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In this day and age, climate change, biodiversity loss, resource depletion, armed conflicts, violence, authoritarian rule, lack of political participation, and growing inequality, are just a few aspects of unsustainable development. To address these Grand Challenges, societies have to undergo substantial transformations. The Sustainable Development Goals (SDGs) are an attempt by the United Nations to define appropriate goals and targets to be reached by 2030, to ensure quality of life for all, now and in the future. Whether or to what extent these goals will be reached will depend in part on how successfully education strategies will empower learners of all ages with the knowledge, skills, attitudes, and, perhaps most importantly of all, values to transform themselves, their communities, and their societies. Educational institutions have critical roles to play in facilitating and supporting the necessary transitions. To fulfill this vision and be truly transformational, however, education and educational institutions themselves will have to undergo profound change. Education for Sustainable Development can play an essential role in achieving necessary processes and outcomes.

In order for Education for Sustainable Development to realize its potential, it must engage with a range of current societal challenges. This is most definitely the case in light of the growing role of digitization and associated widespread adoption of new media. The latter permeates virtually all aspects of our lives, from the individual through to societal levels and is already bringing about fundamental changes. The global climate protests by predominantly young adolescents, driven by digital networking to demand implementation of the Paris agreement, make it clear that youth are ready to take on the challenges associated with sustainable development. This trend illustrates how the transformation toward a sustainable society must take into account developments associated with digitization and in particular, new forms of communication. Importantly, digitization cannot be adopted and accepted as purely being a technological process. Rather, digitization is actively shaped by individual and societal actions, including powerful interests. The SDGs, the biodiversity initiative and Paris agreement are interconnected by political, societal and economic actions. The question therefore arises as to how to shape digitization and the use of new media in ways that result in positive rather than negative contributions toward these goals. There can be no doubt that educational processes will be required at different levels and in a range of settings to ensure learners master the competencies they will need in order to navigate these complexities. Against this backdrop, Education for Sustainable Development offers guidance on how to manage digitization and use new media within the broader context of education including what content to include and which pedagogies to use to advance systems thinking and collective knowledge creation and application.

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Since digitization and the use of new media are strongly driven by a range of powerful profit motives, critical reflection about their possible applications and scientific debate about unanticipated consequences often fall short. Automated algorithms developed by private providers, which are not transparent and therefore elude societal deliberation and democratic political legitimation, influence the content of digital media and play major roles in shaping public opinion. In addition, the growing dominance of a small number of powerful new media providers (e.g., Meta with Whatsapp, Facebook, Instagram, and Messenger) increases the potential for abuse and shaping of public opinion in ways that do not benefit society at large.

It must also be highlighted that digitalization and new media are already and will continue to shape the transformation of education systems globally. The COVID-19 pandemic has demonstrated that massive digitalization in education is possible. Although much remains to be learned about its effects on learning and societal outcomes, home schooling and distance learning have illustrated that formal education does not necessarily have to be restricted to traditional classrooms, and that learners can learn from and with each other across geographical distances. Furthermore, digitalization seems to hold the potential to support self-regulated, situated, and informal learning, which fundamentally changes the way individuals can access, process, and use information, ultimately changing the way individuals think and act. Digitization offers opportunities, particularly in the area of communication and the management of ever larger bodies of knowledge, by enabling new forms of interaction and inspiring creativity for societal transformation. It provides opportunities to make educational processes more collaborative and supports learning independent of time and place. Realizing the positive potential of digitization, however, will need fundamental changes to our education systems.

One question that must be addressed is to what extent the potential of digitalization and new media is actually unlocked in learning settings. Associated processes, resources and tools are only likely to make valuable contributions to empower individuals to actively shape the process of transformation toward sustainability, if teachers and students have acquired the competencies to link digitalization and Education for Sustainable Development. Moreover, the processes on which digitalization and the use of new media depend can have many negative consequences and unanticipated effects. Concerns include, for example, the energy used to produce and store digital content and to power digital devices as well as the risk of spreading distortion and fake news. Additional troubling aspects are the gaps between those who have access to digital infrastructures and the skills to use these effectively and mindfully –and- those who are denied access to them and experience reduced meaningful physical social interactions.

As already suggested, digitization and the use of new media involve many social as well as ecological, economic, legal, political, and educational challenges that will need to be addressed. Within the context of education, differences in living and learning conditions and the associated (lack of) access to digital resources and networks can reinforce educational inequalities. Moreover, data privacy concerns raise questions about the use of learning and communication platforms within the context of protecting learners' fundamental and personal rights. Children and young people may be at particular high risk as a result of uncontrolled use of digital media. The production and operation of information technologies also prove problematic. Both aspects require a lot of energy and as such, represent a considerable burden on the climate. Electronic devices contain precious metals and other valuable non-renewable resources. The extraction of these resources will need to be assessed critically from both a social and ecological perspective, especially if only a small proportion of these can be reused, recycled, or repurposed.

If Education for Sustainable Development is to be successful, these aspects of digitization and its negative societal impacts must be taken into account. There will have to be a willingness to accept the necessity for fundamental changes in education and a commitment to developing, implementing, and evaluating new strategies. Development is sustainable when all individuals from across the world, both in the present and in the future, can live with dignity, meet their needs, and develop their talents while respecting planetary boundaries. Through Education for Sustainable Development individuals can be empowered to understand the impact of their own actions on the world and to make more responsible, sustainable choices. Such a societal transformation requires strong institutions, participatory decision-making and conflict resolution, knowledge, technologies, as well as new patterns of thinking and acting.

Education for Sustainable Development aims to enable individuals to master the competencies they need to think and act in ways that will ensure a sustainable future. Education for Sustainable Development is a holistic and transformative educational approach that focuses on content and learning outcomes as well as learning process and environments. Teaching and learning for sustainability development takes place interactively, and enables inquiry-based, action-oriented as well as transformative learning. It is not only about addressing sustainability issues, but also about using participatory methods to promote critical and networked thinking as well as the skills to work toward solutions in teams. Education for Sustainable Development also aims to help learners develop worldviews that makes it possible for them to recognize themselves as global citizens. Local actions are seen as contributing to global sustainable development.

Networking in the digital world has the potential to generate and bring together knowledge from across the world to allow individuals to interact more easily with others and to develop solutions collectively. When digital competencies are strengthened through educational processes, they can support individuals' decision making and action competence with regard to sustainable development. Digitization can also be used to make it easier for youth as well as adults to participate in sustainable development through opportunities that support learning along with civic engagement.

Education and learning within the contexts of both sustainable development and digitization can also be examined from the perspective of data literacy education. Data literacy has the primary goal of addressing and solving real-world problems in ways that take ethical and contextual considerations into account. Without going into them in greater detail, the competency models underlying these concepts, with the exception of application-related competencies, enable the development of critical attitudes based on these ethical and contextual considerations. Such critical examination of one's attitudes and values, as part of Education for Sustainable Development, leads to reflecting on one's own behaviors in terms of "ethically justifiable action" against the backdrop of guiding sustainability principles. Data literacy tends to look at questions surrounding information and data procurement and evaluation. Taking into account ethical and context-related considerations when exploring these questions, can subsequently improve decision-making processes. One of the main desired competencies is to be able to reflect on which values can, and should, guide data-driven decisions and actions.

Education for Sustainable Development is about finding solutions to the most complex societal challenges of our time. Data literacy can support such educational processes, in part by enabling learners to draw on competencies that facilitate their ability to critically apply (technological) opportunities - as well as providing, analyzing, and interpreting data and information. Education for Sustainable Development with its key competencies emphasizes the links between the current state of affairs and desired future targets, and explores potential pathways to facilitate the transition between the two. The resulting deeper understanding of evidence-based processes and decision-making, in turn, contributes to more informed

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questions and discussions surrounding sustainability challenges in a digitalized world. It offers the opportunity to develop and test potential concrete contributions for shaping a more sustainable future.

Against the background of the necessity of transformation toward sustainability and the certainty that the process of digitization cannot be reversed or stopped, education faces the challenge to develop effective learning settings which, on the one hand, make the most of new possibilities, and on the other, minimize associated risks. The individual contributions in this book examine different aspects of digitization and new media within the context of Education for Sustainable Development. They come from authors from countries in different regions of the world, informed by a range of perspectives derived from diverse settings and conditions.

In “Theoretical reflections on Education for Sustainable Development and Digital technologies,” Ute Stoltenberg and Gerd Michelsen provide an overview of the diverse relationships between digitization and Education for Sustainable Development. They explain that the starting point of all considerations must be the focus of educational processes on the goal of social transformation toward sustainable development. In this paper, based on this concept of education they show both the potential and the limitations of the use of digital technologies for the design of educational processes and discuss the role of data literacy in this context.

Kate Maloney Williams and Jehad Halawani’s “The Impact of Biased Design and Hegemony on Sustainable Future-Ready Learning: Digital Transformation Challenges” draws attention to defining and measuring the goal of ‘Quality Education’, particularly in the face of an increasingly digitized future, fueled by emergencies and the need for quality distance learning. In order to achieve SDG 4 in a digital era, they claim that societies must undergo substantial reforms in conceptualizing teaching, learning, and assessment as well as designing and exporting technology. The authors argue that effective technology-based interventions must include awareness of the externalities that impact digital design, providing examples from the Global South.

In “The Role of Geography Education in Sustainability in a Digital Age,” Inga Gryl looks at current everyday life, where (non-)sustainability and digitalization are closely linked to each other, including societal issues beyond technology and ecology. For instance, digitalization may be a key to solve certain sustainability problems and is the source for challenges to sustainability at the same time. Geography education has both strong links with an education for digitalization and with Education for Sustainable Development. Therefore, it is an ideal learning environment in which to teach the complexity of the links between both fields, and the necessity of thinking about them together in tandem.

Maxim Shatkin explores both the risks of the platform society to sustainability and how education for sustainability can address these risks in his chapter “Education for Sustainable Development and the Platform Society.” The platform society, building on algorithms, bots, and AI, maintains the kind of content that can stimulate user engagement, yet is often related to the polarization of society, the deepening of political conflicts and the diffusion of biased opinions. The response of Education for Sustainable Development could include the widespread use in teaching of triple bottom line, meta-analysis of social media information, elaboration of transition scenarios between different futures, and the nurturing of ecological solidarity.

Ilja Steffelbauer and others look at “Complexity Literacy for a Sustainable Digital Transition: Cases and Arguments From Transdisciplinary Education Programs.” Educational measures, they claim, should go far beyond traditional educational means and require the integration of systems thinking, complexity understanding, knowledge integration across disciplines and between science and practice together with

supporting communication patterns and strategies. Complexity literacy as a core component of sustainability literacy thus becomes indispensable in any educational program that aims to enable students to actively shape the process of digital transition.

In “Digital Literacy Among Teacher Educators in Ethiopia: Implications to the Achievement of SDG4 and (Education for) Sustainable Development,” Aklilu Dalelo, Anteneh Gebremariam, and Kedir Gebi provide interesting insights. The findings of a questionnaire indicate that teacher educators demonstrate marked strengths in certain domains of competence, and have serious limitations in others. With regard to factors that affect the utilization of digital technologies, teacher educators identify the lack of facilities supporting resources, and training as being the most decisive. The chapter ends by making recommendations based on the findings of the study.

Kanako N. Kusanagi examines in “Holistic Learning and Education for Sustainable Development: Building a Virtual Community of Engaged and Responsible Learners by Tokkatsu” the implementation of holistic learning in virtual space and presents it as a humanistic approach to ensure students’ democratic participation in online and distance learning. While Education for Sustainable Development envisions active and engaged learners, students struggled to engage in online and distance learning during the COVID-19 pandemic. This chapter examines the holistic learning curriculum, Tokkatsu – which originated in Japan – and discusses its prospect for nurturing responsible and active learners.

Anton Rahmadi et al. examine the “COVID-19 Impacts on the Traditional Indonesian Community Market: The Global Pursuit of SDGs and Outcome-Based Higher Education in a Multi-Stakeholder Matching Program.” This is carried out in the context of the SDGs and the integration of the Tridharma, with a particular focus on learning processes among the students involved. The authors can show that a multi-stakeholder matching program in terms of outcome-based education for higher education is a suitable approach to address the SDGs in the context.

In “Enabling Education for Sustainable Development Through Digital Storytelling,” Vassilios Makrakis and Nelly Kostoulas-Makrakis discuss digital storytelling as a tool and as a teaching and learning methodology. They show that the interaction between digital technology and Education for Sustainable Development can create new opportunities to address sustainability issues. The teachers who were trained in an international project produced digital storytelling applications that can be categorized as authentic learning activities addressing issues in the real world.

Khalida Nasreen and Muhammad Tanveer Afzal embrace “Linking Culture, Pedagogy, and Digitalization for Education and Sustainable Development in Tribal Areas: A Perspective From Pakistan.” Teachers and parents from primary schools in tribal areas in Pakistan were interviewed for this study, and data was also collected via observational technique in the participating schools. The authors suggest recommendations for the incorporation of Education for Sustainable Development goals in the single national curriculum, the development of teacher education programs, and the facilitation of electricity, computer technology, and internet access for all schools.

In “Updating the US K-12 Information Technology Curriculum,” Cristofer G. Slotteroff examines the increasing influence of algorithms that analyze personal user behavior on the content consumers are confronted with on the Internet. Since content from the Internet is used in more and more areas of life and even in childhood, Cristofer G. Slotteroff calls for increased support for modern information literacy in schools in order to raise awareness of this development and to enable a reflective handling of it. Only through a better understanding of these developments is it possible for a society to deal with the ethical and moral questions associated with these technological developments.

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Alexandra Budke gives “Guidelines for Teachers on the Use of Digital Games on SDG-Relevant Topics in Geography Classes” in her chapter. It not only describes the potential of such media to deal with complex social and socio-ecological topics, but also offers guidelines for assessing digital games with regard to their suitability for teaching. Therefore, this chapter has the potential to improve teachers’ competences in dealing with this medium and to incorporate it in a constructive and efficient manner.

In “Promoting Education for Sustainable Development Using Blended Learning and Digital Tools: Two University Courses – One Case Study,” Helga Mayr presents two interdisciplinary blended learning project-based Master’s courses. Both use the SDGs as a framework and design thinking as an approach, while one also uses digital tools beyond the digital media necessary for collaboration. The students’ reflections on their learning processes are described, and the chapter concludes with considerations regarding the further potential developments of the course.

Marlene Kollmayer and Selma Korlat Ikanovic in their chapter “Digital Learning During COVID-19: An Intersectional Perspective on Secondary Students’ Motivation and Perceived Teacher Support” deal with the expectation that increasing digitization in the educational sector will bring decisive progress for the empowerment of individuals in terms of sustainable development. For their reasoning, the authors draw on a study that examines the effects of distance learning during the COVID-19 pandemics in connection with perceived teacher support. Their results show the importance of teachers and schools to specifically design digital learning environments in a way that all social groups can gain advantage.

Nicole Raschke, Lisa Wey, and Thomas Arendt in “Smart Energy Smart Schools: Project-Based Learning About Energy Transition and Digitalization” present a project dealing with energy in public school buildings. In this chapter, three different educational modules, the environmental measuring station, the history of light sources, and the planetarium are dealt with in more detail. They show a useful connection between Education for Sustainable Development and digitalization or digital media. Another focus is the evaluation of feedback from the participating students and teachers, and the opportunities and challenges that arose on an individual and institutional level during the implementation of the project.

In their chapter “Sustainability Online? Actors, Hierarchies, and Communication Patterns in Collaborative Development of Open Educational Resources,” Jana Dlouhá and others analyze the role of digital media in the context of processes, if different actors, including students, are involved in co-creating learning content. The question raised in this chapter is whether these changes in the “metabolism” of information could contribute to the transformations foreseen by Education for Sustainable Development, and how. The authors focus on open educational resources used in higher education, specifically wiki systems, and explore mutual relationships/ hierarchies of actors involved in its development.

Martin Dür and Lars Keller ask, “Will Social Media Replace Face-to-Face Interactions in International Collaboration Discussions?” Within the project AustrIndia-4QOL, teenagers from Austria and India jointly conducted research on the topics of quality of life and sustainability. While the collaboration was mainly carried out via social media, some of the teenagers took part in an additional one-week face-to-face collaboration. Examinations of the AustrIndia-4QOL project show that social media collaborations have their own limitations and that the total removal of the opportunity for live face-to-face interactions is questionable.

In conclusion, it can be said that the individual contributions differ greatly in their conception, methods, and design, as well as in their understandings and views of Education for Sustainable Development. Our aim is to reflect these unique diversities to feature associated strengths as well as a range of views from across the world, to give them a voice through this book. We have gained new, valuable, and surprising insights from the contributing chapters. We hope that you, the reader, will have the same meaningful experience.

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