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IFIP was founded in 1960 under the auspices of UNESCO, following the first World Computer Congress held in Paris the previous year. A federation for societies working in information processing, IFIP's aim is two-fold: to support information processing in the countries of its members and to encourage technology transfer to developing nations. As its mission statement clearly states:

IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

Publications arising from IFIP events vary. The papers presented at the IFIP World Computer Congress and at open conferences are published as conference proceedings, while the results of the working conferences are often published as collections of selected and edited papers.

IFIP distinguishes three types of institutional membership: Country Representative Members, Members at Large, and Associate Members. The type of organization that can apply for membership is a wide variety and includes national or international societies of individual computer scientists/ICT professionals, associations or federations of such societies, government institutions/government related organizations, national or international research institutes or consortia, universities, academies of sciences, companies, national or international associations or federations of companies.

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Arthur Tatnall · Nicholas Mavengere (Eds.)

Sustainable ICT, Education and Learning

IFIP WG 3.4 International Conference, SUZA 2019
Zanzibar, Tanzania, April 25–27, 2019
Revised Selected Papers

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Preface

The chapters of this book are drawn from papers presented at an International Federation for Information Processing (IFIP) working conference in April 2019, which aimed to address sustainability issues in ICT, education, and learning. The conference was held at the State University of Zanzibar (SUZA) and run by IFIP Working Group 3.4 (Professional and Vocational Education) in collaboration with other TC3 working groups. The conference sought to promote and encourage discussion on different facets of ICT education and learning initiatives: their promise, potential, and challenge for sustainable development, especially in the Global South.

All papers submitted for the conference were peer reviewed before being accepted for presentation in Zanzibar. Of these, a further selection was made after the conference for publication in this book, and those selected were again reviewed after the authors had the opportunity to make improvements following feedback discussions at the conference.

The Sustainable ICT Education and Learning conference aimed, guided by the WCCE 2017 conference declaration for development of ICT, education and learning in the developing countries context, to:

- Focus on new pedagogical opportunities offered by mobile learning applications and their adoption in the education field
- Consider infrastructure challenges, neither as a matter of funding nor as a technocratic approach, but with school administrators and parents being included in developing creative support and maintenance as part of a wider holistic approach to development
- Foster co-operation with countries with a high degree of ICT development in education in sharing their experience in IT skills and usage in the educational domain
- Foster best-practice approaches implemented when using digital technologies to enhance learning in multicultural environments in developing countries

Previous efforts in the context of sustainable development, ICT and education include a Symposium at SaITE 2016 Guimarães, Portugal, and WCCE 2017 Dublin workshop/symposium with input by Kenyan and South African presentations. This led to this conference in Zanzibar bringing together academics, postgraduate students, lecturers, researchers, NGOs, and practitioners such as teachers, experts in learning technology, planners, and consultants. The SUZA community atmosphere enabled the sharing of academic and research experience on conference themes such as:

- Peer and collaborative learning in informatics
- Pedagogical approaches to teaching specific informatics courses
- Case studies of workplace learning related to information systems
- Case studies of e-learning
- ICTs for development

- Mobile solutions in learning in the North and South
- Lifelong learning
- Applications for disabled students
- Traversal skills and computational thinking
- Teacher education in the Global South

The working conference gathered about 40 participants from different continents, and had a strong local representation from East Africa. It included 28 session paper presentations, a keynote and demonstrations from the State University of Zanzibar. The keynote by Mr. Aape Pohjavirta from Funzi, a mobile learning company based in Finland, stressed the importance of applying light-weight, relatively low-tech solutions for e-learning in the Global South. Mobile solutions are able to reach students even in poor and remote areas. Many of the papers also dealt with issues of e-learning and ICTs in developing country settings, allowing participants to exchange views on challenges of deficient infrastructure and funds. In addition to educational technologies, many papers introduced pedagogical solutions and innovations both in developed and developing countries. The first two conference days were held in the Seacliff Resort and Spa outside Zanzibar City, and on Saturday the State University invited participants to their premises where they were shown the laboratories for e-learning and video recording and the drone lab. Moreover, the hospitality students prepared and served delicious spice tea and a sumptuous lunch. Participants were taken for a walk in the historic Stone Town after the lunch.

One of the dimensions in discussing sustainability is how educational systems and learning of work life and entrepreneurship knowledge are represented in university curricula. The article by Taajamaa, Nkonoki, Järvi, and Hooli gives a Tanzanian example of entrepreneurial education innovation in four universities and how it can be aligned into a natural sciences curriculum. At the same time we have the challenge of institutional capacity building in the developing countries. Efforts to make changes, not just with funding but also in building knowledge and capabilities through international collaboration is discussed by El Nabahany, Mosbech, Mgeni, and Yunus. As a result, a digital learning center was launched at the State University of Zanzibar to promote the transformation of education and learning. Carvalho argues that flipped learning and mobile games increase student motivation based on a three-stage case study. Gabi and Mavengere describe the value of the transition from paper-based portfolios to e-portfolios in order to maintain and foster student learning. Andresen describes how certification of e-learning programs in vocational education has been introduced in Denmark. This provides a best practice opportunity for both developed and developing countries to adopt.

Unprivileged and in other ways disabled young adults with learning difficulties need special approaches. One of them is introduced by Mead, Williams, and Mead and is an application of computer-generated music files in teaching. In addition, Bottino, Chiocciariello, Feina, and Travella describe the potential of an important emerging and provoking opportunity – using digital games in primary schools for developing long-lasting transversal skills such as logical reasoning, creativity, and computational thinking. Innovation, creativity, and computational thinking skills are addressed by Reffay and Viroonluecha, who look for future challenges in 21st century skills

building. Tatnall looks at the educational and developmental efforts from the perspective of actor-network theory, one of the respected research lenses in information systems science and education. He also raises the topic of learning objects in the time of Internet of Things.

Japanese researchers Hagiya, Fukuda, Tanabe, and Saito have developed a system to automatically generate questions for university entrance examinations which can also be applied to e-learning systems. Another example of boosting programming learning is introduced by Kloos and his colleagues Alario-Hoyos, Munõz-Merino, Catalan Aguirre, and Gonzales Castro, namely, voice assistance in Java programming in the context of massive open online courses. Voice-based applications are growing in importance and lowering many learning challenges. Learning at workplaces and in organizations – workplace learning, lifelong learning, and other more adult-oriented approaches also need research. Kromidha introduces an interesting case study from Albania about implementing electronic registers in the public sector. This poses an institutional learning challenge.

Teacher education and use of ICT are discussed by El Nabahany and Juma, especially in a Zanzibari context. Virtual courses have been introduced as an opportunity for collaboration between developed and developing countries, and Mavengere and Ruohonen describe the results of an evaluation of using virtual Moodle-based approaches within a multi-university context. More experiences of using emerging applications, such as Kio-Kit digital contents toolbox in STEM education in a regional setting, come from Ahmada, Abdulla, Yunus, and Ismail. Pondiwa and Phiri review experiences of using social media records in learning institutions in Zimbabwe. Osorio and Nieves make an interesting comparison and present an idea-provoking discussion of vocational education arrangements between Northern and Southern Global countries. Educational technology, such as mobile learning, should have an impact outside of schools, too. Romeike offers a big and perhaps fuzzy picture of digital society development, called digitalization, and argues that the driving force behind this is computer science and ICT education.

Web 2.0 technology has provided many opportunities to developing countries as well. A Zanzibari example of using global social media platforms is presented by Yunus, El Nabahany, Abdulla, Ahmada, and Malliga. Holvikivi argues that the increasing visualization in Internet and mobile applications will dramatically change the ways of learning and languages of education, in particularly in the Global South. An interesting country example of using ICT in schools comes from Chile. Toro has investigated the change process, drivers, and burdens in the region of the Mapuche, Chile. Gioko and Waga present survey research from Kenya on how to develop digital literacy for a competency-based curriculum. They conclude that despite major IT device advances, there is still a relatively low implementation of digital literacy. One of the visionary memorandums with technological examples comes from Burgos, who addresses his concept of “transgenic learning,” something that enables you to learn through new emerging technological means both inside and outside of the classroom over your whole life. One of these new opportunities is open educational resources (OER), which is discussed again from a Tanzanian-Zanzibari perspective by Ismail, Mgeni, Yunus, Abdulla, and Ahmada. Virtual reality (VR) is a new opportunity in the emerging world of educational technology. Rötökönen, Najmul Islam, and Sutinen have

launched a teaching arrangement, through VR technology, between two schools in Bangladesh and Finland. Based on their work, their aim is to enlarge their network of VR-based teaching in the future. And finally Yakubu, Kah, and Dasuki raise an important topic for diffusion of educational technology and present experiences and results from Nigeria about the acceptance of learning management systems.

We hope you enjoy this book and find it informative.

July 2019

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