Vol.5 Special Issue No.2 (2022)

Journal of Applied Learning & Teaching

ISSN : 2591-801X

Content Available at : http://journals.sfu.ca/jalt/index.php/jalt/index

Teaching and Learning Mathematics in Sub-Saharan Africa: An Introduction to the Special Issue

Räsänen Pekka[A] A *Turku Research Institute for Learning Analytics, University of Turku, Finland*

Fritz Annemarie[B] B *Department of Psychology, University of Duisburg-Essen, Essen, Germany, Academy Wort and Number, International Institute for Intercultural Education, Cologne, Germany*

Haase Victor Geraldi[C] C *Programa de Pós-graduação em Neurociências, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, Programa de Pós-graduação em Psicologia: Cognição e Comportamento, Departamento de Psicologia, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil*

DOI: https://doi.org/10.37074/jalt.2022.5.S2.1

Abstract

Before the pandemic, it was estimated that globally six out of ten children and adolescents were not able to read or handle mathematics with proficiency by the time they are of age to complete primary education. That makes over 600 million children and teenagers (56%) whom we fail to teach the basic skills required for an independent adult life (UNESCO Institute for Statistics 2017). One of the areas where this educational challenge is largest is Sub-Saharan Africa. Not only is there a constant challenge to offer quality education for all, but due to population growth, an additional challenge is to train millions of new teachers for the growing school systems. This special issue paints a picture of the current state of mathematics learning and teaching in Sub-Saharan Africa with a focus on both teachers and students.

Keywords: Cross-cultural comparisons; mathematical achievement; mathematics education; mathematics learning; Sub-Saharan Africa; teacher education.

We, the editors of this special issue, began our joint academic journey in 2016 when we started as editors for an international handbook of mathematical learning difficulties published by Springer Nature (Fritz et al., 2019). The twist of this book was to have a special section about learning mathematics in different areas of the world. Our book had twelve interesting stories that offered us a quick glimpse into the surprisingly different circumstances in different regions and continents: how students study and learn mathematics, how teachers taught it and what the situation was in educational research. That motivated us to take a deeper look at different regions. First, we invited a group of distinguished researchers from Latin American countries to build a special issue on the local situation (Haase et al., 2020). For this second special issue, we invited a group of experts on maths learning and teaching who have studied broadly the situation in Sub-Saharan African countries. In Sub-Saharan African countries, there is an urgent need for scientific knowledge to guide the actions to improve the quality of education. This special issue is one of the efforts to provide this knowledge to a broader public. We were happy to find JALT to partner with us in this collaboration, which made producing this special issue possible.

In this special issue, we have articles that focus on information from different Sub-Saharan African countries (Botswana, Cameroon, Kenya, Malawi, Namibia, Tanzania, Uganda, Zambia, and Zimbabwe) as well as review papers covering issues like teacher education, low-free private schools, and using educational technologies. We hope the readers will find the authors' contribution to this special issue as interesting as we did.

Case: Sub-Saharan Africa (SSA)

Sub-Saharan Africa is, geographically, the area of the continent of Africa that lies south of the Saharan desert. From the perspective of the immense geographical, cultural and political diversity, the concept 'Sub-Saharan Africa' also could be considered absurd and misleading, if not a meaningless classificatory schema. It is mainly the colonialist history that connects the countries in this area. Otherwise, manifold would be the best word to describe this area that is more extensive than Europe and the USA together, divided into almost fifty countries with over 1.1 billion inhabitants. However, many international organisations, like the United Nations and World Bank, use this areal definition, allowing us to do the same.

With its abundant natural resources and increasing population, Africa has achieved remarkable growth in recent years. As a result, it draws the international community's

attention as 'the future global growth centre'. SSA has had remarkable economic and social development during the last two decades. According to the World Bank statistics (The World Bank, 2022a), the population of SSA increased from 665 million (2000) to 1.17 billion (2021). Urbanisation (currently 40% of the population) has followed a linear trend with a five per cent increase in a decade. Some of this growth is due to migration from rural areas. Still, most of it will occur due to natural increases in the urban population and the reclassification of rural areas as urban.

At the same time, the poverty headcount ratio (persons living below US$1.90/day) dropped from 58% to 38%, life expectancy rose from 50 to 62 years, and GDP per capita increased from $635 to $1,645. All imposing figures of growth, even though, at the same time, these numbers tell a story that there is an extensive amount of work left to improve the quality of living in this area.

Education for all

At the 1990 UNESCO World Conference on Education, the international community formulated the goal of providing all children access to quality primary education within ten years. In 2000, this goal was reaffirmed at the World Education Forum in Dakar with the 'Education For All' (EFA) initiative (26-28 April 2000, Dakar Framework for Education). In the following years, globally, the number of children attending school increased from 59% to 79%. Likewise, in SSA countries, the number of children in primary education has increased dramatically. During the last two decades, it has more than doubled from 90 to 184 million (The World Bank, 2020b), partly because of population growth and partly due to increased enrolment in school.

The percentage of children enrolled in school has continued to increase. In countries such as South Africa, Mauritius, Seychelles, and Kenya, it rose from 80 per cent in 1998 to nearly 99 per cent in 2018. However, some countries still struggle with offering education for all. It is especially true for conflict-depicted areas like Niger (66%), Mali (76%), Eritrea (68%), and especially Somalia (23%). There are also considerable differences in children's school enrolment between rural and urban areas in these countries.

In 2021, UNICEF estimated that 40 per cent of all school-aged children across Eastern and Southern Africa were not in school due to pre-pandemic levels of out-of-school children and COVID-19-induced closures. The pandemic almost doubled the number of out-of-school children. Since schools were closed, many students did not have the opportunity to receive instruction, feedback, or interact with their teachers. The situation was even worse when we add that there is minimal access to technologies such as radio, television, computers, and the internet in the poorest areas. These factors left many students unable to engage in remote learning. Even though governments in the SSA countries have focused on increasing digital education and literacy for teachers and students, widespread challenges remain. A South-African study from public schools (Van der Berg et al., 2022) showed that the pandemic has had a strong negative impact on schooling, with learning losses more significant in mathematics than in reading, and most extensive for the earliest grades.

At school and out-of-school

In 2018, UIS estimated that 20% of the primary school children in SSA were out-of-school. At lower secondary, that figure raised to 37%, and at upper secondary already to 58%, meaning that, in total, almost one-third of the school-aged children and adolescents were not at school. However, the variation between SSA countries is sizeable (see Figure 1).

Inoue et al. (2015) noted that several factors characterise out-of-school phenomena in SSA countries. The out-of-school problem prevails in low-income, Francophone, and fragile or conflict-affected countries. Living in rural areas, where distances are long, and the quality of the schools and education is lower, is also a central factor. Individual risk factors for out-of-school behaviour are low parental education, fewer working adults in the household, and gender, where girls are discouraged from pursuing education.

Early marriage is one thing that is detrimental to female youth's education (Inoue et al., 2015). So are safety, hygiene and sanitation issues, together with cultural and economic barriers. We cite the UNESCO Global Education Monitoring Report 2020: "Despite the proclaimed target of universal upper secondary completion by 2030, hardly any poor rural young women complete secondary school in at least 20 countries, most of them in sub-Saharan Africa" (UNESCO, 2020, Persistence of exclusion).

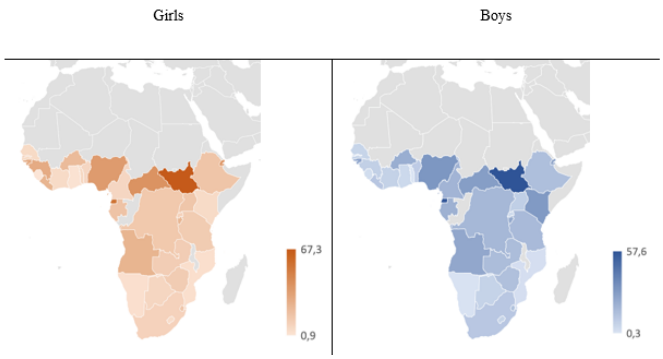

Figure 1. Out-of-school rates for girls and boys of primary school age (%). Note. The year of estimate varies from 2010 to 2021. Data source: UNESCO Institute of Statistics.

A long way to go

Despite the successful efforts to enrol all children in school, mathematics education in SSA is not up to the standard hoped in the mathematics education community. The EFA initiative not only envisioned that all children would receive schooling but that this education would be of high quality. Since the focus up to 2015 was primarily on the quantitative access of children to school, and significant progress has been made here, the 2030 Agenda of the international community will additionally focus on the quality of education.

The key reason for the focus change has been that despite the increased number of children at school, the students' performance levels have been low, and there has been only slow, if almost non-existing, development. For many students, the years at school have not been rewarded as learning. To illustrate this challenge in education in SSA countries, Table 1 shows the percentage of school children who have not attained even the basic skill levels in mathematics in SSA countries with some comparison countries from around the world.

Table 1. Percentage of students who do not reach the minimum threshold of learning.

Country	2000	2005	2010	2015
Sub-Saharan Africa				
Benin		76		
Botswana	49	51	45	36
Burkina Faso		63		
Burundi	48		52	
Cameroon		55		
Chad		75	56	
Comoros			58	
Cote d'Ivoire		75	63	
Democratic Republic of Congo			50	
Eswatini	43	48		
Gabon		65		
Gambia	63			
Ghana		63	54	
Kenya	28	41		
Lesotho	87	65		
Liberia	62			
Madagascar	60	42		
Malawi	96	71		
Mali	95			
Mauritius	35	30	26	
Mozambique	34	60		
Namibia	97	66		
Senegal	65	68		
Seychelles	39	42		
South Africa	71	67	56	47
Tanzania	45	43		
Togo	71		61	
Uganda	58	61		
Zambia	92	72		
Zanzibar	66	62		
Zimbabwe		52		
Comparison countries				
Argentina	40	35	34	29
Brazil	56	42	37	37
Canada	4	4	4	4
Egypt		36	36	36
Germany	16	11	9	8
Indonesia	38	35	37	40
Iran	31	34	33	27

Note. The minimum threshold is defined as low performance in the International Assessments (see Altinok, Angrist, & Patrinos, 2018). Datasource: (Our World in Data, 2022). Colour coding, dark yellow = above 75%, light yellow, above 50%, green = below 25%.

The data in Table 1 is from the The World Bank (Our World in Data, 2015) dataset. They have built globally comparable achievement outcomes for 163 countries and regions from 1965-2015 (Altinok et al., 2018). The estimates were constructed by linking standardised, psychometrically-robust international and regional achievement tests. Based on this data, we also calculated an average score for countries from the available data from the years 2000-2015 (Figure 2). In this analysis, twenty-seven out of the thirty lowest performing countries came from SSA. Only Botswana, Kenya and Mauritius reached the Latin American level. However, there seems to be a slow but systematic trend of improvement in learning outcomes. How severely pandemic affected this development in SSA, is still waiting for future analyses.

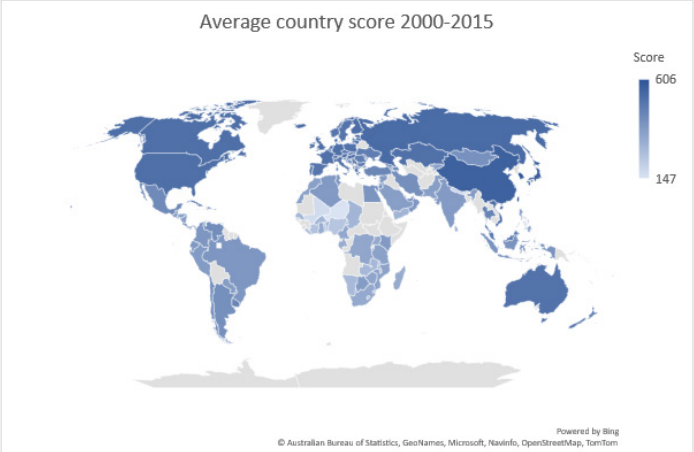

Figure 2. Average mathematics country score calculated from 2000-2015 assessments in 140 countries. Note: The scores from different assessments were transformed to the PISA scale (Mean 500, SD 100). Data source: (The World Bank, 2022b). See Appendix 1 for calculated values.

For some countries, the level of improvement in average scores may be underestimated. Learning outcomes can be expected to decline as the country approaches universal participation. It is because education systems must reach previously excluded and inherently disadvantaged populations where the education provision may be more difficult. Likewise, building quality education in extremely rural areas and circumstances is more demanding. Excluded populations may be poorer or marginalised, and these characteristics are, as known, important determinants of learning outcomes. It will take time for systems to adjust and provide quality education to more disadvantaged students (UIS, 2019).

For similar reasons, these numbers are overestimated for countries with high out-of-school rates. The international and local assessments are typically conducted at schools, not at homes. Conducting home-based surveys with representative samples is very expensive. Likewise, building measures that would reliably capture the thinking abilities of out-of-school youth might require different types of questions and tasks compared to those measures applicable to school children.

The challenge of teacher education

Modern societies depend on education. Societies and the labour markets favour those with higher education. The almost 90 million out-of-school youth, who comprise nearly half of all youth in Sub-Saharan Africa, will present a challenge for the development of the societies when they enter the labour market during the next decade. It has been estimated that another 40 million more youth will drop out and face an uncertain future without proper work and life skills required in the modern, technology- and automatization-driven societies.

However, at the heart of the solution for the educational challenge is high-quality teacher education supported by realistic mathematics curriculums combined with systematic and research-inspired educational methods. To reach the 2030 Education for All goals, an additional 15 million teachers are needed in SSA countries to offer schooling for the increasing number of pupils (ITFTE, 2021). High-quality teachers could create a snowball effect. Good basic education will produce workers with good skills for the labour markets as well as better teachers, and parents who value education and can support their children's academic development.

Political, economic and social stability is required for societies to invest in educational development. However, there are huge risks on the horizon that threaten this stability. For example, the effects of climate change will contest the stability in most of the countries. Therefore, a collaboration between the SSA countries and the global community is needed, not only in education but in all aspects of development.

Research is one of the activities that cross borders. Each new study published offers lessons for others to learn. One of the lessons we learned during this process of collating this special issue, was that there is a minimal number of over-the-borders studies done in SSA. When there is multicultural collaboration, they tend to be global-North-South projects. Cross-cultural studies within SSA are needed to understand better the mechanisms of learning because learning always happens in a particular environment and under certain circumstances. Even though the cognitive mechanisms of learning are the same in every person.

We hope this special issue will inspire more researchers to collaborate across borders to produce open-science and open-access-based publications on teaching and learning mathematics. Researchers, teachers, students and policymakers in the SSA countries need access to the research results. Publications presented behind the paywalls of journals are practically publications undone for most scholars and especially students in SSA universities. Therefore, we thank all our authors and the publisher for producing this open-access publication.

References

Altinok, N., Angrist, N., & Patrinos, H. A. (2018). Global data set on education quality (1965-2015). *World Bank Policy Research Working Paper,* (8314), 1-16.

Fritz, A., Haase, V. G., & Räsänen, P. (2019). *International handbook of mathematical learning difficulties. From the laboratory to the classroom*. Springer.

Haase, V. G., Fritz, A., & Räsänen, P. (2020). Research on numerical cognition in Latin American countries (Investigación sobre cognición numérica en países latinoamericanos). *Studies in Psychology, 41*(2), 217-244.

Inoue, K., di Gropello, E., Taylor, Y. S., & Gresham, J. (2015). *Out-of-school youth in Sub-Saharan Africa: A policy perspective. Directions in development - human development*. World Bank. https://openknowledge.worldbank.org/handle/10986/21554

International Task Force on Teachers for Education 2030, ITFTE. (2021). *Closing the gap. Ensuring there are enough qualified and supported teachers in Sub-Saharan Africa*. https://teachertaskforce.org/knowledge-hub/closing-gap-ensuring-there-are-enough-qualified-and-supported-teachers-Sub-saharan

Our World in Data. (2015). *Average harmonised learning outcome score*. https://ourworldindata.org/grapher/average-harmonized-learning-outcome-scores?tab=table&time=2015

Our World in Data. (2022). *Research and data to make progress against the world's largest problems*. https://ourworldindata.org/

The World Bank. (2022a). *Sub-Saharan Africa*. https://data.worldbank.org/country/ZG

The World Bank. (2022b). *World bank open data*. https://data.worldbank.org/

UNESCO Institute of Statistics, UIS. (2018). One in five children, adolescents and youth is out of school. *Fact Sheet No. 48* (February), UIS/FS/2018/ED/48. http://uis.unesco.org/sites/default/files/documents/fs48-one-five-children-adolescents-youth-out-school-2018-en.pdf

UNESCO Institute of Statistics, UIS (2019). Combining data on out-of-school children, completion and learning to offer a more comprehensive view on SDG 4. *UIS Information Paper No 61*.

UNESCO. (2020). Inclusion and education: All means all. *Global Education Monitoring (GEM) Report 2020*. https://reliefweb.int/report/world/global-education-monitoring-report-2020-inclusion-and-education-all-means-all

UNICEF. (2021). *40 per cent of children in Eastern and Southern Africa are not in school*. https://www.unicef.org/esa/press-releases/40-cent-children-eastern-and-southern-africa-are-not-school

van der Berg, S., Hoadley, U., Galant, J., van Wyk, C., & Böhmer, B. (2022). *Learning losses from Covid-19 in the Western Cape: Evidence from systemic tests.* Research on Socio-economic Policy (Resep), Stellenbosch University February 2022.

Appendix

Appendix A: An average mathematics country score calculated from 2000-2015 assessments in 140.

Country	Score
Albania	410
Algeria	383
Argentina	415
Armenia	476
Australia	508
Austria	520
Azerbaijan	478
Bahrain	424
Belgium	533
Benin	279
Bosnia and Herzegovina	461
Botswana	375
Brazil	393
Bulgaria	479
Burkina Faso	297
Burundi	335
Cameroon	337
Canada	519
Chad	294
Chile	416
China	565
Colombia	393
Comoros	297
Costa Rica	431
Cote d'Ivoire	254
Croatia	475
Cuba	508
Cyprus	500
Czechia	511
Democratic Republic of Congo	340
Denmark	530
Dominican Republic	334
Ecuador	387
Egypt	399
El Salvador	364
England	518
Estonia	538
Eswatini	350
Finland	525
France	514
Gabon	325
Gambia	267
Georgia	442
Germany	519
Ghana	323
Greece	487
Guatemala	373
Honduras	364
Hong Kong	590
Hungary	521
Iceland	526
India	379
Indonesia	401
Iran	414
Ireland	525
Israel	498
Italy	500
Japan	577
Jordan	423
Kazakhstan	515
Kenya	380
Kuwait	357
Kyrgyzstan	358
Lesotho	291
Liberia	274
Liechtenstein	543
Lithuania	510
Luxembourg	497
Macao	553
Madagascar	326
Malawi	280
Malaysia	484
Mali	171
Malta	494
Mauritius	416
Mexico	431
Moldova	452
Mongolia	409
Montenegro	430
Morocco	362
Mozambique	355
Namibia	278
Nepal	190
Netherlands	532
New Zealand	488
Nicaragua	363
Niger	147
Nigeria	241
North Macedonia	425
Northern Ireland	559
Norway	498
Oman	389
Pakistan	368
Palestine	393
Panama	367
Paraguay	370
Peru	378
Philippines	364
Poland	508
Portugal	501
Puerto Rico	396
Qatar	384
Romania	470
Russia	533

Saudi Arabia	368
Scotland	488
Senegal	291
Serbia	494
Seychelles	370
Singapore	606
Slovakia	500
Slovenia	507
South Africa	332
South Korea	599
Spain	498
Sri Lanka	292
Sweden	503
Switzerland	548
Syria	381
Taiwan	583
Tanzania	357
Thailand	451
Togo	279
Trinidad and Tobago	437
Tunisia	388
Turkey	446
Uganda	330
Ukraine	473
United Arab Emirates	447
United Kingdom	521
United States	520
Uruguay	451
Venezuela	423
Vietnam	520
Yemen	297

Sweden	503
Switzerland	548
Syria	381
Taiwan	583
Tanzania	357
Thailand	451
Togo	279
Trinidad and Tobago	437
Tunisia	388
Turkey	446
Uganda	330
Ukraine	473
United Arab Emirates	447
United Kingdom	521
United States	520
Uruguay	451
Venezuela	423
Vietnam	520
Yemen	297
Zambia	284
Zanzibar	316
Zimbabwe	343