders in	There is a large number of prominent leaders in	Leaders start decreasing their contributions and/ or start leaving the system.

				research and development	research and development	
		Relevance of knowledge produced	A small amount of academic knowledge produced is relevant to the sector's priorities.	There is a growing level of activity of academic knowledge produced relevant to the sector's priorities.	More sector-relevant knowledge is produced from academia and the private sector.	The knowledge produced has shifted focus away from the sector and is developed more for other sectors.
		Who collaborates to produce published knowledge?	There is no to minimal collaboration among actors of published knowledge.	Actors collaborating to produce published knowledge increases rapidly.	There is clear evidence of who collaborates when producing published knowledge.	Collaboration efforts, among actors, to produce published knowledge decrease.
		Who collaborates to produce knowledge from R&D?	There is no to minimal collaboration among actors of R&D knowledge.	Actors collaborate to produce R&D knowledge increases rapidly.	There is clear evidence of who collaborates when producing R&D knowledge.	Collaboration efforts, among actors, to produce R&D knowledge decrease.
		Are there partnerships or collaborations?	No clear partnerships between enterprises.	There are some collaborations among enterprises and between academic institutes.	Clear collaboration among enterprises and between academic institutes.	A decreasing number of collaborations among enterprises and academic institutes.
		How is knowledge shared?	Minimal or no knowledge diffusion attempts or events occur in the sector.	Knowledge is mostly shared unintentionally, intentional knowledge events, and sharing are increasing in the sector.	Continuous formal events occur between various innovation-related parties related to the sector.	A decreasing number of formal events focused on previous innovations occur in the sector.
F3	Knowledge diffusion	Is the knowledge diffused relevant to the IS?	The knowledge diffused in the	There is an increase in the efforts to	There is a high level of activity to diffuse new	Participants in the sector have shifted their focus, from the

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			area has small relevance to the main sectors in the IS.	diffuse sector-relevant knowledge.	and sector-relevant knowledge.	currently diffused knowledge, decreasing its relevance.
		Who shares more knowledge?	There are no leaders in knowledge-sharing efforts.	There is an increasing number of prominent leaders in knowledge-sharing efforts.	There is a large number of prominent leaders in knowledge-sharing efforts.	Leaders start decreasing their contributions and refocusing their efforts on other innovations or sectors.
		The absorptive capacity of the IS's actors	IS actors struggle to absorb and utilise the diffused knowledge.	IS actors' ability to absorb and utilise the diffused knowledge improves.	IS actors absorb and utilise the diffused knowledge effectively.	IS actors reject the diffused knowledge as they have shifted their focus and don't absorb it anymore.
		Do clear targets/goals exist?	No innovation-orientated sector-focused targets and goals are set.	Innovation-orientated sector-focused targets and goals are being set and achieved.	Innovation-orientated sector-focused targets and goals have been achieved in the region.	Innovation-orientated sector-focused targets or goals are not revised when met or failed to be achieved.
		Do the goals cause government involvement?	The government is not or is minimally involved with goal setting or contributing to achieving the sector-focused goals.	The government is increasingly involved with goal setting or contributing to achieving sector-focused goals.	The government is steadily involved with goal setting or contributing to achieving the sector-focused goals.	The government decreases its support for goal setting or contributing to achieving the sector- focused goals.
		Does existing or new legislation/ regulation act as a barrier or an enabler?	Current legislation acts as a strong barrier to innovation in the IS.	Impeding legislation is relaxed and/ or new legislation is introduced to aid innovation in the IS.	Impeding legislation is minimal and/ or new legislation strongly aids innovation in the IS.	Current legislation is outdated and hinders innovation, it needs to be updated again.
F4	Guidance of search	Articulation of interest by leading customers	There is minimal to no	Leading customers	It is clear what the IS's	The interest is not articulated well and

			interest articulated by leading customers in the innovation system. The IS actor's demand is not clear.	increasingly articulate their interests showing the IS participant's demand.	interest is and it is well articulated. All actors understand each other's demands.	the customer's interest has shifted to other innovations or sectors.
		Are their policies, or incentives for the market?	No policies or incentives exist to promote innovation or innovative related solutions.	Policies or incentives to support innovation are introduced and utilised by various entities.	The market is well- formed and self-sufficient. Policies or incentives do not have a large effect on the market's growth.	The policies or incentives in place don't have any impact and the market is beginning to decrease in size due to other markets.
		The market size of a specific sector	The sector's market is non-existent/tiny and would require work to develop.	The sector's market is growing rapidly and receives increasing growth.	The sector's market has slowed, but it is receiving a sustaining amount of support.	The sector's market is decreasing in size and needs to pivot to accept newer innovations.
		Who are the sector's market leaders?	It is not easy to identify the sector leaders. The market is still for new entrants to succeed.	Clear sector leader(s) emerge and can be easily identified. There is still space in the market for new entrants.	Sector leaders are easily identifiable, they dominate the market making it difficult for new entrants to succeed.	The sector's market starts to lose its relevance and the sector leaders withdraw or shift their focus from the sector.
F5	Market formation	What lifecycle stage is the market in?	The market is a niche market and has limited structural elements.	The market is bridging and welcomes more elements. The elements find it easy to grow.	The market is mature, it is large and well-established. Structural elements are comfortable and there is minimal change.	The market is declining and is either left to phase out or renewed by aiming to grow again.

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		Nature of financial resources	There are few funding resources or mechanisms available.	There is an increasing number of different funding resources or mechanisms available.	There is a large variety of types of funding resources or mechanisms available.	There is a limited number of types of funding resources or mechanisms available.
		Accessibility of financial resources	Financial resources are not available or are difficult to obtain.	Financial resource access is increasingly easier and investors are showing increased interest.	Established financial resources exist (i.e. established banks, venture capital firms and angel investors).	Financial resources are withdrawing their support from the sector.
		Accessibility of seed and venture capital (VC)	Seed and venture capital are not available or are difficult to obtain.	Seed and venture capital access is increasingly easier and investors are showing increased interest.	Established access to seed and venture capital exists (i.e. established venture capital firms and angel investors).	Financial resources are withdrawing their support and leaving the system.
		Accessibility of infrastructure to provide basic needs (business-facing as well)	The infrastructure to meet basic needs is mediocre or non- existent.	The infrastructure to meet basic needs is improving and is accessible.	The infrastructure to meet basic needs is well developed and stable.	No further investments into the infrastructure to meet basic needs are made, and they start to deteriorate.
		Availability of appropriately skilled workforce	There are minimal or no appropriately skilled workers available.	There is a large increase of appropriately skilled workers to employ.	There are plenty of appropriately skilled workers in the region.	There is a decreasing number of appropriately skilled workers
F6	Resource mobilisation	Availability of a high- skill workforce	There are minimal or no high skilled workers available.	There is a large increase of high skilled workers to employ.	There are plenty of high-skill workers in the region.	There is a decreasing number of high-skill workers

		Strength of resistance to change for a specific sector?	The sector's participants are resistant to change and are not open to innovative ideologies or influences.	The sector's participants are opening up to different innovations and are starting to welcome them into their everyday lives	The sector's participants are accepting of innovative solutions and continuous change. There are plenty of examples of what innovation does for the sector. A clear buy-in can be seen by prominent entities.	The sector's participants are starting to lose trust in new innovations and what innovation does for the sector.
		Is there recognised actor support?	There are no recognisable brands or enterprises supporting innovation.	Large enterprises are starting to support and fund innovation activities and actors within an area.	There is consistent and committed support from recognised enterprises for innovation activities and actors within an area.	Large enterprises are withdrawing their funds and support for innovative activities.
		Are there mechanisms to engage with the community?	There is no to little way for innovation driving actors to engage with the community.	There is an ever- growing number of ways to engage with the community on innovation topics.	There are established mechanisms to engage with the community.	Current engagement mechanisms are overused and the communities focus shifts while participation decreases.
F7	Creation of legitimacy	Do actors lobby for sector support? (Are there resources or formal structures to empower lobbying for actor support?)	Actors do not or barely lobby for support from the appropriate support actors in the IS. There are no formal processes to	Actors are increasingly lobbying for their required resources, changes to legislation, and implementation of goals.	There is a continuous group lobbying for required resources, changes to legislation, and implementation of goals.	Lobbying groups' presence is diminished and there is decreased lobbying activity. Formal processes become difficult to navigate.

			follow to lobby.			
		Are the benefits of innovation marketed effectively?	No to minimal effort to market innovation is performed.	The benefits of innovation are increasingly marketed more and made clearer to actors in the IS.	The benefits of innovation are marketed effectively and are understood by actors in the IS.	There is confusion regarding the benefits of innovation, some of the benefits expressed are outdated and should be revised.

8.3) EduTech

In recent years, EduTech is being hailed as the new fintech by industry experts and speculators are noting the sector's impressive growth rates. However, the education sector in South Africa still remains one of the significant challenges for the country, with private schools being too costly for many South African households to afford and several public schools struggling to yield positive results. This challenge, nonetheless, shows a gap in the market and provides an opportunity for small and medium enterprises (SMEs) in the private education sector to flourish while contributing to enhancements in the education sector (Morobe, 2022).

Although the education sector is still considered to be struggling, the future outlook of the sector provides hope that it will be turned around. This can be seen in the proposed plan that the government has made to spend over the next three years, the South African government aims to spend a total of R792 billion on basic education, with R35 billion being spent on infrastructure and R15.3 billion on learning and teacher support materials. The government also plans to spend an additional R324 billion on higher education and training, with R57 billion to be spent on fee-free higher education and training (Morobe, 2022).

Private school education has grown from 2% to 6% of the total number of enrolled pupils (about 13 million) in SA over the last four years and is set to increase over the next couple of years, predominantly in townships. The opportunities available to SMEs wishing to enter into the education sector are extensive – from private pre-primary schools to support services and innovative educational products. If SMEs take advantage of this opportunity, the education sector can not only be enhanced, but also become more inclusive to provide the best prospects for all of South Africa's children to one day contribute to a better performing economy with lower levels of inequality and lead improved lives. Tertiary education presents further opportunities for SMEs particularly to address the dire shortage of student accommodation currently only catering for 100 000 out of a student population of more than 500 000 (Morobe, 2022).

In the Table 5 below the maturity framework of the EduTech sector is presented:

Table 5: EduTech Maturity Framework

	Functions	Indicator	Birth	Growth	Maturity	Decline
F1	Entrepreneurial activity	Number of new entrepreneurs/ entrants	A low number of new enterprises. Enterprises are not innovation-focused.	A rapid increase of new enterprises. Few established innovation-focused enterprises.	Continuous introduction of new enterprises. Most enterprises are innovation-focused.	It is difficult for newer enterprises to compete due to too many large corporations. Enterprises do not focus on innovation.
		Private vs public sector enterprises	The sector is made up of a small number of private enterprises and is majorly made up of public enterprises.	The sector has a growing number of private enterprises that build healthy relationships with public enterprises.	The sector is majorly made up of private enterprises but works in synergy with the public enterprises present.	The relationship between private and public enterprises deteriorates. A large number of enterprises leave the system in a shake-out event.
		Number of entrepreneurs/enterprises	A low number of enterprises. Enterprises are not innovation-focused.	An increased number of enterprises. Few established innovation focus enterprises.	A large number of enterprises. Most enterprises are innovation-focused.	Multiple large corporations dominate the market. Enterprises do not focus on innovation.
		The entrance vs churn rate of entrepreneurs	There is a slightly higher entrance ratio than the churn rate of entrepreneurs.	There is a continuous increase in the entrepreneur entrance ratio compared to the churn rate of entrepreneurs.	There is little to no difference in the entrepreneur entrance ratio and the churn rate of entrepreneurs.	There is a continuous increase in the churn rate of entrepreneurs compared to the entrepreneur entrance ratio.
		The intensity of the competition	There is no or minimal competition in the IS. There is a small number of	There is increasing competition among a growing actor base. The	There is a large amount of competition in the IS. The market is moderately concentrated.	The market is highly concentrated or is dominated by few market leaders decreasing the intensity of competition.

			actors that compete.	marketplace is competitive.		
		Sources and intensity of knowledge development	Minimal or no knowledge creation occurs from sector participants. No clear R&D efforts from enterprises.	Continuous increase of knowledge created. An academic institution in the sector’s region has an increasing amount of knowledge production. A small number of enterprises are involved in producing R&D contributions.	A large amount of knowledge is constantly generated. Academic institutes produce large volumes of multi-topic knowledge. Enterprises are aiding in knowledge creation through published R&D efforts.	There is a decreasing amount of knowledge generation. The academic institute associated with the sector has a much lower output than usual. Enterprises have shifted their focus away from performing R&D.
		Who finances the knowledge development?	There is minimal or no funding for knowledge development.	There is an increasing number of well-known funding sources for knowledge development.	It is clear where to obtain finances, private or public, for knowledge development.	There is a decrease in the number of sources of funding for knowledge development.
		Who leads research and development?	There are no leaders in research and development.	There is an increasing number of prominent leaders in research and development	There is a large number of prominent leaders in research and development	Leaders start decreasing their contributions and/ or start leaving the system.
		Relevance of knowledge produced	A small amount of academic knowledge produced is relevant to the sector's priorities.	There is a growing level of activity of academic knowledge produced relevant to the sector's priorities.	More sector-relevant knowledge is produced from academia and the private sector.	The knowledge produced has shifted focus away from the sector and is developed more for other sectors.
F2	Knowledge development	Who collaborates to produce published knowledge?	There is no to minimal collaboration among actors	Actors collaborating to produce published	There is clear evidence of who collaborates	Collaboration efforts, among actors, to produce published knowledge decrease.

			of published knowledge.	knowledge increases rapidly.	when producing published knowledge.	
		Who collaborates to produce knowledge from R&D?	There is no to minimal collaboration among actors of R&D knowledge.	Actors collaborate to produce R&D knowledge increases rapidly.	There is clear evidence of who collaborates when producing R&D knowledge.	Collaboration efforts, among actors, to produce R&D knowledge decrease.
		Are there partnerships or collaborations?	No clear partnerships between enterprises.	There are some collaborations among enterprises and between academic institutes.	Clear collaboration among enterprises and between academic institutes.	A decreasing number of collaborations among enterprises and academic institutes.
		How is knowledge shared?	Minimal or no knowledge diffusion attempts or events occur in the sector.	Knowledge is mostly shared unintentionally, intentional knowledge events, and sharing are increasing in the sector.	Continuous formal events occur between various innovation-related parties related to the sector.	A decreasing number of formal events focused on previous innovations occur in the sector.
		Is the knowledge diffused relevant to the IS?	The knowledge diffused in the area has small relevance to the main sectors in the IS.	There is an increase in the efforts to diffuse sector-relevant knowledge.	There is a high level of activity to diffuse new and sector-relevant knowledge.	Participants in the sector have shifted their focus, from the currently diffused knowledge, decreasing its relevance.
		Who shares more knowledge?	There are no leaders in knowledge-sharing efforts.	There is an increasing number of prominent leaders in knowledge-sharing efforts.	There is a large number of prominent leaders in knowledge-sharing efforts.	Leaders start decreasing their contributions and refocusing their efforts on other innovations or sectors.
F3	Knowledge diffusion	The absorptive capacity of the IS's actors	IS actors struggle to absorb and	IS actors' ability to absorb and	IS actors absorb and utilise the	IS actors reject the diffused knowledge as they have shifted their

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			utilise the diffused knowledge.	utilise the diffused knowledge improves.	diffused knowledge effectively.	focus and don't absorb it anymore.
F4	Guidance of search	Do clear targets/goals exist?	No innovation-orientated sector-focused targets and goals are set.	Innovation-orientated sector-focused targets and goals are being set and achieved.	Innovation-orientated sector-focused targets and goals have been achieved in the region.	Innovation-orientated sector-focused targets or goals are not revised when met or failed to be achieved.
		Do the goals cause government involvement?	The government is not or is minimally involved with goal setting or contributing to achieving the sector-focused goals.	The government is increasingly involved with goal setting or contributing to achieving sector-focused goals.	The government is steadily involved with goal setting or contributing to achieving the sector-focused goals.	The government decreases its support for goal setting or contributing to achieving the sector-focused goals.
		Does existing or new legislation/ regulation act as a barrier or an enabler?	Current legislation acts as a strong barrier to innovation in the IS.	Impeding legislation is relaxed and/ or new legislation is introduced to aid innovation in the IS.	Impeding legislation is minimal and/ or new legislation strongly aids innovation in the IS.	Current legislation is outdated and hinders innovation, it needs to be updated again.
		Articulation of interest by leading customers	There is minimal to no interest articulated by leading customers in the innovation system. The IS actor's demand is not clear.	Leading customers increasingly articulate their interests showing the IS participant's demand.	It is clear what the IS's interest is and it is well articulated. All actors understand each other's demands.	The interest is not articulated well and the customer's interest has shifted to other innovations or sectors.
F5	Market formation	Are their policies, or incentives for the market?	No policies or incentives exist to promote innovation or innovative	Policies or incentives to support innovation are introduced and utilised by	The market is well- formed and self-sufficient. Policies or incentives do	The policies or incentives in place don't have any impact and the market is beginning to decrease

			related solutions.	various entities.	not have a large effect on the market's growth.	in size due to other markets.
		The market size of a specific sector	The sector's market is non-existent/tiny and would require work to develop.	The sector's market is growing rapidly and receives increasing growth.	The sector's market has slowed, but it is receiving a sustaining amount of support.	The sector's market is decreasing in size and needs to pivot to accept newer innovations.
		Who are the sector's market leaders?	It is not easy to identify the sector leaders. The market is still for new entrants to succeed.	Clear sector leader(s) emerge and can be easily identified. There is still space in the market for new entrants.	Sector leaders are easily identifiable, they dominate the market making it difficult for new entrants to succeed.	The sector's market starts to lose its relevance and the sector leaders withdraw or shift their focus from the sector.
		What lifecycle stage is the market in?	The market is a niche market and has limited structural elements.	The market is bridging and welcomes more elements. The elements find it easy to grow.	The market is mature, it is large and well-established. Structural elements are comfortable and there is minimal change.	The market is declining and is either left to phase out or renewed by aiming to grow again.
F6	Resource mobilisation	Nature of financial resources	There are few funding resources or mechanisms available.	There is an increasing number of different funding resources or mechanisms available.	There is a large variety of types of funding resources or mechanisms available.	There is a limited number of types of funding resources or mechanisms available.
		Accessibility of financial resources	Financial resources are not available or are difficult to obtain.	Financial resource access is increasingly easier and investors are showing	Established financial resources exist (i.e. established banks, venture capital firms	Financial resources are withdrawing their support from the sector.

				increased interest.	and angel investors).	
		Accessibility of seed and venture capital (VC)	Seed and venture capital are not available or are difficult to obtain.	Seed and venture capital access is increasingly easier and investors are showing increased interest.	Established access to seed and venture capital exists (i.e. established venture capital firms and angel investors).	Financial resources are withdrawing their support and leaving the system.
		Accessibility of infrastructure to provide basic needs (business-facing as well)	The infrastructure to meet basic needs is mediocre or non- existent.	The infrastructure to meet basic needs is improving and is accessible.	The infrastructure to meet basic needs is well developed and stable.	No further investments into the infrastructure to meet basic needs are made, and they start to deteriorate.
		Availability of appropriately skilled workforce	There are minimal or no appropriately skilled workers available.	There is a large increase of appropriately skilled workers to employ.	There are plenty of appropriately skilled workers in the region.	There is a decreasing number of appropriately skilled workers
		Availability of a high- skill workforce	There are minimal or no high skilled workers available.	There is a large increase of high skilled workers to employ.	There are plenty of high-skill workers in the region.	There is a decreasing number of high-skill workers
F7	Creation of legitimacy	Strength of resistance to change for a specific sector?	The sector's participants are resistant to change and are not open to innovative ideologies or influences.	The sector's participants are opening up to different innovations and are starting to welcome them into their everyday lives	The sector's participants are accepting of innovative solutions and continuous change. There are plenty of examples of what innovation does for the sector. A clear buy-in can be seen by	The sector's participants are starting to lose trust in new innovations and what innovation does for the sector.

					prominent entities.	
		Is there recognised actor support?	There are no recognisable brands or enterprises supporting innovation.	Large enterprises are starting to support and fund innovation activities and actors within an area.	There is consistent and committed support from recognised enterprises for innovation activities and actors within an area.	Large enterprises are withdrawing their funds and support for innovative activities.
		Are there mechanisms to engage with the community?	There is no to little way for innovation driving actors to engage with the community.	There is an ever- growing number of ways to engage with the community on innovation topics.	There are established mechanisms to engage with the community.	Current engagement mechanisms are overused and the communities focus shifts while participation decreases.
		Do actors lobby for sector support? (Are there resources or formal structures to empower lobbying for actor support?)	Actors do not or barely lobby for support from the appropriate support actors in the IS. There are no formal processes to follow to lobby.	Actors are increasingly lobbying for their required resources, changes to legislation, and implementation of goals.	There is a continuous group lobbying for required resources, changes to legislation, and implementation of goals.	Lobbying groups' presence is diminished and there is decreased lobbying activity. Formal processes become difficult to navigate.
		Are the benefits of innovation marketed effectively?	No to minimal effort to market innovation is performed.	The benefits of innovation are increasingly marketed more and made clearer to actors in the IS.	The benefits of innovation are marketed effectively and are understood by actors in the IS.	There is confusion regarding the benefits of innovation, some of the benefits expressed are outdated and should be revised.

9) Findings

This section presents the findings of this chapter by discussing the promoters and barriers of innovation in FinTech, EduTech and HealthTech in the WC.

9.1) Promoters

There are various promoters of innovation in FinTech, EduTech and HealthTech in the WC. The main promoters are (InvestCapeTown, 2022):

- **Seed Fund**

The fund's goal is to allow innovators to evaluate, demonstrate and advance the commercial potential and value proposition of their research outputs. Hence, the fund contributes towards derisking research outputs to increase the pipeline for other funders (InvestCapeTown, 2022).

- **SA SME Fund**

The SA SME Fund invests in funds that support and develop entrepreneurs. The fund was established by members of the CEO Initiative, a collaboration between labour force, government, and business to address some of the most pressing challenges to the country's economic growth. It serves as an avenue of support for the SME sector (InvestCapeTown, 2022).

- **Pre-Commercialisation Fund**

The Pre-Commercialisation Support Fund assists potential or existing individual entrepreneurs and Small Micro and Medium Enterprises to obtain funding to support pre-commercialisation activities involving developing production / service capacity to levels that will support operational sustainability. This further includes market testing and validation of the technology in the potential customer environment and bridging finance in preparation for commercialisation (InvestCapeTown, 2022).

- **Technology Development Fund**

The Technology Development Fund provides funding to advance technologies from proof of concept to technology demonstration (InvestCapeTown, 2022).

Other promoters are:

An incubator supports startups by offering services ranging from training and mentorship to office space. They help startups develop their business ideas and often end up owning an important amount of equity in the resulting business. Some incubators in the WC are (InvestCapeTown, 2022):

- Meltwater Entrepreneurial School of Technology (MEST) is a seed-fund, non-profit incubator offering shared workspaces for entrepreneurs and startups to collaborate and connect. MEST currently operate in four sub-Saharan markets: South Africa, Ghana, Côte d'Ivoire, Nigeria and then also in India. Their tech training programme targets entrepreneurs and entails full sponsorship and mentorship.
- Bandwidth Barn forms part of the Cape Innovation and Technology Initiative (CiTi), a non-profit organisation focused on boosting the Western Cape's technology sector by offering co-working space and incubation for tech-enabled companies to connect and grow. Besides access to working spaces, event, and meeting room facilities, Bandwidth Barn also provides expert business mentorship.

Accelerators support early-stage growth-driven organisations through various means involving financing, mentorship, and education. The startups enter the accelerator for a fixed period, and through immersive, intense, and rapid education, the life cycle of these firms are accelerated.

Academic incubators offer formal entrepreneurial programmes run through accredited tertiary institutions.

Investors provide funding which is crucial in the expansion and growth of the HelathTech, FinTech and EduTech landscape. Several funding sources are available, some traditional and some that have emerged to support these non-traditional innovators. However, many entrepreneurs do not know how and where to access this funding.

9.2) Barriers

The South African financial, health, care, and educational system has their sets of challenges with regard to the viable implementation and adoption of technology. These challenges are discussed in the following lines:

9.2.1) FinTech

Financial markets are tightly regulated in South Africa, and while such regulation is crucial to protect the sector and consumers from systemic risk, it does create high and insurmountable barriers to entry for fintech innovators. While the regulators are open to discussion with these innovators, and are giving serious thought to the regulatory challenges posed by fintech, they have been slow to adapt regulations to embrace fintech. Unlike other jurisdictions, such as the United Kingdom and Singapore, neither the FSCA (previously the FSB) nor SARB have to date, created regulatory sandboxes for these companies (Cassim, 2020).

The SARB is exploring blockchain and cryptocurrencies and is interested in innovations that may stem from its development. On January 31st 2019, the SARB released a media statement confirming that it is joining the Global Financial Innovation Network ("GFIN") as a member. This is part of SARB's journey to support responsible financial innovation for the benefit of all South Africans. Joining GFIN will provide the SARB with the opportunity to share and gain insights from its fellow regulations on experiences in enabling innovation. The GFIN will pilot the hosting of cross-border trials by financial entities through the regulatory sandboxes of those members who have chosen to participate in the pilot. Although the SARB supports this initiative, it has elected not to partake in the pilot to first focus on the appropriateness and feasibility of a SARB regulatory sandbox. The SARB will first put in place a fair and open process for South African firms and ensure that consumer protection is in place for citizens who are clients of those companies participating in the trials (Cassim, 2020).

Another challenge faced by FinTechs is difficulties of access to skills sets and access to capital. Unlike incumbents who generally have reasonable access to finance, fintech firms, specifically fintech SMMEs may experience significant additional challenges accessing finance. While consumer credit is likely well-served in South Africa, SMMEs struggle to access critical funding to grOw and sustain themselves. This is despite these businesses' significant contributionto gross domestic product (GDP) and employment (Cassim, 2020).

The inability of SMMEs to raise funds is caused by several demands- and supply-side factors, such as the incapacity of lenders to tailor their loan terms to match the company's needs or the lack of financial records. According to a 2019 report by one of the large banks in South Africa, few fintechs manage to secure startup capital, with the general sentiment indicating that funding seems to be readily, but not openly, available. More broadly, SMMEs operate in a mostly invisible, informal, and cash-based economy. Addressing this issue is related to the broader need to digitise these companies and ensure that they are involved in the digital economy (Cassim, 2020).

Turning attention to the importance of access to skills: while much emphasis is placed on the technologies in the fintech domain, it is the people, the talent and the skills that create the innovation and propel the change. However, like most countries, particularly developing countries, South Africa has a shortage of technical skills. The 2019 South African Information, Technology and Communication (ICT) Skills Survey found that the Fourth Industrial Revolution (4IR) has not yet impacted the South African ICT skills landscape. According to the report, the skills associated with emerging technologies such as the Internet of Things, AI, automation, blockchain, programming, and data science – were the scarcest. This leads to a race for skilled and talented individuals such as programmers, data scientists, design thinkers, and software developers. The challenge is not specific to fintech firms because it also affects regulators. However, the race for such skill sets is pronounced for fintechs, particularly if they are still in their early phases of development and/or maturity. It is less so for big-tech firms with well-established markets (Cassim, 2020).

9.2.2) HealthTech

- User resistance: The success of many technologies depends on levels of adoption by either patients/consumers, health professionals, or in many cases both. Reluctance to move to new ways of doing things is a serious problem among many health professionals (FTIConsulting, 2019).

- Regulatory constraints: The regulatory environment presents a constant challenge across the industry, but various regulatory and regulations bodies are relevant in different subsectors. For instance, the Health Professions Council South Africa (HPCSA) ethical rules for members have played a significant role in preventing the expansion of telemedicine. At the same time, in the medical devices space, the certification backlog at the South African Health Products Regulatory Authority (SAHPRA) is the most significant issue.
- Bureaucratic decision making: Protracted decision-making processes are an issue in both the public and private sectors in South Africa. This can make the sales cycle for new products very long, especially when the required financial investment is large, or the innovative nature of the product means that the resulting benefits are uncertain.
- Financing constraints: Implementing new technology often involves very substantial financial investments, with resulting cost savings often only being realised some time down the line. In today's challenging economic environment, the lack of available financing is a constraint in both the public and private sectors.
- Lack of appropriate solutions: Many interviewees reported struggling to find technologies that were able to meet their particular needs or were appropriate to the specific South African context.

9.2.3) EduTech

- **Local Infrastructure:** The WC used to face immense challenges with the provision of internet access in the expensive broadband connection costs and realm of poor coverage. This has largely been alleviated, however, the challenges still exist in some rural areas. Data providers are providing learners free data for at-home usage to access educational resources (Morobe, 2022).
- **Pricing constraint:** The licensing prices for educational content are among the reasons for the slow adoption of e-books and other educational technologies (Morobe, 2022).
- **Digital divide**: educational technology is far more advanced and prevalent in urban areas than in rural areas. Although, the government is committed to advancing digital equality and thus addressing the digital divide (Morobe, 2022).

- **Resistance to change:** Many learners are able and more willing to adopt educational technology than their teachers. Access to affordable content and quality devices is a constraint in this regard (Morobe, 2022).

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