



Orientation needed - ESD in a digital world

Discussion paper on mutually complementing
Education for Sustainable Development and
Digital Education at schools

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Context

In June 2017, the National Action Plan Education for Sustainable Development (NAP) was adopted as Germany's contribution for the UNESCO Global Action Programme on ESD. The NAP has the „goal of structurally embedding Education for Sustainable Development (ESD) within all areas of education“ (translated from the German: Nationale Plattform BNE, 2017, page 4). It aligns all educational activities towards the Sustainable Development principle which is open for design. Furthermore, regarding its goals and recommendations for action, it calls for the utilisation of the opportunities and the identification of the risks of digital applications in education. In chapter 2.3 „Use of digital media and media-related lifeworlds“, the Curriculum Framework Education for Sustainable Development (KMK/BMZ, 2016) focuses the development of curricula and learning processes on the link between digitalisation and ESD (KMK/BMZ, 2016, pages 68-74).

The present discussion paper „ESD in a digital world“ strives to continue this intention and to concretely implement it. Here, the guiding question is how the mutual complementation of ESD and Digital Education can be structured and organised.

The drafting of this discussion paper has been stimulated by the workshop „ESD and Digital Education“ during the Conference on the Curriculum Framework Education for Sustainable Development on September 04-05, 2017 Bad Honnef, Germany, and by the discussion that Dr. Michael Kaden had prompted there in order to implement and advance the Curriculum Framework Education for Sustainable Development through the proposed mutual complementation of Digital Education and ESD¹. The workshop participants² said that they would like to continue to work on these subjects beyond the conference in order to develop ideas for action concepts and steps for implementation. The workshop results are part of this paper.

In the following text, the discussion is segmented in five steps to arrive at concrete action: Education in times of digitalisation (1), Concepts of ESD and Digital Education (2), Revision and expansion of education goals (3), Potentials and concrete approaches (4) and Coordinated strategies in education planning (5).

The respective steps towards concrete implementation raise questions (a – f) to clarify the relationship between ESD and digitalisation in school education. These questions are not yet fully answered but stimuli offered to clarify the context and the issues that have been elaborated in the joint discussion of those who have contributed to the discussion paper. Its target is to stimulate a broad discussion³ in order to encourage the ongoing conceptual development and implementation.

¹ See the documentation of the 8th KMK/BMZ Conference on the Curriculum Framework Education for Sustainable Development: www.engagement-global.de/achte-kmk-bmz-fachtagung-zum-orientierungsrahmen.html [April 16, 2018].

² Among the workshop participants there were actors from politics, administration, sciences, civil society and schools with background knowledge on ESD and/or digitalisation. The imprint at the end of this document lists all those who have contributed to this paper.

³ See also the expertise of the „Aktionsrat Bildung“ (education action council) on „Digital sovereignty and education“ (vbw, 2018), which states that „society's education system should not allow digitalisation to ‚run off‘. Instead, we need a concept on the image/perception of man who accepts digitalisation in a constructive way and who participates in its design and also approaches it critically.“

Any comments, amendments, questions and proposals for implementation are highly welcome. They can further stimulate measures of the NAP in this context⁴.

Engagement Global coordinates this discussion in the context of the advancement of the Curriculum Framework Education for Sustainable Development.

The discussion paper shall also contribute to the discussions on the fundamental design of digitalisation, which have been stimulated by the German Advisory Council on Global Change (WBGU) with their call "Digitalisierung braucht dringend Gestaltung" (it is paramount to actively shape digitalisation) (WBGU, 2018) and by the Federal Government and the Federal States (BMBF, 2016) with the implementation of the DigitalPakt Schule (Digital Pact School).

⁴ Engagement Global organises the collection, summary and dissemination of all mailings to the editorial board; please send them to the following address: orientierungsrahmen@engagement-global.de.

Orientation needed - ESD in a digital world

Discussion Paper

1. Education in times of digitalisation

In the past decades, the globally increased use of digital technologies and of the internet has considerably changed the lives of people who regularly have access to digital devices and virtual worlds. The creation of new opportunities for digital communication and participation has dramatic influence on our ways of communication. These trends will continue to induce considerable changes and requirements on the personal, societal and professional levels of life (Industry 4.0, Internet of Things or IoT, automation of smart behaviour, Education 4.0 and much more). Since the beginning of the 21st century, the combination of digital technologies has led to even more comprehensive developments. By now, digital artefacts are omnipresent and most of them online generally accessible. Often they include invisible functions, which do not open up to those who have no (informatic) background knowledge.

On the one hand, digitalisation offers great chances to find solutions for global challenges and the potential to improve the access to knowledge and education. On the other hand, the processes of digitalisation confront us with tremendous challenges, for instance regarding the manipulation of facts and information and regarding informational self-determination or the legally secure handling of data and media. Democratic structures require self-determination and maturity as goals of education, as these structures are more and more affected by algorithmic analyses and automatic controls. In this context the question arises: How do we want to design digitalisation, and what should be its goals based on which values?

With its 17 Sustainable Development Goals (SDGs), the Agenda 2030 offers a reference framework that the world's nations have agreed to. Quality education, the acquisition of knowledge and qualifications to enhance Sustainable Development (SDG 4) are among its central objectives. To reach them, SDG 4.4 claims the development of basic informational and communication-technological capabilities. According to the WBGU discussion „It is paramount to actively shape digitalisation“ the following basic question arises:

a. What is quality education⁵ according to the Agenda 2030 in a digital world?

⁵ In September 2015, the UN General Assembly passed the Sustainable Development Goals (SDGs). SDG 4 says: „Ensure inclusive and equitable quality education for all and promote lifelong learning opportunities for all“.

2. Concepts of ESD and Digital Education

ESD⁶ is a comprehensive education concept that is targeted at the open guiding principle of Sustainable Development which has been stipulated as goal of the Agenda 2030. It is supported in formal education by active, student oriented forms of learning and directed towards acquiring competencies for the transformation towards a sustainable society. Digital Education⁷ meets the opportunities and challenges of the digital world in a comprehensive way, can be applied to the entire (school) education and includes areas like media education, computer sciences and IT education.

According to the Dagstuhl Declaration, digital education needs to be addressed from technological, socio-cultural and application oriented perspectives. Close links to ESD are particularly visible in the „socio-cultural perspective that investigates the interaction between the digital networked world with individuals and the society“ (Gesellschaft für Informatik, 2016, page 3)⁸. This means for schools: Both educational concepts, ESD and Digital Education, meet the current and forthcoming global challenges and their concepts have much in common. They are no autonomous school subjects and they are realised by being embedded in traditional subjects or cross-curricular projects and extra-curricular activities of a holistic concept of school. Common features can be seen in a number of competencies aimed at by both which gives rise to the following question:

b. Which competencies are particularly meaningful to quality school education for Sustainable Development in a digital world?

For learning processes at school it is essential to start early with the pupils'/students' preparation for their private and professional lives as well as for an active participation in society by means of flexibly applicable competencies. This means to focus not only on the multitude of particulate technological developments and the qualifications needed for their operation, but also on the goals of a self-determined participation of responsible citizens in society and on sustainable globalisation⁹. The strategy „Education in the digital world“ of the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK) has

⁶ Education for Sustainable Development (ESD) in this context includes numerous educational approaches with different foci like Environmental Education, Global Learning, Global Citizenship Education, Peace and Human Rights Education, Intercultural Education and others – as well as cultural contributions to Education for Sustainable Development.

⁷ Here, as in the Dagstuhl Declaration of the Gesellschaft für Informatik, Digital Education is a short form for saying „Education in the Digital Networked World“ and is also used as a (provisional) working term for communication in this context that is needed for the discussions.

⁸ The socio-cultural perspective needs to be viewed in interaction with the technological one (which challenges and evaluates the functions of systems in a digital networked world) as well as with the application oriented perspective (which is focused on the targeted selection of systems and their effective use for the implementation of individual and cooperative projects) (see Gesellschaft für Informatik, 2016, pages 3-4)

⁹ As an example, the 4C model outlines some required competencies for the learners of the 21st century: Critical thinking, communication, collaboration and creativity; see: National Education Association (2012): *Preparing 21st Century Students for a Global Society*. Online at: www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf [April 16, 2018]. The use of digital media and tools in the classroom should – together with the use of the media themselves – inspire the learners to proactively design their own ways of learning, to work creatively, alone and together with others, and to be able to share and communicate their learning with others. See (in German): Fadel, C. (2017). *Die vier Dimensionen der Bildung: Was Schülerinnen und Schüler im 21. Jahrhundert lernen müssen*. Hamburg: ZLL 21.

stipulated a competence framework (KMK, 2016), which is being implemented in the German federal states within the development of their curricula. This framework shows many common features and convergences with the education principles and competencies of ESD (KMK/BMZ, 2016, page 95). But there are also differences in emphases, for example regarding the focus on action towards the principle of Sustainable Development. There are common features with respect to KMK goal 2.5 „Active participation in society“ and with respect to most of the competencies in area 6 „Analyse and reflect“¹⁰. As a result of the workshop „ESD and Digital Education“ within the 8. KMK/BMZ Conference on the Curriculum Framework Education for Sustainable Development, it was emphasised that the ESD competencies „Reflecting on values“, „Changing perspectives“, „Thinking and acting inclusively“ are less accentuated in the KMK strategy „Education in the digital world“.

In the current trends of economy and society a basic understanding and competent handling of digital information and communication technologies and of digital information will be among the crucial key qualifications. Especially the ability to use digital media in order to initiate and shape sustainable processes in the field of digitalisation is among those qualifications. But it is also important to be able to identify unsustainable developments of digitalisation trends and to use digital media for decision-making as well as the ability to handle uncertainty. KMK's claim to „identify and formulate algorithmic structures in utilised digital tools“ (KMK, 2016, page 18) also expresses the need for critical reflection of automatic forecasts and decisions. It is crucial to understand and challenge the power structures that emerge from the algorithms, in order to enable personal and informational self-determination and to safeguard and shape the participation in a digital society (in the spirit of democratic values).

Given a development driven by digitalisation, with access to huge amounts of data and information with all their processing options, a professional and ethical orientation is needed in order to find sustainable solutions – in the spirit of the open guiding principle of Sustainable Development – for individual decisions and developments in society.

Digital applications can strongly promote competencies in sustainability issues. Here, the point is not to focus on analogue and digital learning processes as different ways, but to „interconnect digital and analogue aspects“ (Baecker, 2017; Kerres, 2018).

¹⁰ On other convergences see Michal Kaden's compilation in „Den Tiger reiten?“, published in the documentation of the 8th KMK/BMZ Conference on the Curriculum Framework Education for Sustainable Development: www.engagement-global.de/achte-kmk-bmz-fachtagung-zum-orientierungsrahmen.html [April 16, 2018].

3. Revision and expansion of education goals

The KMK strategy „Education in the digital world“ states that, facing the „digitalisation of our world (...) the goals of education need to be reflected and expanded “ (KMK, 2016, page 8). This call is a chance for the concern discussed in this paper; it raises the question:

c. How can we shape the expansion of fundamental and subject-specific goals of education as suggested by the KMK, given the complementarity of ESD and Digital Education?

The expansion of educational goals addresses the right to informational self-determination, but also the alignment towards a transformation of society and shared global responsibility in the spirit of Sustainable Development for everyone. Contemporary education goals have to pursue far-reaching targets of self-determined participation by responsible citizens in society as well as towards a sustainable globalisation. Educational goals manifest in the selection of issues, in the design of the learning process and most of all in developing competencies.

Media education has contributed to similarities between ESD and Digital Education with regards to their respective methodological concepts. Especially the processes of teaching and learning require common stimuli from ESD and Digital Education for the advancement of an education focused on competencies. Even though both concepts do respond to the different challenges of a rapidly changing complex society to education, they offer significant potentials for mutual support.

If we regard Digital Education as exclusively application-based qualification, the effect may be that knowledge is only reproduced but not comprehended and challenged. We need to strengthen the ability to scrutinise critically and profoundly. This includes being ready for unprejudiced and dedicated participation in the debate about global challenges like the search for a sustainable economy which is not purely based on growth as a solution of social problems (Raworth, 2018).

Apart from addressing the respective problems, it is necessary for students to have a basic understanding of digital systems and processes, in order to find appropriate positions at school for meeting linked personal, local, national, European and global challenges. With its phenomena and systems, the digital networked world has an impact on students lifeworlds, and indirectly on school lessons. School subjects will have to look at the manifestations of digitalisation from different perspectives, in order to fulfil their educational mandate and to shape ESD in a digital world.

So students need to be as capable as possible to analyse the opportunities and risks of digital systems for individuals, society and environment. In order to draw conclusions for a Sustainable Development, an understanding of algorithms, data and software as technical artefacts is needed that human beings have designed intentionally. The ability to evaluate

these algorithms and, if possible, to participate in designing them, is a crucial qualification for leading a life of informational self-determination in a digitally networked world. The competent application of existing systems can facilitate certain processes of learning and working. It can initiate processes of reflection on the complex interaction with a focus on society, environment, individuals and the right to privacy.

4. Potentials and concrete approaches

As ESD is about understanding complex relationships, with the focus on attitudes and on participation and as Digital Education cares for the competent, responsible and creative use of technical applications, both these educational approaches have the potential to complement each other.

There are already plenty of positive experiences of the support and effective enhancement of learning processes by means of digital tools and applications (see Attachment 2). Among others they refer to data research and application and to the support of cognitive processes (f.e. by visualisations, simulations and animations), to the communication with different groups, also in the Global South, to the culture of feedback and to the efficiency and effectiveness of learning processes in various subjects. The selection of digital tools and applications within ESD can be guided by the following question:

d. What is the additional benefit of using digital learning concepts and applications with regard to the desired competence orientation within ESD?

Already today there seem to be unlimited opportunities to make reasonable use of digital media in Education for Sustainable Development. Whether or not the use of these media is successful from a pedagogical point of view does not only depend on the digital learning environment and on the teachers technological skills. Another significant factor is the combination of thematic contents and learning methods that is well concerted with the learner group. ESD has particularly high requirements regarding this factor, because it goes beyond the acquisition of knowledge and is targeted at the development of competencies, a focus on action and participation in society.

Some encouraging best practice examples have been published, but they should not blur the awareness that there is an amazing continuity regarding the practices of teaching and learning at school and that the mere use of digital technology – without pedagogical embedding – will not generate significant changes of the learning performance that is measured with cognitive benchmark tests (Kerres, 2018). But a positive development of the learning performances is possible, if educational goals are revised and adapted and if ESD and Digital Education supplement each other. This significantly depends on the education actors to initiate a change in the culture of learning.

5. Coordinated strategies in education planning

Given the potentials of coordinated pedagogies of ESD and Digital Education, the following question arises:

- e. **Which aligned strategies can help to embed the complementarity of ESD and Digital Education in curricula, in teacher training as well as in learning materials and learning environments?**

Curricula, school development and support

The federal state Ministries of Culture / Education are about to implement the KMK strategy „Education in the digital world“ by appropriate actions. They have also expressed their willingness to consider the NAP (for ESD) in curricula revisions and to expand their support for schools. In this context it would be expedient to implement the complementary structure of ESD and Digital Education as far as possible. When revising their curricula, the German federal states can build on their own experience and in part also on concepts called “Übergreifende Themen (ÜT)” (interdisciplinary subjects)¹¹.

For the successful embedding of ESD within all school subjects and activities as well as for Digital Education, effective measures of relief, support, consultancy and incentive need to be offered by the public sector but also by foundations and other funding institutions. Many parents also need support in order to have equal opportunities but also to avoid a disparity of digital lifeworlds among parents and their children, which would impede processes of understanding.

In some federal states local school-specific curricula have to be created, and they can significantly contribute to what is appreciated as „good school“. But under the given circumstances, many schools are not ready to meet this challenge. They need professional support, incentives, counselling and additional budgetary resources. Irrespective of their location and own potential, all schools depend on a cooperation with partners from science, civil society (NGOs) and business, in order to meet the requirements of „ESD in a digital world“. School supervising authorities should intensively support this process and attend it by means of target and performance agreements. To that end, it is not only important for schools that their guiding principles and profiles serve these objectives, the entire school development with its educational programme and supplementing activities (Whole School Approach) needs to be aligned towards this goal, and cooperating partners have to understand this and align their respective roles.

¹¹ In the new framework curriculum of Berlin-Brandenburg for grades 1 to 10, the acquisition of media competencies was declared a task of media education in all subjects. Furthermore, general themes assigned to „Sustainable Development/Learning in Global Contexts“ are being integrated in the subject lessons and implemented in cross-curricular or subject-linking formats and within all-day learning opportunities.

Teacher training

One of the core issues of the NAP is the implementation of ESD in the training of teachers. Pending restructurings should be used to realise the described interconnection of ESD and Digital Education in the basic training (first phase) as well as in the didactic development and in the preparation of trainee teachers for respective forms of teaching. Here it is particularly challenging to improve the coordination of scientific and pedagogic education which are often rather disconnected. In this regard, the teacher training laboratory in Hamburg has been quite successful with cooperative projects in past years (Lehberger, 2018).

It seems to be reasonable for closer linking of ESD to Digital Education and for its integration in teacher training for all subjects to initiate similar projects. Given the dynamics of both areas and the long time periods between the education of teachers and its transforming effects on school education, direct structural changes in the coordination of the three phases of teacher training are nevertheless needed, as well as expanded portfolios of school development.

In order to prepare teachers to foster effective competency-oriented learning, an orientation towards individual processes of learning and towards cognitive performance is needed – simultaneous with the focus on current and future challenges of the society (Frohn & Heinrich, 2018). Through the use of digitally supported learning environments, the concepts of individual management of learning and of Adaptive Learning by Educational Data Mining (EDM) and Learning Analytics (LA) provide potentials. Currently, there are intensive researches on their forms and their effectiveness for the support of learning processes. The goal is to model the students' behaviours and behavioural patterns, to offer digitally supported assistance, to generate immediate individual feedback, to offer further relevant learning tools adaptively, to enhance the students' attention and their reflection on their own process of learning, as well as to use the support of data to take action for the improvement of social teaching and learning environments (Verbert, Manouselis & Drachsler, 2012).

Regarding the assessment of the use of digital technologies, high demands are made on the school development, on the teachers' pedagogical self-image, on teacher training and training and on the pedagogical sciences. In some fields that already have sufficient experience with the complementing application of digital media and tools, the opportunities and risks of a link between ESD and digital applications can already be described and partly evaluated (see Appendix 2).

Lessons, learning environment and educational material

The integration of digital technologies and media into lessons offers opportunities to implement quality standards for teaching scenarios and learning processes according to ESD on different levels (organisational, didactic, methodological) (Engagement Global, 2017): The combination of contents which are as authentic as possible with a student-centered methodology and a type of learning that is aligned towards the challenges of society, project based, self-organized, that links the local with the global level, inclusively and focused on competencies.

Here the digital media assume certain functions within the organisation and process of learning by which the students can – to some extent – determine methods, contents, paths or processes of learning by themselves. Through a targeted use of digital technologies, the learning scenarios and environments can be designed open and flexible enough to offer sufficient scope and individual study formats for the students' differentiated interests in learning and designing. Most of all this is the case for a product oriented creative use of digital technologies when media are being applied as tools to support the learning processes.

Whenever, in the course of the implementation of the KMK strategy „Education in the digital world“, central learning labs are organised and schools are being advised on the design of their virtual learning environment, we have to be sure to consider the suggestions coming from this paper with their respective digital offers and opportunities for training and development. Beside other reasons time efficiency will be an argument why teaching and learning with digital technologies will not be possible without textbooks and learning materials, which, however, should focus more on the use of digital technologies and give this approach subject-specific impulses. It is obvious that textbook publishers need to be included. Regarding the fundamental alignment towards Sustainable Development, the embedding of ESD as suggested and outlined by the UNESCO manual Textbooks for Sustainable Development (2017) is very important in order to achieve the complementarity of ESD, digital and subject-specific education. Facing these challenges, the following question arises for the cooperation of ESD and Digital Education:

f. What needs to be taken into account when designing learning units in order to enable the students to participate in solving global challenges in a digital world?

To begin with, learners should – wherever possible – participate in the selection of digital applications and in the discussions on alternatives of commercial and Open Source software (Open Source, f.e. in the field of operating systems, office packages, mail programmes and browsers). Usually, the respective communities are self-organised via internet services or moderated platforms which are generally open for everyones contribution. They also include the Wikis and the Wikipedia encyclopedia. For the educational work it is essential that important discussions and contributions are transparent and that one's own comments can be published. The concept of cooperative and transparent production of goods and services can also be applied to other fields, like the producing of educational material.

For the action oriented learning field ESD and Digital Education it is obvious that licence-free Open Education Resources (OER) should be produced, which are promoted by the UNESCO and the German Federal government. It is very much in line with the pedagogical approaches preferred by ESD (learning by doing, collaborative learning, culture of sharing) if students and teachers produce their own learning-/ teaching material, from the simple work sheet to comprehensive supplementary material.

If students and/or teachers produce their own course material for the themes proposed in the Curriculum Framework Education for Sustainable Development, the addressed

potentials of interconnecting ESD and Digital Education should be included wherever possible, for example with references to helpful digital tools up to a digital space of communication for the exchange of the users experience with the application of these tools. This material will be offered free-of-charge on the Global Learning platform EWIK and by Engagement Global. The EWIK portal (www.globaleslernen.de) has already published an OER site which includes (among others) specific information on Creative Commons Licences (CC Licences) and on quality management. The perspective goal is to make EWIK to be a repository for open ESD material (Danz & Widholm, 2018).

Appendix 1

Overview of the central questions

- a. **What is quality education according to the Agenda 2030 in a digital world?**
- b. **Which competencies are particularly meaningful to quality school education for Sustainable Development in a digital world?**
- c. **How can we shape the expansion of fundamental and subject-specific goals of education as suggested by the KMK, given the complementarity of ESD and Digital Education?**
- d. **What is the additional benefit of using digital learning concepts and applications with regard to the desired competence orientation in ESD?**
- e. **Which aligned strategies can help to embed the complementarity of ESD and Digital Education in curricula, in teacher training as well as in learning materials and in learning environments?**
- f. **What needs to be taken into account when designing learning units in order to enable the students to participate in solving global challenges in a digital world?**

Appendix 2

Examples of helpful digital applications within ESD

- Guided **internet research on required data and information** for a learning unit in ESD has already become methodical standard. It allows an additional didactic benefit (compared to edited text- and reference books), due to the requirement to differentiate between relevant and irrelevant information and to develop strategies for evaluating the integrity, objectivity and topicality of sources. It is also about a **critical approach to authentic sources** that the learners are confronted with when they use media outside the school. They are different from „instructional“ material for which the sources have already been selected and solutions to problems predefined.
- The possibility to **edit and process** available digital data and information from different perspectives, f.e. in search for the solution of social and ethnical conflicts as well as the **visualisation of results**, are areas of digital programme application that reach far beyond analogue methods and can supplement them effectively.
- The numerous possibilities to **disseminate or forward data, information and project results** to a major circle of actors, f.e. in the cooperation with NGOs within Sustainable Development projects or in Citizen Science activities and the connected **exchange of experience and opinions** extend the opportunities of analogue teaching methods in many respects. As an example, we want to mention the „Mini Stream Assessment Scoring System (MiniSASS)“. By use of a website or an app, water samples from rivers can be evaluated and the respective data fed into an online chart. This gives the students the chance to contribute to the (local) monitoring of SDG 6: Clean Water and Sanitation (www.minisass.org/en [May 18, 2018]).
- Similar possibilities apply to the **extension of (analogue) discussions** on school related, local, national, European and international controversies beyond the classroom **into the virtual diversity of social networks, blogs, portals and communication channels**. Here we have special potentials regarding the global exchange on issues of sustainable development. Beyond borders, students can use video conferences, Media Sharing and other forms of digital interaction to exchange experiences and to receive impulses for their own activities (example: „Go! Global“: www.esd-expert.net/go-global-virtueller-schulaustausch.html [May 18, 2018] or „CHAT der WELTEN“ (CHAT of the WORLDS): www.engagement-global.de/chat-der-welten.html [May 18, 2018]).
- For years school projects have been conducting joint teaching units (English, Mathematics etc.) via video or skype with partner schools in the Global South, for instance the Edith-Stein Schule in Darmstadt together with the Chaminade Secondary School in Karonga/Malawi. The experience of the youth exchange project „Hessen meets Vietnam – Vietnam meets Hessen“ is another inspiring education project: 50 young students from Hesse cooperated for more than 18 months with 50 youths from Vietnam on issues of Sustainable Development – by means of video conferences between Hanoi, Wiesbaden, Darmstadt and Fulda in 9 weekend workshops (WUS 2011).

- Furthermore, there are digital applications that open up classroom activities on certain subject issues, f.e. **spatial analyses with geo information systems** (that have been technically adapted for school purposes) or the **use of realtime data**, for instance on air and ship traffic, for weather or disaster monitoring. The study of these applications shows that their use can only generate the desired additional benefit if the respective issue is oriented towards ESD and if the pedagogical setting is appropriate. The same applies to **virtual simulations** of the feasibility of certain solution methods for manageable conflicts in the SDG context or for the embedding of **digital experimental and simulation games** within the learning process, f.e. for the rise of the sea level or the sustainable supply of energy and the use of **forecast models** for the presentation of spatial transformation processes, f.e. by means of parameter modelling to visualise climatic effects.
- In general, the focus of ESD-oriented lessons is on the analysis of existential global problems and conflicts and on the search for sustainable solutions. As this is always about a multitude of complex facts, the use of digital applications seems obvious. But often the fact is ignored that ESD learning processes do require a fine tuning of contents and pedagogical approach in order to be didactically successful. **IT services**, f.e. **for steering the different educational requirements and time units** of inclusion or the use of **digital project management tools**, can supplement analogue methods of education. If students are included in the production of the needed educational material by **Open Educational Resources (OER)**, this (digitally supported) connection of content and learning method will be an additional learning experience.
- The additional benefit of digital applications is not at all limited to certain subject contents (scientific or technical), but also well-known from **language, music, arts and sports education**. The **quality and relevance** of education will increase not only due to the mutual supplementation of analogue forms of teaching and digital applications, but also through the focus on common goals in society. As an example, **digital storytelling**, whether individual or collaborative, can, if linked to a content focus of ESD, enable the creative-emotional research of complex political areas through personalised reports, (picture) stories, works of art and performance events. Through digital means they will be accessible for a larger public audience and will inspire feedback. In physical education, the film **documentation of movement sequences** linked to graphical analytical tools and slow motion functions as well as the sensory documentation of individual and medical data help changing the perspective towards an individualised, health related and body-protecting mobility.
- Last not least, students **(meta) reflection processes** on their learning experience clarify and support sustainable learning processes, f.e. by means of **podcasts or screencasts** and through the documentation of learning processes in supporting **e-portfolios**.
- The field of digital applications in education for development cooperation and international cooperation is wide and diverse. So f.e., a game-based learning device oriented at the maths curriculum in Sudan, could substantially contribute to the mathematical skills of children who do not have access to school education (BMZ, 2016).

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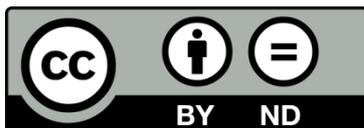
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