“Digital Education - a chance for good early STEM Education for Sustainable Development”

Position paper of the “Haus der kleinen Forscher” (Little Scientists’ House) Foundation

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Summary

Various studies have shown that digitalisation brings both opportunities and challenges for child development and education.[1] Furthermore, there are also unanswered questions with regard to early childhood educators and primary school teachers who accompany children in educational institutions, especially in the area of didactic competencies. Against the background of an increasingly digitalised world, the Foundation focuses on both areas, children and adult learning, in this position paper.

In the educational policy debate on the topic of digitalisation, the "Haus der kleinen Forscher" Foundation sees the associated change primarily as an opportunity to further advance the quality and impact of STEM Education for Sustainable Development. Digital media form a fundamental part of a child’s world and can play a key role in educational processes. Children should acquire the ability to understand digital media, use them responsibly, reflect on them critically and also apply them to explore the world. The Foundation therefore promotes an age-appropriate, protected, competently accompanied, self-determined, critical, creative and active use of digital media in the everyday pedagogical life of educational institutions.[2]

For the Foundation, the principles of its pedagogic approach remain the centre of educational programmes and learning.[3] This approach uses co-constructive learning support to address children's questions and

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[1] Betsy Sparrow, Jenny Liu, Daniel M. Wegner https://science.sciencemag.org/content/333/6043/776; Eyal Ophir, Clifford Nass, Anthony D. Wagner https://www.pnas.org/content/106/37/15583; Frederick J. Zimmerman, Dimitri A. Christakis, Andrew N. Meltzoff https://www.jpeds.com/article/S0022-3476(07)00447-7/fulltext; Tamar Lewin / https://www.nytimes.com/2009/10/24/education/24baby.html; Rana M. Tamim, Robert M. Bernard, Eugene Borokhovski, Philip C. Abrami, Richard F. Schmid https://journals.sagepub.com/doi/abs/10.3102/0034654310393361

[2] Gesellschaft für Medienpädagogik und Kommunikationskultur (GMK) e.V. [Society for Media Education and Communication Culture]. Position paper: Kinder im Mittelpunkt: [Children in focus]: Frühe Bildung und Medien gehören zusammen [Early education and media belong together]

[3] “Haus der kleinen Forscher“ Foundation https://www.haus-der-kleinen-forscher.de/fileadmin/Redaktion/1_Forschen/Paedagogik/Broschuere_Paedagogik-HDKF_2020.pdf

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encourage action-oriented, active engagement with science, technology, engineering/computer science, and mathematics (STEM). The use of digital media can contribute to method diversity when exploring and investigating. Therefore, the Foundation sees digital media as tools in the repertoire of good learning support.
For a meaningful and targeted use of digital media in educational institutions, early childhood educators and primary school teachers are needed who feel competent to facilitate learning with digital media. With a variety of professional development programmes and practical impulses, the Foundation shows how the educational offer for early childhood educators and primary school teachers can look in practice in an increasingly digitalised world. In its continuing professional development programme, the Foundation has set itself the goal of efficiently combining the best of its many years of experience in the field of professional face-to-face development with the possibilities of digital media, expanding and supplementing it and making it accessible to all educators and primary school teachers via its nationwide network.

Preface

Never before has the world changed so rapidly technically and socially. The current challenges, but also the major tasks facing humanity in the 21st century, such as the climate crisis or demographic change, are driving the digitalisation of our society and thus permeate all areas of our lives. This requires great flexibility from all people and the willingness to constantly learn new things, often in a very short time. An event like the COVID-19 pandemic also shows how rapidly and fundamentally our everyday lives can change. The pandemic reveals many challenges, also in the field of education: Children, for example, who cannot be adequately supported at home, and do not have the technical means to participate in digital education opportunities. This also applies to early childhood educators and primary school teachers, who have so far lacked the skills, methods and tools to integrate digital learning options into their pedagogical practice. This shows that: early childhood educators and primary school teachers who know how to integrate collaborative digital learning and work into educational processes are better equipped to face current and future challenges. The Foundation's aim here is to reduce fears and provide security, to make experimental spaces accessible and to encourage early childhood educators and primary school teachers to learn together.

It would be a mistake to look at the particular challenges of the COVID-19 pandemic for education in an isolated way, because the complexities in an increasingly digitalised world will continue to exist for early childhood educators, primary school teachers and for children.
Digital media can play a significant role in the educational processes of children. Accordingly, they should acquire the ability to understand digital media, use them responsibly, reflect on them critically and apply them to explore the world. Corresponding goals have been anchored, for example, in the educational programmes and curricula of the 16 federal states. They are thus an integral part of the educational mandate and hence a consensus in educational policy. For the “Haus der kleinen Forscher” Foundation, there are two central aspects: Education ABOUT digital media and education WITH digital media - both at childhood and adult level.
As Germany's largest early childhood STEM education initiative, the "Haus der kleinen Forscher" Foundation recognises its responsibility to publicly help shape the discourse on early childhood education in the digital world and to provide guidance on the key issues. Therefore, the Foundation has formulated central theses in this paper that reflect its current position on STEM Education for Sustainable Development in a world shaped by digitalisation. With this paper, the Foundation also wants to advance the idea of networking in the field of education and invites all stakeholders to discuss and learn from each other.

The theses of the position paper

1. STEM Education for Sustainable Development empowers children for the future - also in a world shaped by digitalisation.

2. The didactic basis for the use of digital media, which is monitored by educators and teachers, supports children in investigating and exploring.

3. Digital media are equally important tools in the repertoire of good co-constructive learning support.

4. Digital media promote continuous professional development support that is geared to the individual interests and needs of the learners.

5. STEM Education for Sustainable Development with digital media requires conducive framework conditions in educational facilities.

Explanation of terms
Media education - computer-science education - digital education: all approaches deserve attention

The terms media education, computer-science education and digital education are blurred in the public perception. How does the Foundation define these terms and what does this mean for the Foundation's work?[4]

- **Digital education** is an umbrella term that encompasses both media education and computer-science education. It combines all approaches of an increasingly digitalised world and, in addition to application and use, selection and deployment of media, also places emphasis on understanding and grasping the basic concepts of computer science. The influence of digital technologies shapes all cultural techniques, such as reading, writing or arithmetic. Digital education is thus relevant in all subject areas and learning topics and forms part of STEM Education for Sustainable Development.

- From a **media education** perspective, the focus is on media as tools: producing own contents and critically reflecting on the use, meaning and impact of such media. Media education is a cross-sectional task and the “Haus der kleinen Forscher” Foundation

[4] “Haus der kleinen Forscher“ Foundation https://www.haus-der-kleinen-forscher.de/fileadmin/Redaktion/4_Ueber_Uns/Evaluation/Wissenschaftliche_Schriftenreihe_aktualisiert/180925_E-Book_Band_9_final.pdf

considers it an integral part of all educational fields. As part of the Foundation's professional development programmes and as a stimulus for everyday pedagogical work in educational institutions, digital media and their use are addressed in areas where they can meaningfully contribute to the Foundation's goal of good, high-quality STEM Education for Sustainable Development.

- From the perspective of **computer-science education,** the focus is on information technology: understanding the basic concepts of automated information processing and applying these concepts to solve problems and understand information society. The Foundation has developed a professional development programme that enables early childhood educators and primary school teachers to explore computer science in everyday situations and gain access to computer-science education.[5] Pedagogues thus acquire the professional competence and skills to help boys and girls observe, discover, question and understand digital devices and IT systems, and to critically reflect on how they work and how they are used. This can be done with or without the use of digital media and devices in educational institutions.

[5] "Haus der kleinen Forscher" Foundation" https://www.haus-der-kleinen-forscher.de/de/fortbildungen/bildungsangebot/fortbildungen-vor-ort/informatik-entdecken

1. **STEM Education for Sustainable Development empowers children for the future - also in a world shaped by digitalisation.**

The “Haus der kleinen Forscher” Foundation stands for STEM Education that is aware of its responsibility for people and the planet. Its educational work is based, among other things, on the global sustainability goals, the so-called 17 SDGs (Sustainable Development Goals) of the United Nations and strives to contribute to a sustainable development of the world.

In its vision and mission, the “Haus der kleinen Forscher” Foundation formulates its goals and tasks: To enable children to think independently, act responsibly and to deal with the technological and social changes in a reflective manner, in line with sustainable development. Important prerequisites for this are STEM competencies, such as inquisitiveness, observation, reflection and knowledge of interrelationships. Building on the pedagogical approach,[6] STEM Education for Sustainable Development promotes a wide range of skills in children to empower them for a world shaped by digitalisation and thus prepare them to solve future challenges.[7] As an educational initiative, the “Haus der kleinen Forscher” Foundation helps to develop the children's future skills for an increasingly digitised world: creativity, communication, collaboration and critical thinking.

2. **The didactic basis for the use of digital media, which is monitored by educators and teachers, supports children in investigating and exploring.**

The pedagogical approach of the “Haus der kleinen Forscher” Foundation focuses on children's questions. The use of analogue and digital media can help with exploration and investigation. The Foundation is looking for ways to provide good STEM Education for Sustainable Development using digital media. The educational programme “STEM goes digital”[8] shows how digital media can be used didactically for investigation.

The Foundation supports the use of digital media for individual, child-oriented, creative, independent and self-effective learning in educational institutions. Children under the age of ten investigate and explore their environment, primarily through active engagement with concrete objects and pedagogical resources in their surroundings. In the Foundation’s view, digital media are among the technical objects and formats relevant to everyday life that arouse children's curiosity and can thus be understood as learning opportunities to the same extent as water, magnets or bubbling gas.

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6 “Haus der kleinen Forscher“ Foundation https://www.haus-der-kleinen-forscher.de/de/fortbildungen/paedagogik

7 “Haus der kleinen Forscher“ Foundation https://www.haus-der-kleinen-forscher.de/en/international-dialogue-on-stem-education/idos2019/position-paper

8 “Haus der kleinen Forscher“ Foundation’s educational programme “STEM goes digital“

Digital media are a contribution to the method diversity in exploration and investigation. The Foundation therefore advocates that digital media be used in education in a pedagogically-didactically explicable and competent manner. With its qualification programmes for STEM Education for Sustainable Development, the “Haus der kleinen Forscher” Foundation aims to encourage and enable educators and teachers to use digital media in the sense of the pedagogical approach of the educational initiative. This also lowers the hurdle of using digital tools in non-STEM-related educational areas.

The Foundation recommends that educational institutions develop a media concept together with the relevant stakeholders (early childhood educators and primary school teachers, children, parents and sponsors) as part of their pedagogical concept. The media concept should provide orientation for all stakeholders for the goals and the use of digital media in pedagogical situations and increase acceptance. Since media education as such is not an objective of the Foundation's educational programme, we refer in this context to the relevant institutions and actors in the field of media education.[9]
As in any educational situation, learning support should also take into account the children’s individual previous experiences when dealing with digital media. There are various applications and media[10] that encourage interaction, design and communication among children, as well as among early childhood educators, primary school teachers and children. Against this background, the “Haus der kleinen Forscher” Foundation recommends more intensive support in early childhood education and care centres than in primary school. Competent learning support basically offers added value - for example through the use of educational games. In primary school, however, teachers can use digital media to a greater extent and give learners the opportunity to use them independently in the didactic setting, e.g. educational games at www.meine-forscherwelt.de.

3. Digital media are equally important tools in the repertoire of good co-constructive learning support.

The development and implementation of all the Foundation's educational offers is based on its pedagogical approach. This also applies to educational programmes involving the use of digital media. The focus is always on co-constructive learning support. Pedagogues can offer children experiences that help them expand their abilities and understand the world.

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[9] e.g. Gesellschaft für Medienpädagogik und Kommunikationskultur in der Bundesrepublik Deutschland [Society for Media Education and Communication Culture in the Federal Republic of Germany] https://www.gmk-net.de

[10] “Haus der kleinen Forscher“ Foundation e-book “STEM goes digital“ LINK: https://www.haus-der-kleinen-forscher.de/fileadmin/Redaktion/13_Landing_Pages/MINT_geht_digital/MINT_geht_digital_eBook.pdf

A learning-stimulating interaction of early childhood educators and primary school teachers with children is characterised by three essential elements: an appreciative atmosphere, orientation towards the child and dialogue. From the Foundation's point of view, this applies to all learning situations - whether with or without digital media.

We assume that early childhood educators and primary school teachers have two central competencies that are essential for their profession today and in the future: Empathy and pleasure in learning. In addition, early childhood educators and primary school teachers have a rich repertoire of methods and a wealth of experience in how to accompany and support children in their learning. Well-designed learning situations offer children different ways of access, tie in with previous experience and leave room for their own exploration. This also applies to learning situations in which digital media are used.
It is known from neuroscience that learning content is anchored in the brain in a particularly sustainable way when it is actively addressed via different approaches.[11] Multimedia preparation of educational offers for children, but also for educators and teachers, can provide excellent support to the learning process, e.g., by animating the contents with sound and images. The learners benefit from the combination of sensory-physical activation, visual-auditory access and stimulating interaction.
This is not about a valuation or strict separation of analogue, digital, real and virtual approaches; digital media are rather seen as equally important tools in the repertoire of good learning support. Likewise, digital and analogue learning activities can often be combined and complemented. The Foundation aims to enable early childhood educators and primary school teachers to design suitable learning arrangements according to the learning objective, situation, interests and previous experiences of the children, whether with or without digital media.

For a sensible and targeted use of digital media in educational institutions, early childhood educators and primary school teachers are needed who feel competent to facilitate learning with digital media. The "Haus der kleinen Forscher" Foundation supports them with suggestions that show how digital media can be applied usefully and appropriately in everyday educational activities for investigation and exploration. This is also an attempt to counteract fears and reservations about digital media and, quite incidentally, to strengthen the media competence of early childhood educators and primary school teachers.

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[11] Mayer, K., M., Yildiz, I., B., Macedonia, M., von Kriegstein, K.: Visual and motor cortices differentially support the translation of foreign language words. In: Current Biology, 25 (4), 2015, pp. 530-535.
Ungerer-Röhrich, U., Popp, V., Quante, S.: Bildung durch Bewegung. Kita-Kinder ganzheitlich in ihrer Entwicklung fördern. In: Cornelsen Verlag, Berlin 2015, p. 17f.

4. **Digital media promote continuous professional development support that is geared to the individual interests and needs of the learners.**

All early childhood educators and primary school teachers should have the opportunity for advanced training - also by using digital media. The Foundation is convinced that educators can reflect and decide for themselves which form of advanced training, whether face-to-face training, online learning or other formats, best supports them with which goal and at what time.

The "Haus der kleinen Forscher" Foundation pursues an approach to advanced training of early childhood educators and primary school teachers that combines face-to-face formats and various digital formats. The aim is to effectively combine the best elements of its many years of experience in the field of professional face-to-face development, which is implemented together with network partners throughout Germany, with the possibilities offered by digital media, and to expand and supplement them (blended learning).
The Foundation's portfolio of educational programmes includes a variety of formats. These can be used independently of each other, depending on the individual interests, needs and time resources of the users. For example, the educational programme "STEM is everywhere" consists of a face-to-face professional development programme, a variety of online offers and print materials that offer early childhood educators and primary school teachers various opportunities for learning and interaction with each other and with the Foundation.
To ensure that the educational programmes are even better linked to previous experiences, needs and individual learning paths of early childhood educators and primary school teachers, and to enable low-barrier and user-friendly access, the Foundation is continuously developing its technical infrastructure and conducts regular needs assessments to determine previous experiences and wishes for professional development programmes.

5. **STEM Education for Sustainable Development with digital media requires conducive framework conditions in educational facilities.**

The Foundation advocates that online advanced training be formally recognised as professional development programmes. The sponsors of educational institutions and employers should recognise online development programmes on an equal footing with face-to-face training. Pedagogues should have the opportunity to participate in online development programmes during their working hours. This presupposes technically well-equipped and digitally networked educational institutions, because adequate technical equipment and infrastructure enable the early

childhood educators and primary school teachers to participate in educational offers, to integrate digital media in a targeted and meaningful way in their pedagogical work and to better manage administrative activities.

Practice in educational institutions shows that the pedagogical work of educators and teachers often competes with tasks such as documenting development processes, communicating with parents and administrative duties. These tasks can be facilitated and possibly even accelerated through the use of digital applications (e.g., apps) and infrastructure (devices) for data protection-safe communication, documentation and administration. The result would be that early childhood educators and primary school teachers, who can more quickly master the organisational demands of everyday life at school and early childhood education and care centres, would have more time for their professional pedagogical work with the children and continuously expand their own media competence.

In the increasingly digitalised educational work, the protection of the data of children, parents and early childhood educators and primary school teachers must be safeguarded. The introduction and use of digital learning and professional development programmes for children and adults raises questions about data protection for parents and early childhood educators and primary school teachers. In principle, the General Data Protection Regulation (GDPR) and the state-specific recommendations, as well as the guidelines of data protection supervisory authorities on data protection standards for digital learning offerings apply here.

Outlook

The Foundation advocates that the field of education with digital media, especially in the early childhood sector, be further researched in order to be able to draw on more up-to-date data-based scientific findings and, building on these, to integrate them into the development of the Foundation's educational offerings.