

A systematic literature review and mapping of systemic barriers to digital learning innovation in Africa in the context of changing global value chains

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In the context of COVID-19, universities, national innovation systems (NIS) and global value chains (GVCs), this paper explores systemic barriers (trends and factors) that influence digital learning innovation (DLI) in Africa. The study used the PRISMA framework and Scopus data for a systematic literature review (SLR) and a bibliometric analysis spanning 2000–2021. It also mapped universities globally and in Africa based on Webometrics (Jan 2022) and the Global Innovation Index (Feb 2022) data using a typology. A broad SLR on digital learning extracted two African samples of 2,640 and 4,669. A narrow SLR on DLI, Innovation Systems (IS) and Innovation Barriers (IB) extracted 221 studies. The broad SLR showed that Africa (with the exception of South Africa continentally and Kenya regionally) lags globally in digital learning literature. It also identified country, affiliation (university) and funding sponsor as three possible factors that influence DLI. The narrow SLR revealed a gap in the literature on DLI – IS – IB and a low emphasis on GVCs. From the literature, this paper proposes a conceptual model spanning DLI – IS – IB and a typology of systemic barriers to inform future research. It also provides unique empirical data to inform DLI and GVC focused public policies.

Keywords: Africa, digital learning, global value chains, innovation barrier, innovation system, systematic literature review

Introduction

The COVID-19 pandemic offered universities and governments around the world a unique opportunity to rethink innovative digital learning in the context of disrupted global value chains (GVCs) (Hodges et al. 2020). Due to the pandemic, there was disruption in the production, transportation and delivery of various intangible and tangible goods and services, including education and learning. Digital learning is defined ‘as any set of technology-based methods that can be applied to support learning and instruction’ (Ifenthaler 2017, 401). It is a ‘superordinated concept’ spanning multiple forms of learning: e-learning, online learning, e-learning 2.0, mobile learning and blended learning (Becker and Otto 2019, 2). Jones, Demirkaya, and Bethmann (2019, 3) note that the concept of global value chains (GVCs) – also referred to as global supply chains (GSCs) – is the international extension of definitions of ‘value chains’ and ‘supply chains’ in response ‘to the growing phenomenon of global production fragmentation – the fact that business functionalities and production activities along a value chain are increasingly carried out by various entities located in different countries.’ Porter (1985, 36) defines a value chain ‘as a set of activities that a firm performs to deliver a valuable product or service to the market.’ Vitasek (2013, 186) defines a supply chain, ‘as the links between companies which interchange materials and information in the logistics process, stretching from acquiring unprocessed raw materials to delivering finished goods to end users.’

Arguably, when the pandemic struck, digital education and learning had not been conceptualized and governed within the framework of GVCs. On one hand, governments needed to rapidly drive organizational innovation in education within their national innovation

systems (NISs) as an ‘area of physical contact, non-market “service” delivery which was abruptly subject to social distancing’ (Soete 2021, 1). On the other hand, governments had to re-align their sectoral policies and programmes closely with those of ICT GVC actors as essential service providers supporting business continuity within the education value chain (UNICEF 2020; WEF 2020; World Bank(a) et al. 2021; World Bank(b) et al. 2021). Rikap and Lundvall (2021, 1) argue that such ICT GVC actors’ ‘data-driven intellectual monopolies’ are arguably predators of knowledge which they turn it into intangible assets through a global corporate innovation system (CIS) at the expense of developing country (NIS) interests.

The concept of NIS (Freeman 2002; Lundvall 2007) is a useful framing device for contextualizing digital learning within a learning economy. Freeman’s analysis refers to ‘macro-phenomena’ and to ‘international trade and development’ while Lundvall’s refers to the ‘micro level’ where innovation is seen as ‘shaped by user-producer relationships’. Mugabe (2011) provides a mapping of NIS institutions within the context of regional economic communities (RECs) in Africa. Universities (and firms) are examples of institutions that exist at the core of innovation systems where they play a central role in learning. The impact of universities and firms is felt at different levels of the economy as envisioned through concepts like regional systems of innovation (Cooke, Uranga, and Etxebarria 1997; Malmberg and Maskell 1997), the triple helix (Etzkowitz and Leydesdorff 2000), industrial clusters (Porter 1990), sectoral systems of innovation (Breschi and Malerba 1996), technological innovation systems (Carlsson and Stankiewicz 1991; Bergek et al. 2008), and corporate innovation systems (Rikap and Lundvall 2021).

Combining the NIS and GVC approaches offers a useful conceptual framing device to analyze this dilemma faced by governments in the education sector with a particular focus on digital learning innovation in universities. Jurowetzki, Lema, and Lundvall (2018, 1) argue for the importance of combining ‘the national innovation system and global value chain literatures for the study of economic development’. It is argued that the two lenses are ‘helpful both in enhancing understanding of socioeconomic processes in developing countries and in building a more useful knowledge base for action’ (Jurowetzki, Lema, and Lundvall 2018, 1). This combination proposes a research agenda that looks at the public policy strategies in governments of successful catch-up countries like South Korea and China which have ‘built strong national innovation systems’ and ‘engaged in upgrading in global value chains’ and can serve as ‘inspiration for developing-country governments’ (Jurowetzki, Lema, and Lundvall 2018, 1)¹. Fagerberg, Lundvall, and Srholec (2018) complement Jurowetzki, Lema, and Lundvall (2018) by exploring the link between NIS and GVCs from a perspective of capability building within low-income countries. Using a quantitative approach, Fagerberg, Lundvall, and Srholec’s (2018, 1) paper examines ‘the hypothesis that increased participation in global value chains (GVCs), such as assembly of imported parts for exports, leads to higher economic growth’ using evidence from 125 countries over the period 1997–2013. The study’s ‘results suggest that countries that increase GVC participation do not grow faster than other countries, when other relevant factors are controlled for’ where ‘small countries, and countries with low capabilities, appear to be particularly disadvantaged’ (Fagerberg, Lundvall, and Srholec 2018, 1). The need to explore the NIS approach in an African context has been highlighted by Christopher Freeman from the concept’s early years as captured by Muchie, Gammeltoft, and Lundvall (2003, v),² which notes, ‘to understand the patterns of existing innovation systems, and their limitations and to devise ways to deliver much greater benefits to all the peoples of Africa is a fundamental need for the continent.’ Neither Fagerberg, Lundvall, and Srholec (2018) (2018) nor Jurowetzki, Lema, and Lundvall (2018) discuss digital learning as a concept, nor do they explore universities as a unit of analysis in an African context. This represents a knowledge gap which acts as point of departure for this study.

As governments globally instituted movement restrictions to mitigate the spread of COVID-19 infection in early 2020, digital learning rapidly replaced face-to-face learning approaches within universities in many parts of the world. Such innovation is an example of the ‘creative destruction’ metaphor coined by Schumpeter (Leydesdorff and Etzkowitz 1998, 3). Some universities were able to introduce and deploy new virtually-enabled ways and means of learning and teaching quickly while others just did not have the organizational and technological capabilities to do so. In many countries, systemic barriers to innovation in digital learning were vividly exposed by COVID-19.

This exploratory study is a systematic review of literature and mapping of interacting or systemic barriers to

digital learning innovation conceptualized within NIS and GVCs lenses. It focuses on two interrelated questions: ‘What are the systemic barriers to digital learning innovation in Africa as experienced by universities?’; and ‘What are the trends and factors that influence digital learning innovation in African universities from a continental and global perspective?’. There are limited studies that focus on systemic barriers to digital learning within NIS specifically in the context of universities in Africa. These studies (Gunga and Ricketts 2006; Juma 2001; Kingiri et al. 2016; Mukama 2018; Mugabe 2011; Munene 2007; Nafukho and Muya 2013; Nyerere and Friso 2013) only provide a partial perspective across the three domains of digital learning innovation, innovation systems and innovation barriers.

This paper aims to fill the knowledge gap in academic work on innovation for Africa’s development. It is a source of empirical data on systemic barriers to innovation in digital learning and aims at informing public policy on how best to unlock such barriers. The knowledge gap manifests in two ways. First, innovation studies do not say much on digital education and learning. A focus on systemic barriers is more prevalent in studies on industrial production, especially in the context of manufacturing and energy. A systematic literature review (SLR) can help to reveal whether trends have shifted to look at innovation in non-industrial sectors like digital learning. Secondly, most research on digital learning appears to be done outside Africa. In Africa, most of it appears to be concentrated in South Africa. The SLR can help to confirm this trend from both a global and a continental perspective. The paper introduces a typology as a basis for mapping digital learning institutions globally and by continent / region. Using the typology, it is illustrated using two indices (Webometric and Global Innovation Index rankings) that universities in African national innovation systems (countries) lag behind others globally, arguably due to significant innovation barriers.

The paper concludes by proposing a conceptual model of innovation derived from the literature that maps digital learning innovation (viewed from a perspective of systemic barriers) as a dependent variable against two units of analysis (universities and NIS) as two independent variables. The paper also proposes a typology for mapping the systemic barriers based on the literature. The conceptual model of innovation and typology of barriers offer opportunities for future research with a focus on GVCs.

This initial section has introduced the research problem that the study addresses and explored the relevant literature. The remaining four sections of the paper are structured as follows. The next section discusses three methods used in the study to explore systemic barriers to DLI: SLR, bibliometric analysis, and mapping using index data. The section thereafter presents the results from applying the three methods. This is followed by the section that discusses the results guided by the research questions in the context of GVCs to introduce a conceptual model of innovation and a typology of barriers, both derived from the literature. The final section concludes by discussing areas for future research.

Methods

The study undertook a SLR and a bibliometric analysis using data from the Scopus database. This was combined with a mapping using university ranking data from the Webometrics index and NIS (country) ranking data from the Global Innovation Index (GII).

The SLR used the PRISMA³ framework (Liberati et al. 2009; Pahlevan-Sharif, Mura, and Wijesinghe 2019; Sharif, Mura, and Wijesinghe 2018). The framework involves the following four steps: identification; screening; eligibility; and inclusion as shown in Table 1.

Guided by the research questions, the SLR helped to determine trends and factors that influence digital learning innovation in Africa from both a continental and global perspective.

The SLR was conducted in two phases. First was a broad SLR that focused on identifying the corpus of knowledge on 'digital learning' both globally and in Africa. Second was a narrow SLR that hived off from the corpus a subset of studies specifically focused on 'digital learning innovation'. This subset was compared to studies focused on 'national innovation systems' and 'innovation barriers'.

Using the narrow and broad SLRs, the paper aimed at mapping the research that has been done on digital learning. The relevant literature was found in a variety of domains including education, virtual education, innovation systems and innovation policy. Some of these domains are established schools of thought while others are not distinct areas of scholarship. There is a wide variety of scholars on the topic spanning innovation, systems of innovation, and innovation policy. They approach the topic using different conceptual lenses based on their unique backgrounds including economics, political science, and sociology. The result of the SLRs could help identify whether GVCs feature prominently within the literature.

Building on the SLRs, a bibliometric analysis was used to identify linkages between digital learning and two domains: national innovation systems and innovation barriers. The bibliometric analysis revealed little overlap across the three domains.

The mapping effort used a typology of digital learning institutions to sort Webometrics and GII data into specific clusters at a global and continental level.

The next two sub-sections discuss the broad and narrow SLR, while the sub-section thereafter discusses the mapping effort using webometrics and global innovation index ranking data.

Broad systematic literature review

The broad SLR focused on digital learning. Studies from the most recent decade were prioritized given the rapid pace at which technology evolves. The SLR focused on the period between 2000 and 2021 which coincides with the evolution of the internet as a driver of DLI.

Overall, the selection criteria were based on PRISMA as follows:

- the search focused on the subject area of: 'social science'; 'business, management and accounting'; and 'economics, econometrics and finance' at the identification step
- the search was limited to all studies until 31 December 2021 at the identification step
- the search was initially focused on studies from all countries but eventually narrowed down to Africa after the inclusion step
- the search initially focused on all document types but eventually narrowed down to articles and book chapters only after the inclusion step
- the search initially focused on all stages but eventually narrowed down to final publications only after the inclusion step

The process is summarized in Table 2 and discussed in detail within the subsequent sub-sections.

In order to answer the secondary research question, the search strategy was guided by the primary research question to identify all the relevant literature in 'digital learning'. All the searches were conducted in two phases between the months of August and October 2021 and the months of March to May 2022. The search strategy used an iterative approach over the six-month period to arrive at the final text string. Initially, a search was conducted for the phrase 'digital learning' (or similar, i.e., combining the phrase 'digital learning' with 'online learning'; 'distance learning'; 'elearning'; 'e learning'; 'open learning'; 'virtual learning'; 'blended learning'; 'mobile learning'; and 'virtual university'). To situate the search strategy, an initial search was conducted for all types of records within the Scopus, Web of Science, and Google Scholar databases for the three concepts of 'learning', 'university', 'innovation and digital learning' or similar.

To refine the strategy further, the search was narrowed down to the three subject areas: 'Social Sciences'; 'Business, Management and Accounting'; and 'Economics, Econometrics and Finance'.

A total of 63,477 records on digital learning was screened.⁴

Guided by the research questions, the following exclusion criteria were applied to the studies:

- 1a. Country is African reduced to 2,640 OR 1b. Topic includes 'Africa' reduced to 4,669.
- 2a. Study is among the 200 most cited OR 2b. Study is among the 200 most relevant.

Table 1: Steps of PRISMA methodology (Liberati et al. 2009).

STEPS
1. Identification
of records identified through database searching
of additional records identified through other sources
2. Screening
of records after duplicates removed
of record screened
of records excluded
3. Eligibility
of full-text articles assessed for eligibility
of full text articles excluded with reasons
4. Inclusion
of studies included in qualitative synthesis
of studies included in quantitative synthesis (meta-analysis)

For the broad literature review, the studies in the screening stage were narrowed down to 2,640 (country is African) and 4,669 (topic includes ‘Africa’) samples, respectively, based on the first criteria only. These are the studies that were extracted from the screening step.

Using the PRISMA framework, a total of 2,640 and 4,669 studies were eligible for quality assessment in the eligibility step. Guided by the research questions, the following quality assessment criteria were considered for the studies:

- Year falls between 2002 and 2021.
- Studies were limited to English/
- Studies were articles or book chapters.
- Studies were in their final stage.
- Duplicate records were reviewed and excluded.

However, given the choice of a broad SLR, none of the articles was assessed on the indicated inclusion and exclusion criteria. Therefore, the initial sets of 2,640 and 4,669 studies were extracted in the eligibility step.

Using the PRISMA framework, the titles and abstracts of 2,640 and 4,669 articles were eligible for review to ensure the quality and relevance of academic literature in the inclusion step. Guided by the research questions, the following quality assessment criteria were considered for the studies:

- a focus on digital learning in a global or African context;
- the methodology could be qualitative, quantitative or mixed;

- the unit of analysis is a university (or learning/knowledge in a higher education context).

However, given the choice of a broad SLR, none of the articles was assessed on the indicated inclusion and exclusion criteria. Therefore, the initial sets of 2,640 and 4,669 studies were extracted in the inclusion step.

The 63,477 records representing a global sample and the 2,640/4,669 records representing an African sample were sorted by year and presented graphically as discussed in the section on the descriptive quantitative analysis of broad SLR.

Narrow systematic literature review

The narrow SLR situated the subset of studies on digital learning innovation in the broader context of innovation systems and innovation barriers. The SLR focused on the period between 2000 and 2021 which coincides with the evolution of the internet as a driver of DLI.

The process is summarized in Table 3 and discussed in detail within the subsequent sub-sections.

To situate the search strategy, initial searches were conducted for all types of records within the Scopus and Web of Science databases for six concepts derived from the primary research question. These concepts were: ‘system’, ‘learning’, ‘university’, ‘innovation’, ‘barrier’ and ‘digital learning’. Subsequent searches were limited to Scopus for two reasons. First, the Scopus database had more records than Web of Science. Second, there was consistency and replication in the type of records that were identified across the two

Table 2: Summary of broad systematic literature review (Broad SLR) based on PRISMA framework.

STEPS	SEARCH STRING ‘TITLE-ABS-KEY (‘digital learning’ OR ‘online learning’ OR ‘distance learning’ OR ‘elearning’ OR ‘e learning’ OR ‘open learning’ OR ‘virtual learning’ OR ‘blended learning’ OR ‘mobile learning’ OR ‘virtual university’) AND (EXCLUDE (PUBYEAR, 2022)) AND (LIMIT-TO (SUBJAREA, ‘SOCI’) OR LIMIT-TO (SUBJAREA, ‘BUSI’) OR LIMIT-TO (SUBJAREA, ‘ECON’))’
5. Identification	
5.1 Records identified through database searching in Scopus	63,477
5.2 Additional records identified through database searching in Web of Science	0
5.3 Combined records	63,477
6. Screening	
6.1 Records Screened	63,477
6.2 Records Excluded	
(n = Country is African)	= 63,477–2,940
(n = Topic includes ‘Africa’)	= 63,477–200 + 200
(n = 200 most cited)	= 63,477–200 + 200
(n = 200 most relevant)	= 64,477–200
7. Eligibility	
7.1 Full text articles assessed for eligibility (n = ?)	= 2,640 + 4,669
7.2 Full text articles excluded with reasons	
(n = ? Duplication)	N/A
(n = ? English Language)	N/A
(n = ? Type)	N/A
(n = ? Stage)	N/A
(n = ? Year)	N/A
8. Inclusion	
8.1 Studies included in qualitative assessment (n = ?)	= 2,640 + 4,669
8.2 Full articles excluded with reasons	
(n = ? methodology)	N/A
(n = ? University as unit of analysis)	N/A
8.3 Studies included in data extraction (n = ?)	2,640 + 4,669

Table 3: Summary of narrow systematic literature review (Narrow SLR) based on PRISMA framework.

	UNIT OF ANALYSIS: university and national innovation system (country)			
	Digital Learning Innovation	Innovation Systems	Innovation Barriers	TOTAL
1. Identification				
1.1.1 Records identified through database searching in Scopus ($n = ?$)	1,686	1,240	1,164	4,091
1.1.2 Additional records identified through database searching in Web of Science ($n = ?$)	0	0	0	0
1.1.3 Records after duplicates removed ($n = ?$)	1,686	1,240	1,164	4,091
2. Screening				
2.1 Records Screened ($n = ??$)	1,686	1,240	1,164	4,091
2.2 Records Excluded ($n = ??$)	1,617	1,170	1,098	3,885
3. Eligibility				
3.1 Full text articles assessed for eligibility ($n = ?$)	136	133	113	382
3.2 Full text articles excluded with reasons				
($n = ?$ Duplication)	5	1	2	8
($n = ?$ English Language)	3	0	1	4
4. Inclusion				
4.1 Studies included in qualitative assessment ($n = ?$)	128	132	110	370
4.2 Full articles excluded with reasons:				
($n = ?$ digital learning innovation in a Global or African context)	0	0	0	0
($n = ?$ methodology)	0	0	0	0
($n = ?$ innovation in the context of a university)	35	25	73	133
($n = ?$ innovation barrier at systemic level)	17	3	0	20
($n = ?$ NSI approach in IS in a national context)	6	0	0	6
4.3 Studies included in data extraction ($n = ?$)	80	104	37	221

databases. Therefore the records identified through Scopus were considered to be representative of what would have been retrieved from Web of Science. To refine the strategy further, the search was narrowed down to the three subject areas of 'Social Sciences', 'Business, Management and Accounting', and 'Economics, Econometrics and Finance'. Specifically for the concept of 'digital learning', the search was refined to identify records that were either book chapters or articles and thereafter the subset of records that focused on Africa.

To answer the secondary research question, the search strategy was guided by the primary research question to identify all the relevant literature in the three categories of digital learning innovation, innovation systems, and innovation barriers. All the searches were conducted between the months of August and October 2021 using three databases: Scopus; Web of Science and Google Scholar.

The search strategy in the three categories used an iterative approach over the three-month period to arrive at the final text string. The selection criteria were based on PRISMA as follows:

- the search focused on the subject area of: 'social science', 'business, management and accounting' and 'economics, econometrics and finance'
- there was no time limit for any of the searches
- the search focused on studies from all countries
- only articles and book chapters were considered
- only final publications were considered
- only studies with the keyword 'innovation' were considered for the search on 'innovation barriers'.

The respective search strategies for the three categories are discussed below:

- **Digital learning innovation** – Initially, a search was conducted for the phrase 'digital learning innovation' (or similar, i.e., replacing the phrase 'digital learning' with 'online learning'; 'distance learning'; 'elearning'; 'e learning'; 'open learning'; 'virtual learning'; 'blended learning'; 'mobile learning'; and 'virtual university') yielding 77 records. Given the small number of records, the search strategy shifted to using a combination of the phrase 'digital learning' (or similar) and the word 'innovation'. This yielded 1,683 records. These were the records used in the screening step.

- **Innovation systems** – Initially, a search was conducted for the phrase 'innovation system' and it yielded 7,502 records. When the search was refined using the phrases 'learning' and 'university' the number reduced to 1,240. These were the records used in the screening step.

- **Innovation barriers** – Initially, a search was conducted for the phrase 'innovation barrier' and it yielded 202 records. Given the relatively small number of records, the search strategy shifted to using a combination of the phrases 'innovation' and 'barrier'. This yielded 1,164 records. These were the records used in the screening step.

A total of 4,091 records (1,683 on digital learning innovation, 1,234 on innovation Systems and 1,164 on innovation barriers) were screened.⁵

Guided by the research questions, the following exclusion criteria were applied for the studies:

- Digital learning innovation
 - Country is African (1,619 were excluded)

OR

- 20 most cited book chapters (228 were excluded); 30 most cited articles (1,405 were excluded); 20 highest ranked studies based on relevance using Scopus algorithm (1,663 were excluded)
- Innovation systems
 - o Country is African (1,377 were excluded)

OR

- o 20 most cited book chapters (153 were excluded); 30 most cited articles (1,037 were excluded); 20 highest ranked studies based on relevance using Scopus algorithm (1,220 were excluded)
- Innovation barriers
 - o Country is African (were excluded 1,121)

OR

- 20 most cited book chapters (7 were excluded); 30 most cited articles (1,107 were excluded) 20 highest ranked studies based on relevance using Scopus algorithm (1,144 were excluded)

A total of 3,885 studies were excluded and therefore 382 studies were extracted at the screening stage. The title, abstract and number of citations were reviewed for all the extracted studies.

The study focused only on articles and book chapters. To maintain the quality of the review, all duplicate records were reviewed and excluded. After the removal of 8 duplicate records, the next exclusion criterion was to limit to papers in English. Hence, an additional 4 papers were excluded. Thus, a total of 370 articles was selected after each article was assessed on the indicated inclusion and exclusion criteria.

In the data extraction phase, (number) articles or book chapters were selected and the characteristics extracted were one or more of the following combinations:

- a focus on digital learning innovation in a global or African context– **0 were removed**;
- the methodology could be qualitative, quantitative or mixed methods – **0 were removed**;
- the unit of analysis is a university (or learning/knowledge in a higher education context) – **133 were removed**;
- the innovation barrier is systemic – **20 were removed**; and
- the focusing device is a national innovation system approach (or an innovation system approach in a national context) – **6 were removed**.

Hence, a total of 221 articles were selected after each article was assessed on the indicated inclusion and exclusion criteria.

A bibliometric analysis was conducted using Vos Viewer on the combination of 221 documents extracted from Scopus spanning ‘digital learning innovation’, ‘innovation systems’ and ‘innovation barriers’. The bibliometric analysis identified the following: common references across the records through bibliographic coupling (Kessler 1963); common citations across the records through co-citation analysis (Small 1973); and clusters of themes across the records. The bibliometric analysis is presented in the narrow SLR comparing literature on DLI, innovation systems and innovation barriers section.

Typology mapping using webometrics and global innovation index (GII) ranking data

The study compiled Webometrics university ranking data collected in January 2022 and Global Innovation Index data compiled in February 2022. The data were sorted by country and continent in order to produce an updated index that could be compared to the SLR data.

A four-part typology was used to map selected digital learning institutions at the tertiary level both globally and within Africa. The mapping was based firstly on whether the entity is a traditional brick-and-mortar university and secondly on whether accreditation of the learning offered digitally leads to the attainment of an accredited degree. Based on the resulting two by two matrix, the typology is shown in Figure 1.

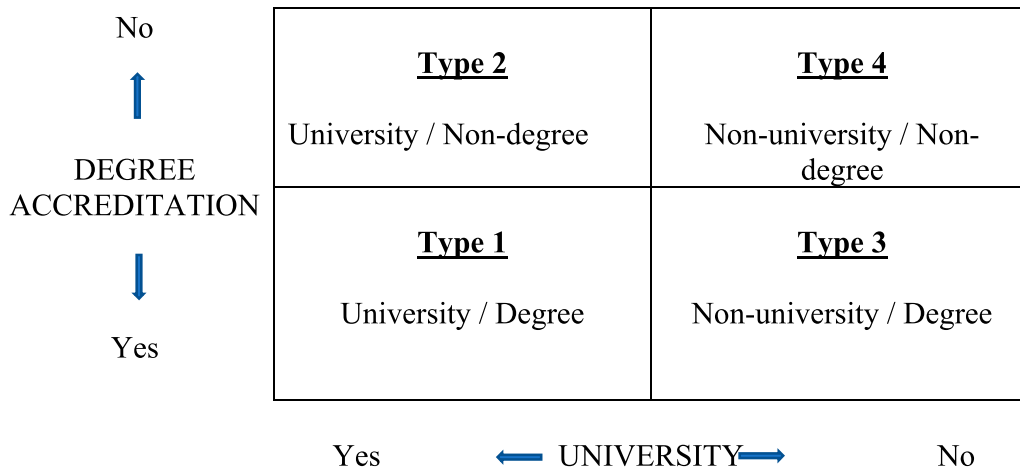


Figure 1: Four-part typology of digital learning institutions.

The four-part typology makes it possible to define and map digital learning innovation by institution globally and continentally. Additionally, it offers a basis for linking policy to innovation. Finally, it helps to illustrate the dichotomy of the Science – Technology – Innovation (STI) and Doing Using Interaction (DUI) modes of learning as discussed by Lundvall (2007).

From a policy perspective, learning at the tertiary level is regulated within the education sector of most countries globally. Within the education sector, this offers two important criteria in establishing a typology of digital learning institutions. The first criterion is whether an organization is established as a university. The second criterion is whether an organization has received accreditation from the regulator to offer a degree. The regulator is usually a public sector actor that constantly weighs the trade-off between access and quality.

A discussion of the four types follows.

Type 1 – University / Degree: The first type of digital learning institution based on the typology is a traditional brick-and-mortar university that offers learning digitally leading to the attainment of a degree. The offerings from such institutions are typically described as courses leading to Bachelor, Master and Doctoral degrees. Arguably, such institutions can be considered the domain of the STI mode of learning offered through agents that are constrained by government regulations. There is an overlap between Type 1 and Type 2 institutions as they are not mutually exclusive.

Type 2 – University / Non-degree: The second type of digital learning institution is a traditional brick-and-mortar university that offers learning digitally without leading to the attainment of a degree. The offerings from such institutions are typically described as certificates or diplomas resulting from executive education, customized programmes and corporate training. Arguably, such institutions can be considered the domain of the STI mode of learning offered through agents that are driven by market forces but are constrained by government regulations. There is an overlap between Type 1 and Type 2 institutions as they are not mutually exclusive.

Type 3 – Non-university / Degree: The third type of digital learning institution is a single entity (typically a company, government department, inter-governmental organization, non-governmental organization or an academic institution) that offers learning digitally leading to the attainment of an accredited degree (usually through affiliation with a traditional brick-and-mortar university and, in exceptional cases, based on a special exemption by the regulator). The offerings from such institutions are typically described as courses leading to a Bachelor, Master and Doctoral degrees. Arguably, such institutions can be considered the domain of the DUI mode of learning offered through agents that are constrained by government regulations.

Type 4 – Non-university / Non-degree: The fourth type of digital learning institution is a single entity (typically a company, inter-governmental organization or non-governmental organization) that offers learning digitally

without leading to the attainment of an accredited degree. Arguably, such institutions can be considered the domain of the DUI mode of learning offered through agents that are driven by market forces.

The top 300 higher education institutions (universities) globally and the top 200 in Africa based on the January 2022 Webometrics index ranking were identified and grouped by country. The countries were then ranked based on the total number of universities that featured in the top 10, 50, 100, 200 and 300 categories, respectively. This was compared against the 2022 GII ranking of the top 10 countries globally as well as the top 10 in Africa. The information was mapped using the typology introduced in this section.

Results

Based on the methodology discussed in the previous section, the findings are discussed in the following three sub-sections for the broad SLR, the narrow SLR and institutional typology mapping, respectively.

Descriptive quantitative analysis of broad SLR

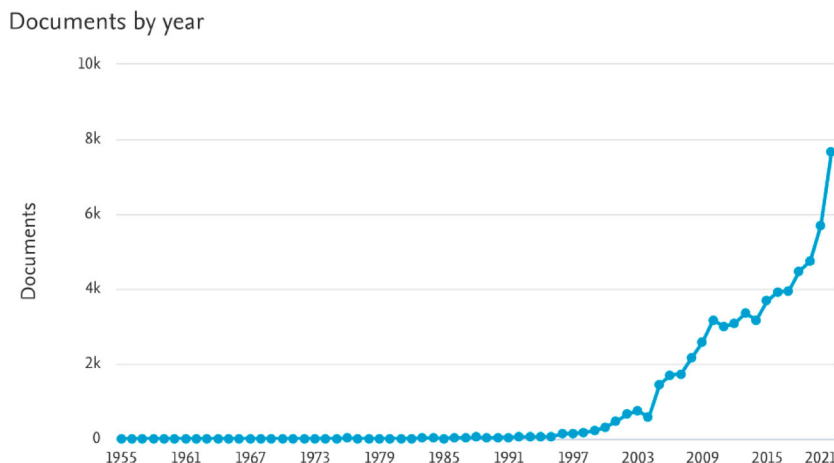
The records retrieved from Scopus for the six concepts of ‘system’, ‘learning’, ‘university’, ‘innovation’, ‘barrier’ and ‘digital learning’ (with a focus on ‘social sciences’, ‘business, management and accounting’ and ‘economics, econometrics and finance’) showed a large volume of studies. For a subset of the concepts, Google Scholar enabled an estimation of the total volume of studies irrespective of quality and therefore yielded the largest number of studies (6.93 M on learning, 8.91 M on university, 4.76 M on innovation and 0.61 M on digital learning or similar). Subsequent searches were limited to Scopus for two reasons. First there was a relatively larger number of records in Scopus (2.02 M on learning, 1.70 M on university and 0.14 M on digital learning or similar) relative to the Web of Science (2.21 M on learning, 1.38 M on university, 0.45 on innovation and 0.09 M on digital learning or similar). Secondly there was relative consistency in the number of records identified across both Scopus and Web of Science.

A descriptive analysis of the studies from the screening step of the broad SLR (global sample) and the inclusion phase (African samples) follows. The descriptive analysis maps out geography on digital learning and innovation in digital learning. The global analysis is based on a sample of 63,477 studies. The African analysis is based on two samples. The first sample is of 4,669 studies drawn from the global sample which includes ‘Africa’ in the topic. The second set of samples is of 2,604/4,669 studies drawn from the global sample which is affiliated with an African country. The descriptive analysis focuses on the global and African samples based on record distribution by years (Figure 2), country-wise distribution (Figure 3 and Table 4), affiliation (Figure 4), and funding (Figure 5).

The record distribution by year is shown in in Figure 2.

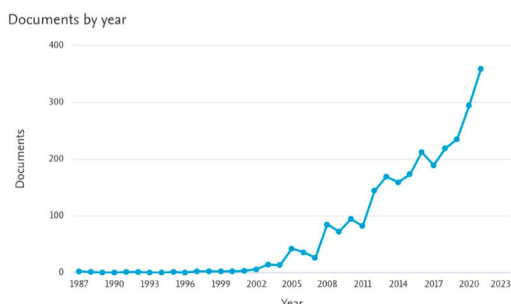
The distribution over the years shows that most research output globally has been in the past 20 years.

Global



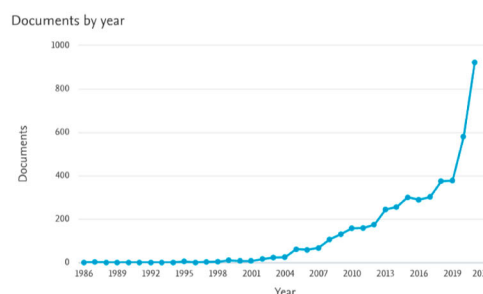
8 April 2022 version: 63,477 records 1955–2021

African countries



14 April 2022 version: 2,640 records 1987–2021

Topic ‘Africa’



14 April 2022 version: 4,669 records 1986–2021

Figure 2: Records distribution over the year on digital learning in broad SLR.

There has been a steady growth over the two-decade period with a peak of 7,673 studies in 2021. Conversely in Africa and for the topic ‘Africa’, the focus has only been the past decade and a half peaking in 2021. Globally, in Africa and for the topic ‘Africa’ there has been a rapid growth in studies from 2020, coinciding with the COVID-19 pandemic.

The country wise distribution by year is shown in in [Figure 3](#).

Globally, the country wise distribution shows that Africa, with the exception of South Africa, does not feature much among top researching countries on digital learning. The top 5 countries globally undertaking research on digital learning are the US, UK, China, Australia and Spain. The US has more than double the number studies compared to the next country (UK) and thirteen times more studies than the highest-ranking African country (South Africa). Based on an Africa sample of 2,640 records by country and 4,669 records by topic ‘Africa’, South Africa is dominant. By country, it is notable that most regions are reflected: Northern Africa (Morocco, Egypt, Tunisia, Sudan); West Africa (Nigeria, Ghana, Senegal); Eastern Africa (Kenya, Tanzania, Uganda); and Southern Africa (South Africa, Botswana, Mauritius, Zimbabwe, Namibia). It is notable that global countries (US, UK, Australia, Malaysia, Canada,

India, Indonesia, China, Spain, Taiwan, Turkey) dominate research on the topic ‘Africa’.

A review of the top ranked country by continent is shown in [Table 4](#).

When compared to the highest ranked countries in the Americas (US), Europe (UK), Oceania (Australia), Asia (China), Middle East (Saudi Arabia), it is notable that Africa (top 4 countries) lags significantly based on the number of studies.

The distribution by affiliation is shown in in [Figure 4](#).

Based on the global sample, affiliation shows that African institutions only feature slightly among the top 15 research entities globally focused on digital learning. However, an African institution (University of South Africa – UNISA) features among the top three research entities globally. The top three institutions globally are the Open University, UNISA and the University of Hong Kong. Based on an Africa sample of 2,640 records by country and 4,669 by topic ‘Africa’, UNISA is the most prominent while South African universities dominate the top three positions (UNISA, the University of Pretoria and the University of Cape Town, respectively).

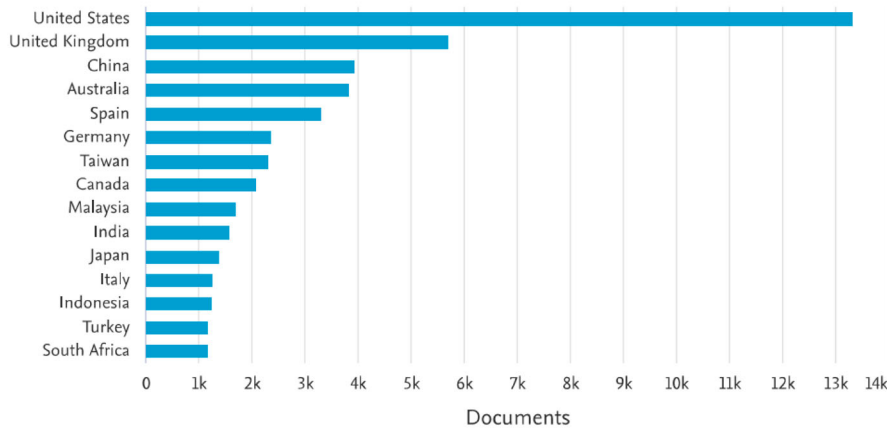
The funding sponsor distribution is shown in in [Figure 5](#).

The global sample shows that Africa does not feature among the top 15 funders globally for research

Global

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

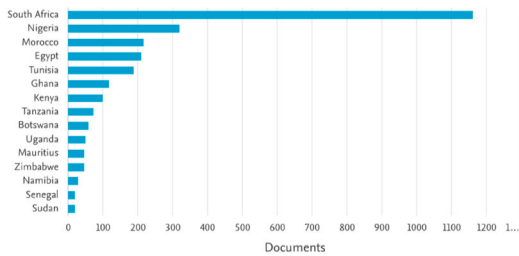


8 April 2022 version: 63,477 records 1955–2021

African Countries

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

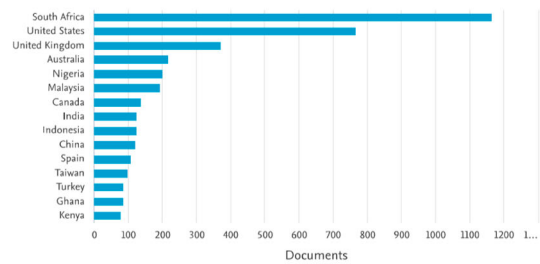


14 April 2022 version: 2,640 records 1987–2021

Topic ‘Africa’

Documents by country or territory

Compare the document counts for up to 15 countries/territories.



14 April 2022 version: 4,669 records 1986–2021

Figure 3: Country wise distribution on digital learning in B-SLR.

on digital learning. The top three funders at a global level are the National Science Foundation, the European Commission (EC), and the National Natural Science Foundation. Based on an Africa sample of 2,640 records by country and 4,669 by topic ‘Africa’, the EC and the National Research Foundation stand out as a common funding sponsor (EC ranks second in both

samples) and first and third, respectively, for the latter. The top funders in the Africa sample by country are the National Research Foundation (global) and UNISA (African). The top funder in the Africa sample by topic ‘Africa’ is the National Science Foundation, whereas among the top 15 entities, no African funder features.

Table 4: Selected studies distributed by region and country on the evolution of digital learning globally in B-SLR.

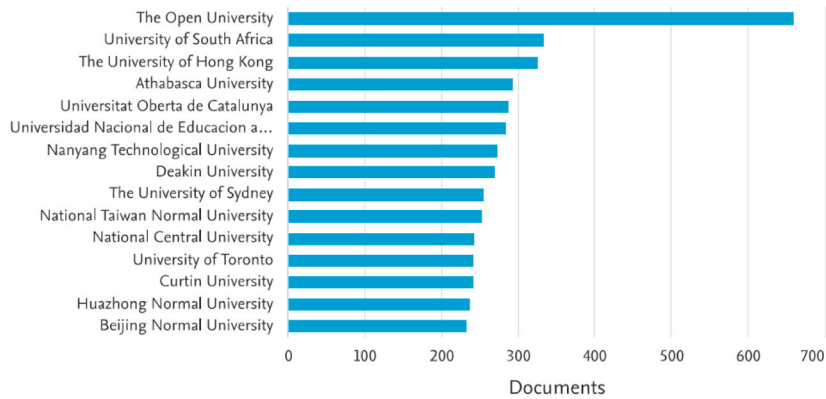
CONTINENT (COUNTRY)	SELECTED COUNTRIES BY REGION # STUDIES (63,477 sample)	
Americas (US)	US (13,317)	
Europe (UK)	UK (5,686)	
Oceania (Australia)	Australia (3,805)	
Asia (China)	China (3,925)	
Middle East (Saudi Arabia)	Saudi Arabia (607)*	
Africa (top 4 countries with research undertaken on digital learning)	By African Country (2,640 sample)	By Topic ‘Africa’ (4,669 sample)
	1. South Africa (1,162)	1. South Africa (1,162)
	2. Nigeria (318)	2. Nigeria (199)
	3. Morocco (216)	3. Ghana (83)
	4. Egypt (210)	4. Kenya (78)

*Figure based on a global sample of 63,738.

Global

Documents by affiliation

Compare the document counts for up to 15 affiliations.

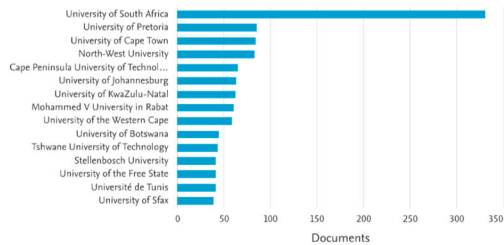


8 April 2022 version: 63,477 records 1955–2021

African Countries

Documents by affiliation

Compare the document counts for up to 15 affiliations.

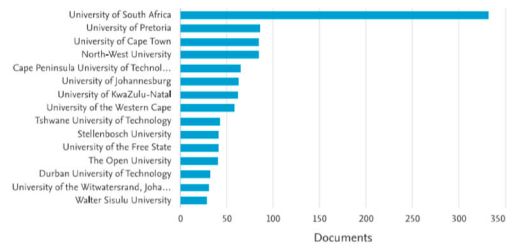


14 April 2022 version: 2640 records 1987–2021

Topic ‘Africa’

Documents by affiliation

Compare the document counts for up to 15 affiliations.



14 April 2022 version: 4,669 records 1986–2021

Figure 4: Affiliation on digital learning in B-SLR.

The output of the broad SLR serves as a foundation for a narrow SLR that situates digital learning innovation in the broader context of innovation systems and innovation barriers. A discussion of this follows next.

Narrow SLR comparing literature on DLI, innovation systems and innovation barriers

Based on an overall global sample of 4,091 studies, selected literature in the areas of digital learning innovation (1,686), innovation systems (1,240) and innovation barriers (1,164), demonstrated limited overlap among studies and limited literature from Africa. A detailed discussion follows.

Digital learning innovation

Based on the global sample,⁶ the most prolific authors show that Africa does not feature prominently for research on digital learning innovation. Globally, the most prolific authors have five publications each (Laurillard, D.; Looi, C.K.; Miniaoui, H.; Songkram N.). Based on the African sample of 64 records, the most prolific authors in Africa have three publications each (Kpolovie, P.J.; Ololube, N.P.; Umunadi, K.E.). The top three authors in Africa are therefore ranked among the top 10 globally. One notable author among the top 15 in Africa is Nyerere,

J. Two notable authors (Nafukho, F.M. and Muiya J.H.) were ranked as among the most relevant based on the Scopus algorithm. Their affiliations listed the US as the country of publication. However, their publication focused on the African Virtual University. Conversely at least one the publications listed under African by Scopus was focused on Turkey (Bozkurt A.).

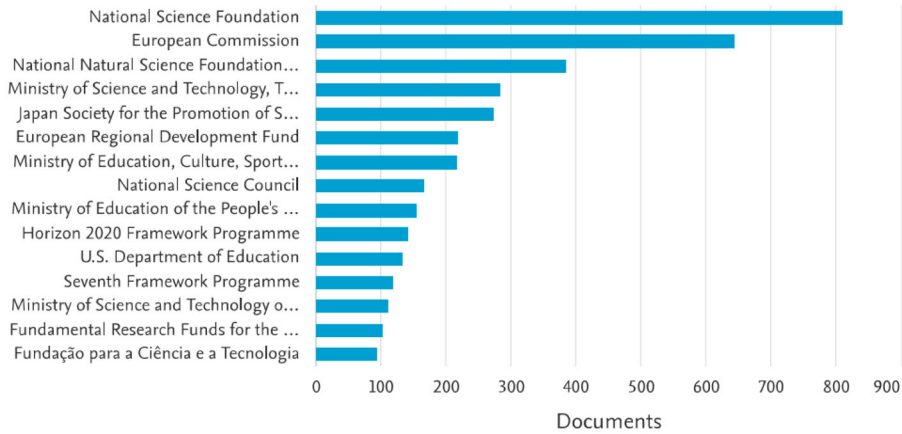
Based on the global sample⁷ records and an African sample,⁸ the five most cited authors both for books and articles show that Africa does not feature prominently for research on digital learning innovation. The leading author globally has 704 citations compared the leading author in Africa with 123 citations. Globally, one of the top five most cited authors for books is also a top author based on number of publications (Laurillard D.).

Based the global sample,⁹ the country-wise distribution shows that Africa, except for South Africa, does not feature much among top researching countries on digital learning innovation. The top five countries globally undertaking research on digital learning innovation are the US, the UK, Spain, Australia, and China. The US with 300 studies has six times more studies than the next country and twelve time more studies than the highest-ranking African country. Globally South Africa ranks 18th based on the sample data. Based on the African sample,¹⁰ the top five

Global

Documents by funding sponsor

Compare the document counts for up to 15 funding sponsors.

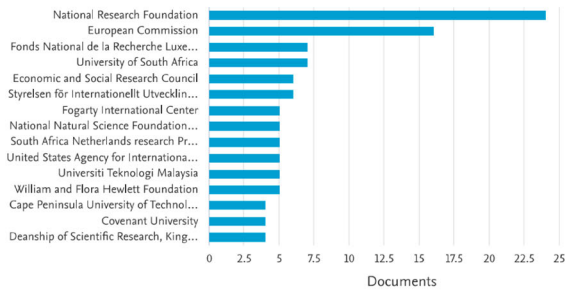


8 April 2022 version: 63,477 records 1955–2021

African Countries

Documents by funding sponsor

Compare the document counts for up to 15 funding sponsors.

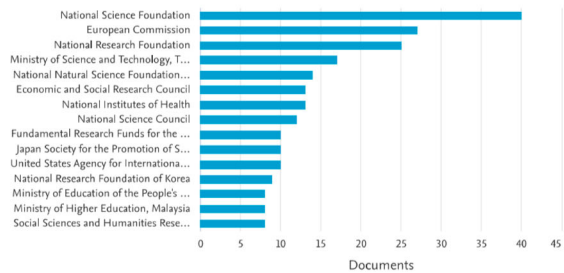


14 April 2022 version: 2640 records 1987–2021

Topic 'Africa'

Documents by funding sponsor

Compare the document counts for up to 15 funding sponsors.



14 April 2022 version: 4,669 records 1986–2021

Figure 5: Funding sponsor on digital learning.

countries on the continent are South Africa, Nigeria, Ghana, Morocco and Botswana.

Innovation systems

Based on a global sample¹¹ and 63 records for Africa, the most prolific authors show that Africa does not feature among the top 15 authors for research on innovation

systems. The two leading authors have 13 (Leydesdorff, L.) and 11 (Cooke, P.) publications, respectively. Notably, Cooke, P.; Etzkowitz, H.; Leydesdorff, L.; and Ranga, M. each feature among the 15 most prolific authors. One of the 15 most prolific authors (Klerkx, L.) in 'innovation systems' also features in the similar list for 'innovation barriers'.

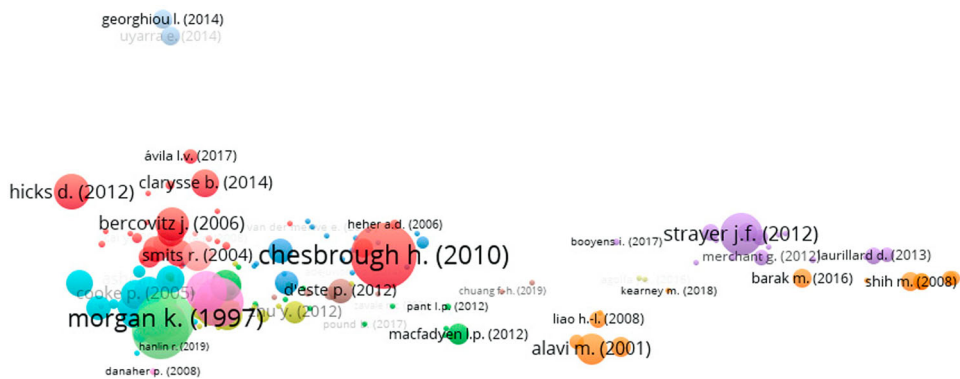


Figure 6: Bibliographic coupling by document (fractional) – 221 records on 25 October 2021 in N-SLR.

Based on the global and African samples, respectively, the five most cited authors both for books and articles show that Africa does not feature prominently in research on innovation systems. The leading author globally has 1,301 citations compared with the leading author in Africa with 93 citations. Four of the five most cited authors globally are Cooke P., Uranga M.G., Lundvall B.A., and Brundenius C. Globally, one of the top five most cited authors both for books and articles is also among the top two authors based on number of publications (Cooke, P.). Globally, one of the authors has two books and two articles ranked among the top five with the highest citations (Lundvall B.A.).

Innovation barriers

Based on a global sample¹² and an African sample of 43 records, the most prolific authors show that Africa does not feature for research on innovation barriers. The leading author has six publications. One of the 15 most prolific authors (Klerkx, L.) in ‘innovation barriers’ also features in the similar list for ‘innovation systems’.

Based on the global sample¹³ and African sample,¹⁴ the five most cited authors by single publication (both in the case of books and of articles) show that Africa does not feature prominently in research on innovation barriers. The leading author globally has 1,627 citations compared the leading author in Africa with 63 citations. Two notable authors featured among the five most cited globally are Hadjimanolis, A. and Drazin, R.

Bibliographic coupling and co-citation analysis

The results of the bibliographic coupling is shown in Figure 6

Notably, the studies on innovation barriers from an organizational perspective¹⁵ and within innovation systems¹⁶ represented key thematic clusters with close linkages. Additionally, the key studies on digital learning innovation¹⁷ were not clustered together and neither were they close to the clusters on innovation systems and innovation barriers.

The co-citation analysis is shown in Figure 7.

Notably, the studies on innovation systems and innovation barriers¹⁸ are closely clustered with various strands developing in unique directions. Conversely,

studies on digital learning innovation do not feature prominently within the cluster.

Mapping universities using Webometrics data and Global Innovation Index data

Based on the January 2022 Webometrics Index, it is estimated that globally, there are 31,586 higher education institutions (mostly universities) for which comparative data existed.¹⁹

A mapping of all digital learning institutions (universities) globally (by country and continent / region) is shown in Figure 8.

Globally ‘Type 1’, ‘Type 2’ and ‘Type 3’ institutions (universities and entities offering degrees) have the most comparable data (annual university rankings) collected over more than a decade-and-a-half through an index like Webometrics established in 2004. As of December 2021, the US accounted for just over one third (107) of the top 300 universities globally, followed by the UK (31) and China (22). Overall, Asia accounted for most universities (14,468), while Oceania had the least (270). The rest of the continents / regions had 7,515 (Americas), 5,735 (Europe), 2,019 (Africa) and 1,579 (Middle East). A notable ‘Type 3’ institution is the African Virtual University.

In Africa, South African universities dominated ‘Type 1’ and ‘Type 2’ institutions (especially among the top 10 ranking) closely followed by Egypt and Nigeria (among the top 200 ranking). African countries had at least one institution (University of Cape Town) featuring within the top 100 ranking globally. Notable ‘Type 3’ institutions include the Kenya / Senegal based African Virtual University in partnership with universities in 23 different countries; Zambia based COMESA Virtual University in partnership with universities in 22 African countries (conceptually) of which two represented actualized instances (Kenyatta University in Kenya and University of Mauritius in Mauritius); and Kenya based Maarifa Education in partnership with two African countries (Uganda and Zambia based Cavendish Universities and previously with an attempted partnership in Kenya with KCA University).

South African institutions represent the greatest number of universities within the top 10 ranking, closely followed by Egypt and Nigeria (who dominate the top 200 ranking). Twenty-three African countries



Figure 7: Co-Citation analysis minimum 2 references (fractional) – 221 records on 25 October 2021 in N-SLR.

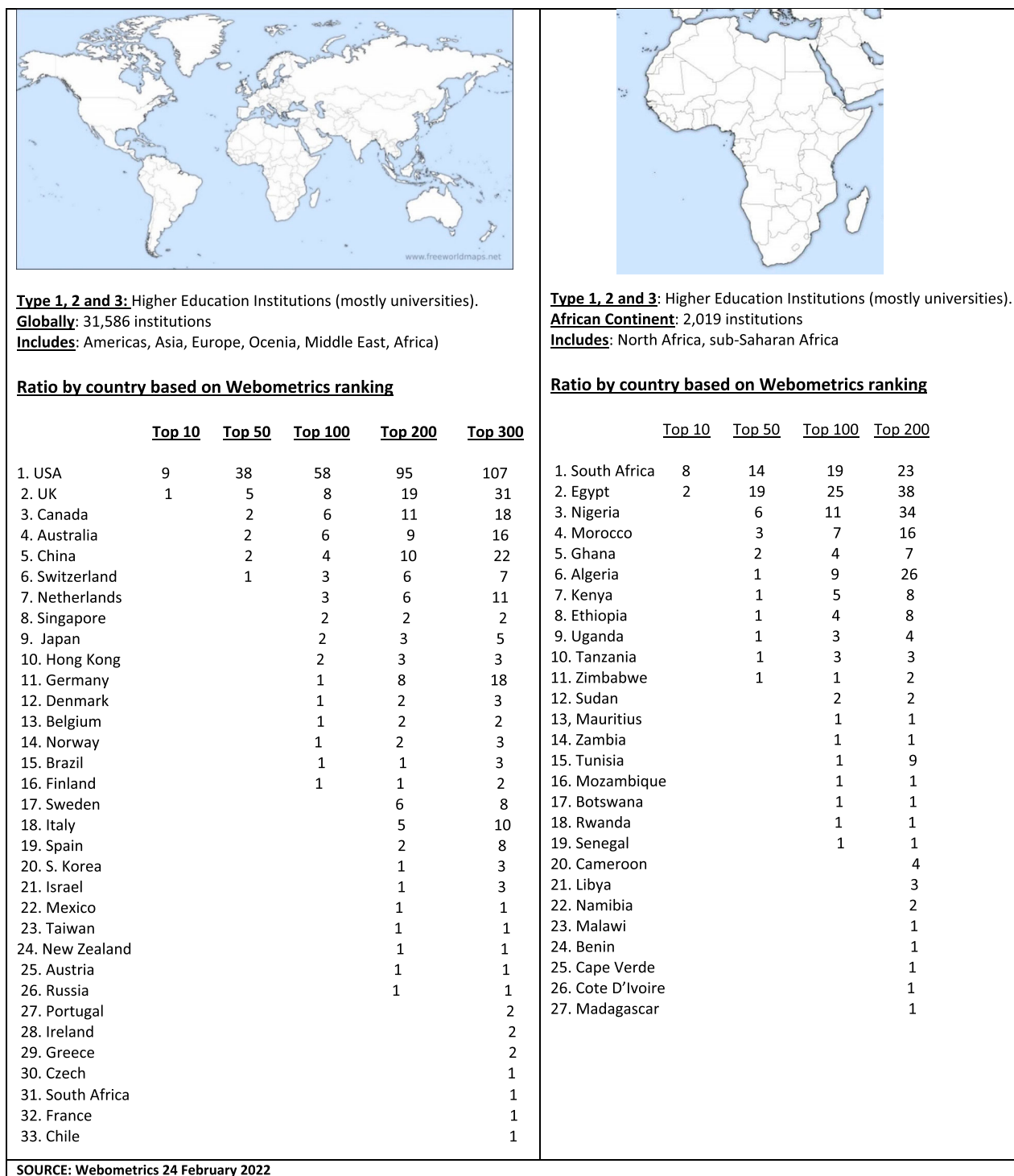


Figure 8: Mapping of digital learning institutions (Type 1, 2 and 3) globally and in Africa.

have at least one institution featuring within the top 100 ranking.

It is notable that all eight of the AU recognized RECs have at least one country with representation in the top 100 ‘Type 1’ and ‘Type 2’ Digital Learning Institutions on the continent as shown in the list below:

- Arab Maghreb Union (AMU): Morocco, Algeria, Tunisia
- Common Market for Eastern and Southern Africa (COMESA): Egypt, Tunisia, Kenya, Ethiopia, Uganda, Zimbabwe, Sudan, Mauritius, Zambia
- Community of Sahel-Saharan States (CEN-SAD): Egypt, Nigeria, Morocco, Tunisia, Ghana, Kenya, Sudan, Senegal
- East African Community (EAC): Kenya, Uganda, Tanzania, Rwanda
- Economic Community of Central African States (ECCAS): Rwanda, Cameroon
- Economic Community of West African States (ECOWAS): Nigeria, Ghana, Senegal
- Intergovernmental Authority on Development (IGAD): Kenya, Ethiopia, Uganda, Sudan

- Southern African Development Community (SADC): South Africa, Tanzania, Zimbabwe, Mauritius, Zambia, Mozambique, Botswana

Among the RECs in terms of member states, COMESA has the highest number (9) while ECCAS has the lowest (2). One country features in the most number (4) of RECs (Kenya: COMESA, CEN-SAD, EAC, IGAD). Two pairs of countries feature in the most number (3) of overlapping RECs with each pairing having one country in common: Kenya/Sudan (COMESA, CEN-SAD, IGAD); and Kenya/Uganda (COMESA, CEN-SAD, EAC).

Using the GII data, it is notable that South Africa ranks among the top 100 countries globally in a cluster that includes other African countries like Mauritius, Tunisia, Morocco, Kenya, Tanzania, Egypt, and Namibia. These are closely followed by Rwanda and Senegal. The top 10 ranked countries (overall and based on knowledge and technology output – KTO) in the 2021 Global Innovation Index at a global level and in Africa are as follows:

- 2021 GII Rank (Global: **KTO**): Switzerland (1:1); Sweden (2:2); US (3:3); UK (4:10); South Korea (5:8); Netherlands (6:7); Finland (7:5); Singapore (8:13); Denmark (9:14); Germany (10:9); France (11:16); China (12:4); Japan (13:11); Hong Kong / China (14:62); Israel (15:6)
- 2021 Africa Continent GII Rank (Global: **KTO**):
 1. Mauritius (52:93);
 2. South Africa (61:61);
 3. Tunisia (71:55);
 4. Morocco (77:67);
 5. Kenya (85:65);
 6. Tanzania (90:100);
 7. Egypt (94:70);
 8. Namibia (100:119);
 9. Rwanda (102:96);
 10. Senegal (105:88)

Discussion

Digital learning can be analyzed in the contexts of an innovation system (more specifically a national innovation system) and innovation barriers. Various barriers have an impact on digital learning in the context of universities in an innovation system. Despite the existence of such barriers, digital learning innovation provides many opportunities, especially in the context of universities in Africa.

In response to the research question on trends and factors, the SLR confirmed that digital learning has evolved over a period of two decades starting from around the late 1990s and early 2000s. The onset of this evolution coincided with the advent of the internet as an innovation that disrupted communication globally. As reflected by the number and quality of studies in the broad SLR, it is confirmed that this evolution has played out differently on different continents. The distributions by country, affiliation (university) and funding sponsor point to three possible factors that influence digital learning innovation. First, distribution by country may indicate a possible variety in how digital learning is undertaken within different national innovation systems. Secondly, distribution by affiliation (university) may indicate a possible variety in how digital learning is undertaken within different types of universities

spanning different innovation systems. Thirdly, the distribution by funder may indicate a possible variety in how digital learning is undertaken based on the quantity and quality of funding in universities and national innovation systems. A deep dive of selected universities within their national innovation system based on the typology discussed in the section on mapping universities using Webometrics data and Global Innovation Index data can be used to explore each of these possible factors further. However, this is beyond the scope of the current paper and represents an opportunity for future research that is explored through a case study approach in a PhD study (Mbaya forthcoming).²⁰

In three of the following sub-sections, additional insights are provided based on a keyword search, a content analysis through a review of selected abstracts, and a comparison of works from the narrow SLR. In the final two sub-sections, the paper proposes a typology of barriers and an emerging conceptual model, respectively, both based on the studies from the SLR.

Keyword search

A keyword search was conducted on the 63,477 records on ‘digital learning’ (or similar) to identify concepts covered in the literature. The top ten keyword categories based on the keyword search were:

- | | |
|-----------------------------|---------------------------------------|
| 1. e-learning (28,792) | 6. online learning (5,699) |
| 2. students (12,783) | 7. engineering education (5,679) |
| 3. teaching (9,064) | 8. computer aided instruction (5,603) |
| 4. education (7,743) | 9. curricula (4,564) |
| 5. learning systems (5,888) | 10. distance education (3,782) |

There was a larger number of studies in the following categories of keywords: ‘technology’ (1,248); information technology (1,095) and ‘COVID-19’ (1,323). There were only limited studies that appeared in the categories of these keywords: ‘research’ (639); ‘innovation’ (548); ‘sustainable development’ (406); and ‘higher education institution’ (456). There were no studies in the category of keywords ‘global value chain’, ‘GVC’ or ‘policy’. This points to an opportunity for new research streams to explore the concept of global value chains and digital learning in the context of national innovation systems and economic development, as argued by Jurowetzki, Lema, and Lundvall (2018, 1). Against the backdrop of the COVID-19 pandemic, such research streams are important for the continent of Africa, especially in the context of increasing digitalization.

Content analysis of selected abstracts on digital learning

A sub-set of studies was drawn non-systematically from the broad SLR global sample of 63,477 records on digital learning for content analysis of their abstracts, as shown in Table 5.

The non-systematic approach focused on top-ranked publications, their references, and citations. Three sets of highlights were identified.

Table 5: Selected studies from screening sample of 63,477 subjected to abstract content analysis.

SELECTED STUDIES ON DIGITAL LEARNING FROM SCREENING SAMPLE OF 63,477	
1. Aldowah, Al-Samarräie, and Ghazal 2019 (in Aldowah, Al-Samarräie et al. 2020; Aldowah, Umar et al. 2020);	17. Hodges 2020 (in Hodges et al. 2021);
2. Aldowah, Al-Samarräie et al. 2020;	18. Hodges et al. 2021;
3. Aldowah, Umar et al. 2020;	19. Juma 2001;
4. Amutabi and Oketch 2003;	20. Kanwar et al. 2018;
5. Bacow et al. 2012 (in Bowen 2013, Hollands 2014, Moscova 2012);	21. Kitawi et al. 2021;
6. Becker and Otto 2019 (in Bernhard and Krichner 2007; de Witt and Gloerfeld 2020);	22. Makokha and Mutisya 2016;
7. Bowen 2013;	23. McPherson 2003;
8. Chuang 2016;	24. McPherson and Bacow 2015 (in Bowen 2013);
9. de Witt and Gloerfeld 2017 (in 2020);	25. Mukama 2016 (in Kanwar et al. 2018);
10. de Witt and Gloerfeld 2020;	26. Mukama 2018 (in Nketekete and Mojalefa 2021);
11. DeBoer and Breslow 2016;	27. Munene 2007;
12. De Boernd Breslow 2016;	28. Nafukho 2007;
13. Gunga and Ricketts 2007;	29. Nafukho and Muyia 2013;
14. Gunga and Ricketts 2008;	30. Neema-Abooki and Kitawi 2014;
15. Gwamba et al. 2018 (in Lim and Lee 2018);	31. Nketekete and Mojalefa 2021;
16. Hadullo, Oboko, and Omwenga 2018;	32. Nyerere, Gravenir and Mse 2012;
	33. Nyerere and Friso 2013.

Firstly, studies focused on the higher education sector tended to approach digital learning (in the broader context of technology) from three dimensions. One set of studies looked at the **management** dimension by focusing on the alignment between business and IT strategies within an institution (Gwamba et al. 2018; McPherson 2003). Such studies explored concepts and models like strategic information systems planning (SISP), enterprise resource planning (ERP), lean management, knowledge management (KM) and learning management systems (LMS). A second set of studies looked at the **pedagogical** dimension by focusing on the definition and interpretation of education variables (Bacow 2012; Chuang 2016; DeBoer et al. 2014; Gunga and Ricketts 2007, 2008 Hadullo, Oboko, and Omwenga 2018; Juma 2001; McPherson and Bacow 2015; Neema-Abooki and Kitawi 2014). Such studies explored the process of instructional design relative to indicators like assessment, curriculum, participation, enrolment, achievement, and certification. A third set of studies drawn from the field of innovation systems looks at the **policy** dimension by focusing on the relationship between government and academic institutions (Kanwar et al. 2018; Nyerere and Friso 2013). Such studies explore concepts like accreditation, intellectual property, innovation systems, regional economic integration, and science technology and innovation (STI). The concept of GVCs did not feature much.

Secondly, a small proportion of the of the studies on digital learning provide a holistic view of barriers in the context of universities and innovation systems as units of analysis. We could distinguish four subsets of these studies. The first subset (Aldowah, Al-Samarräie, and Ghazal 2019; Amutabi and Oketch 2003; Juma 2001; Gunga 2006) (referenced by 2007 and 2008), Makokha and Mutisya 2016; Mukama 2018; Munene 2007; Nafukho 2013, and Nyerere 2013) is focused on the experience of developing countries analyzed either at a national level (for example Malaysia and Kenya) or continental level (for example Asia and Africa). The second subset (Bacow et al. 2012; Bowen et al. 2013; McPherson

and Bacow 2015; Hodges et al. 2020) is focused on the experience of developed countries analyzed at a national level (for example the US), continental level (for example North America) or global level (for example North America, Asia and Africa). The third subset (Becker and Otto 2019) is focused on a single cross-cutting issue such as the SDGs impacting digital learning innovation at a continental level (for example Asia). The fourth subset (DeBoer et al. 2014; Nketekete and Mojalefa 2021) is focused on the experience of digital learning within an organizational setting at a national level (for example a single university in the US or South Africa). A perspective of GVCs was absent.

Thirdly, none of the studies places equal emphasis on all the three categories of digital learning innovation, innovation systems and innovation barriers, particularly in the context of universities in Africa. The perspective of GVCs was absent.

Therefore, the content analysis on the non-systematic sample revealed a gap in the investigation of systemic barriers to digital learning innovation in Africa, especially in the context of GVCs. A richer content analysis could reveal even greater insights. However, this is beyond the scope of the current study and represents an opportunity for future research.

Comparison of literature on digital learning innovation, innovation systems and innovation barriers

Based on a global sample of 4,091 studies in the areas of digital learning innovation (1,686), innovation systems (1,240) and innovation barriers (1,164) there appears to be limited overlap among the three areas as well as limited literature from Africa. Further there appears to be limited emphasis on GVCs. Notably, many of the key works from the sample were published before Jurowetzki, Lema, and Lundvall (2018), Fagerberg, Lundvall, and Srholec (2018), Hodges et al. (2020), and Rikap and Lundvall (2021) and Soete (2021). This represents an opportunity for new research directions.

Table 6: Emerging typology of systemic barriers based on systematic literature review.

LITERATURE INFORMED DIMENSION	ATTRIBUTES
Hadjimanolis 2003: Innovation Barriers (Internal vs external) – ORGANIZATION (University as a unit of analysis)	<ul style="list-style-type: none"> • Internal (People, Structure, Strategy) • External (Market, Government, technical/societal/inter-governmental)
Woolthuis, Lankhuizen, and Gilsing 2005: Innovation Failures (rules vs actors) – ENVIRONMENT (National Innovation System as a unit of analysis)	<ul style="list-style-type: none"> • Rules (Infrastructure, Institution, Interaction, Capability) • Actors (Demand, Companies, Knowledge Institutes, Third Parties)
Borrás and Edquist 2019: Activities/Functions (systemic market vs non-systemic market) – INNOVATION SYSTEM	<ul style="list-style-type: none"> • SYSTEMIC MARKET <ul style="list-style-type: none"> o SUPPLY: Provision of knowledge inputs into the innovation process (2) o DEMAND: Demand-side activities (2) o PRICE-QUANTITY MIX: Support services for innovating firms (3) • SYSTEMIC (NON-MARKET) <ul style="list-style-type: none"> o ACTORS/LINKAGES/NETWORKS: Provision of constituents for Systems of Innovation (3)

Establishing a typology of barriers based on literature

The SLR also identified a three-dimensional emerging typology of barriers focused on the organization (Hadjimanolis 2003), the environment (Woolthuis, Lankhuizen, and Gilsing 2005), and the innovation system (Borrás and Edquist 2019). Each dimension has a series of attributes, as shown in Table 6.

The typology of systemic barriers enables an analysis based on policy regimes within a given national innovation system (Borrás and Edquist 2019; Chaminade et al. 2009). Policies exist to address a problem which indicates a barrier. Such an approach identifies systemic barriers to digital learning innovation from a perspective of a national innovation system’s structure (Woolthuis, Lankhuizen, and Gilsing 2005) and functions/activities

(Borrás and Edquist 2019). These systemic barriers can either be internal to an organization or exist externally in the environment (Hadjimanolis 2003). The proposed typology would look at systemic barriers to innovation. The literature on systemic barriers is scattered and views barriers from policy, social, institutional, organizational, technical, legal, cultural, and technical perspectives. The typology of barriers offers possible variables that can be used to explore the three emergent factors from the literature that influence digital learning innovation, namely national innovation systems, universities, and funders. The PhD study (Mbaya, Martin, forthcoming) has undertaken such an exploration with a focus on two case study countries in Africa. A presentation of those findings is beyond the scope of this paper.

5. Conceptual model and selected references

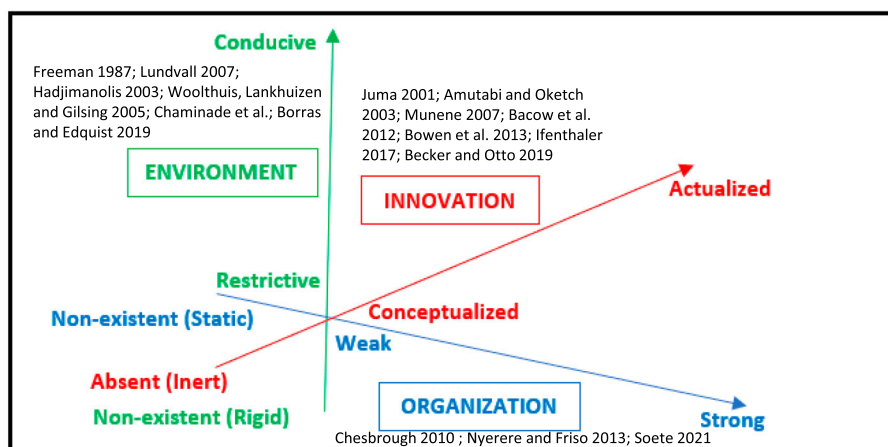


Figure 9: Emerging conceptual model based on literature mapping systemic barriers to digital learning innovation.

Emerging conceptual model based on systematic literature review

In conclusion, the paper builds on selected literature to propose a three-dimensional conceptual model, as shown in [Figure 9](#).

The conceptual model is based on a framework that maps the dependent variable (digital learning innovation) against two independent variables framed through the two units of analysis (systemic barriers from the perspectives of both universities and national innovation systems). The conceptual model can therefore be framed as three perpendicular axes spanning digital learning (the innovation), the national innovation system (the environment), and the university (the organization).

The emerging conceptual framework spanning the innovation (conceptualized or actualized, otherwise inert), the organization (weak or strong, otherwise static), and the environment (restrictive or conducive, otherwise rigid) enables mapping of universities and national innovation systems based on systemic barriers to digital learning innovation. Key references for the conceptual model with an emphasis on digital learning focus on the three dimensions of: innovation (Juma 2001; Amutabi and Oketch 2003; Munene 2007; Bacow et al. 2012; Bowen et al. 2013; Ifenthaler 2017, Becker et al. 2019); the organization (Chesbrough 2010; Nyerere and Friso 2013; Soete 2021); and the environment (Freeman 1987; Lundvall 2007; Dosi et al. 1988; Hadjimanolis 2003; Woolthuis, Lankhuizen, and Gilsing 2005; Borrás and Edquist 2019; Chaminade et al. 2009; Mazzucato 2013).

Conclusion

The SLR confirmed the opportunity for a theory building study focused on barriers to digital learning innovation in the context of universities within innovation systems in a developmental context that includes global value chains. From a perspective of countries (and by extension national innovation systems) the review confirmed that few studies have focused on Africa with the exception of South Africa which leads the continent on studies in digital learning. From a regional perspective, North Africa (Egypt, Morocco, Algeria), West Africa (Nigeria and Ghana) and East Africa (Kenya, Uganda, Tanzania) stand out as leaders in research on digital learning. From a perspective of organizations (and by extension universities), the review confirmed that few studies are affiliated with African entities with the exception of the University of South Africa (UNISA). UNISA ranked second among universities globally studying digital learning.

Digital learning can be analyzed in the contexts of an innovation system (more specifically, a national innovation system) and innovation barriers. Various barriers have an impact on digital learning in the context of universities in an innovation system. As noted in the introduction section, the failure by governments globally to conceptualize and govern DLI within the framework of GVCs during the COVID-19 pandemic represented such a systemic barrier impacting economic development. Despite the existence of such barriers, digital learning innovation provides many opportunities, especially in

the context of universities in Africa as captured in recent literature like Soete (2021).

By focusing on the university as a unit of analysis, the SLR helped to identify trends and possible factors in digital learning innovation in Africa universities from both a continental and global perspective. This has been achieved by mapping the distribution of studies based on region / continent relative to global efforts. In this way, the SLR offers a basis for choosing African case studies for further research of the kind encouraged by Fagerberg, Lundvall, and Srholec (2018). Additionally, the SLR provides a basis for exploring the linkage between research output and innovation policy. This was achieved by comparing the ranking of a country based on publications against the ranking using an innovation index like GII. The study therefore provides a preliminary overview of digital learning innovation in Africa from a global and continental perspective based on existing literature on digital learning and index data on innovation.

Future research by building on the proposed conceptual model of innovation and typology of barriers through a cases study approach can help to show that not just one single barrier exists, but rather multiple barriers interact. The use of case studies can help to understand the different barriers within a national innovation system and to look at the attempt by countries to address them. As an area for future research, there is an opportunity for a deep dive targeting two African countries as NIS where limited studies have been undertaken. Given the large amount of emphasis on the African Continental Free Trade Area at the time that this study was conducted, such future research could focus on a common Regional Economic Community. Ideally, the study could focus on countries that have signed and ratified the AfCFTA in the context of Africa's RECs (Mangeni and Juma 2018; Mbaya, Mudida, and Omwenga 2023). Further, given the strong interest in the digital economy during the COVID-19 pandemic, it would be ideal to situate the study's units of analysis within countries that meet the following four criteria. First, they are spearheading the African Union's Smart Africa Initiative. Second, they are strong champions of the UN Sustainable Development Goals (Ouma-Mugabe et al. AfricaLics 2022 Conference) and the UN Global Principles on Business and Human Rights (O'Brien, Ferguson, and McVey 2021). Third, they should vary in their characteristics with respect to size, population, historical legacy, socio-economic factors and governance models. Finally, case study universities within the selected countries should ideally enable analysis across different innovation systems. Building on this paper, Mbaya and Mugabe (forthcoming)²¹ discuss the effect of digital learning innovations on the global value chain (among other factors) based on empirical data collected from East Africa (Kenya and Rwanda) and secondary data globally.

Notes

1. A 16 February 2023 webinar presentation by Prof. Oluseye Jegede also discusses Asian case studies that

- include China and South Korea in the context of Global Value Chains. See: <https://africalics.org/event/webinar-series-on-industrialising-through-global-value-chains-what-africa-can-learn-from-east-asia-and-latin-america/>.
2. The perspective of Africa and Global Value Chains was also explored extensively in a webinar series entitled “Putting Africa First.” The six-part series brought together the books authors, Prof. Mammo Muchie, Prof. Bengt-Åke Lundvall and Prof. Peter Gammeltoft to discuss the book 20 years later. The first part is available here: https://www.youtube.com/watch?v=p_MDd1txQdU.
 3. PRISMA stands for Preferred Reporting Items for Systematic Reviews and Meta Analyses.
 4. Refer to PDF files in consolidated database: https://drive.google.com/drive/folders/1P8J9n8xgn1Y1ERDmpG6QvJYfejLgh3mz?usp=drive_link
 5. Refer to MS Excel Spreadsheets and PDF files consolidated database: https://drive.google.com/drive/folders/1P8J9n8xgn1Y1ERDmpG6QvJYfejLgh3mz?usp=drive_link
 6. 1,679 records.
 7. 1,686 records.
 8. 66 records.
 9. 1,683 records.
 10. 64 records.
 11. 1,236 records.
 12. 1,163 records.
 13. 1,163 records.
 14. 43 records.
 15. Chesbrough, H. 2010. “Business Model Innovation: Opportunities and Barriers.”
 16. Morgan, K. 1997. “The Learning Region: Institutions, Innovation and Regional Renewal.”
 17. Strayer, J. F. 2012. “How Learning in an Inverted Classroom Influences Cooperation, Innovation and Task Orientation”; Alavi, M., and D. E. Leidner. 2001. “Research Commentary: Technology-Mediated Learning—A Call for Greater Depth and Breadth of Research”; Macfadyen, L. P., and S. Dawson. 2012. “Numbers Are Not Enough: Why e-Learning Analytics Failed to Inform an Institutional Strategic Plan.”
 18. Cooke, P. 2007. “Regional Innovation Systems, Asymmetric Knowledge and the Legacies of Learning”; Maskell, P., and A. Malmberg. 2007. “Myopia, Knowledge Development and Cluster Evolution”; Freeman, C. 2002. “Continental, National and Sub-national Innovation Systems -Complementarity and Economic Growth.”
 19. Source: Webometrics accessed on February 2nd, 2022 <https://www.webometrics.info/en>. Note Webometrics ranking is most relevant for the comparative exercise when compared to other rankings (QS, RUR and uniRank) given the methodology used. Webometrics emphasizes technology and uses website data which represents a good proxy for digital learning. The total number of universities across the four ranking databases varies from 25,000–31,000. The chapter chooses to go with the upper range and refers to Higher Education Institutions which may also include Polytechnics, Technical and Vocational institutions.
 20. *ibid.*
 21. Mbaya, Martin; Mugabe, John. 2023. “Systemic Barriers to Digital Learning Innovation in Africa: The Case of Strathmore University and Kenyatta University within the Kenyan National Innovation System.” Virtual conference presentation in Warsaw, Poland, on 15 November 2023, at ABIS Colloquium 2023 - Navigating Multiple Transitions. <https://www.abis-global.org/blog/22nd-abis-annual-colloquium-2023>.
 22. Mbaya, Martin; Mugabe, John 2022 Systematic Literature Review on Systemic Barriers to Digital Learning Innovation in African Universities, Paper presented at 5th AfricaLics Conference in Yaounde, Cameroon.
 23. Mbaya, Martin, PhD Dissertation (expected September 2024) supervised by Prof. John Ouma-Mugabe at the University of Pretoria Graduate School of Technology Management titled, ‘Systemic Barrier to Digital Learning Innovation: Comparative Case Studies’.

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