

‘There Is No Cloud?’ Awareness of Digital Technology in a Sustainability Perspective in Teacher Education

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Abstract

The Global North can be described as postdigital societies where digital infrastructure and applications such as social media or so-called artificial intelligence are ubiquitous. Schools are obviously part of the postdigital society, and there is a call for teachers to use digital tools to engage and facilitate learning for pupils. However, from a sustainability perspective, the digital society also has significant adverse effects, including water and energy consumption and social polarization. Thus, teachers need to be aware of both positive and negative aspects of digital tools. This action research study reflects on an instructional design intended to support Norwegian student teachers in analyzing digital tools with respect to sustainability. Although it has been challenging to create awareness of the tools in a holistic conception of sustainability, the project provides a starting point for reflections on how the positioning of knowledge and pupils connects with perspectives on sustainability.

Keywords: Action research, ICT, postdigital *Bildung*, sustainability, teacher education.

Introduction

‘There is no cloud’ was a sudden realization made by a student in her first year of a Norwegian science teacher education program. As part of a project on digital information and communication technology (ICT) for educational use, the student and I discussed digital infrastructure. The images she took as part of the project were not stored in the sky but rather in data centers, which are huge consumers of water and energy and require rare metals from conflict areas; moreover, the centers often supplant wildlife or farming areas (Monserrate, 2022). Sustainability regarding ICT raises several concerns environmentally, socially, politically, and economically. These concerns are far-reaching both temporally and spatially; thus, in the context of sustainability, ICT in education

is a truly complex issue. The project aimed at addressing this complexity. Thus, the project was about ICT in an education for sustainable development (ESD) perspective. To make it more concrete, the project focused on ICT tools that students could use in their own teaching. Tools are bidirectional: They are used for the purpose of instigating some change, but they also have an effect on the user (Cole & Engeström, 1993). An ICT tool used for teaching and learning will thus affect how students are positioned (e.g., collaborating or competing), as well as the knowledge, skills and attitudes it enables. Hence, ICT tools are an important part of what teacher education needs to deal with (e.g., Foulger et al., 2017; Makrakis & Kostoulas-Makrakis, 2012). ICT in teacher education is a growing field, and there are studies “that mention the importance of using digital learning and teaching tools for ESD” (Gavinolla et al., 2022, p. 159). As ESD promotes a view of students and pupils who deal with the world in an empathic and constructively critical manner to enable new ways of relating and being in the world (Jickling & Wals, 2013), it is important to explore how to prepare student teachers’ use of ICT critically and constructively. The study presented in this article can serve as an example of preparing student teachers to deal with ICT and ESD.

There is a need to prepare student teachers for using ICT as part of their teaching practice (Gudmundsdottir & Hatlevik, 2018). However, what this might entail as part of on-campus preparation needs to be questioned. There is a growing scholarship problematizing the ‘use perspective’ and that ICT can provide learning benefits and solutions to educational problems (see, e.g., Lund & Aagaard, 2020; Selwyn, 2024a; Werse, 2023). Selwyn (2024a, p. 56) states, “Education technology is not often framed in terms of being nourishing, fair, respectful, a site of solidarity or even a source of light-heartedness. Amplifying these aspects of current education technology practice is a big task”. As part of teacher education, it is essential to amplify respect, fairness, and solidarity as well as mitigate negative side-effects of ICT tools, such as exclusion and extreme individualization. In this article, the term “postdigital *Bildung*” is used to capture how student teachers can engage critically and constructively with ICT tools in education.

The term “postdigital” refers to the notion that digital technologies are interwoven in everyday practices (Weich & Macgilchrist, 2023). In education, such practices include making schedules, communicating via platforms and using digital tools. In other words, the aim is not to de-digitalize education but to create an awareness of the objectives of ICT in education. *Bildung* can be one such objective, where important values are self-determination, participation, solidarity, and democracy (Klafki, 2002). *Bildung* stems from a German and Scandinavian educational traditions that differs from the competence-based traditions (e.g., advocated by OECD), as, in *Bildung*, students are seen as actively shaping and being shaped by content (Willbergh, 2015). Both the outcome and process of learning are open. The choice of content is important and it should enable the students’ moral growth and provide opportunities for collaboration and developing their (professional) autonomy (Klafki, 2002). Hence, *Bildung* can be considered in opposition to neoliberal approaches to education where consumer culture, competition, and efficiency are valued (Blum, 2023). These neoliberal values often underpin the digitalization of education (Selwyn, 2024a).

Additionally, the connection between nature, digital technology, and society is a growing educational research field (e.g., Selwyn, 2017, 2024b; Werse, 2023), yet these

kinds of discussions have not made their way into teacher education with much force (Grünberger, 2023). However, teacher education is considered vital for promoting sustainability to young people and local communities (King et al., 2022). Hence, there is a need for exploring how the connections between ICT tools and sustainability can be played out when the objective is self-determination, participation, solidarity, and democracy. The present study can serve as an example for such an exploration. The research question guiding this article is as follows: *What tensions are revealed by critical reflection on an ICT and ESD project through the lens of postdigital Bildung?*

The study is part of an action research project conducted within a Norwegian teacher education program. This is a five-year program where the students enroll in science and mathematics courses, learn teacher professional knowledge, and enhance their teaching skills over several practicum periods. This project is part of the first-year students' professional knowledge course on campus. In this course, the students learn about planning teaching, teaching methods, ESD, and more. All the students are extensive ICT users; however, thinking about ICT as (prospective) teachers is something quite new for them.

Theoretical Background

Sustainability is often viewed as having three dimensions: environmental, social, and economic – dimensions that need to be understood collectively (Gamage & de Silva, 2022). Gamage and de Silva (2022) draw attention to 'development' in sustainable development, and that it should not be understood in a pure economic sense. Kopnina (2012) raises a similar concern, highlighting that environmental issues tend to be understood as less important than economic considerations, and that education needs to equip future generations with knowledge and skills to address environmental degradation.

Extensive ICT use leads to environmental degradation (Monserrate, 2022) – even if ICT is often seen as developing solutions to sustainability issues through, for instance, reducing the carbon footprint or having a low environmental impact (Selwyn, 2021). However, the 'invisible' infrastructure, such as satellites, cables, and data centers, consumes vast amounts of energy and water and produces considerable amounts of waste (Monserrate, 2022; Srinivasan & Bloom, 2021). This means that ICT tools are connected to what is called hyperobjects, objects that are far-reaching and interconnected in complex systems. These hyperobjects influence society and work life because of automatization and algorithmic decision-making that are outside democratic control (Selwyn, 2017). Hence, there are radical changes in society by, for instance, speeding up processes in ways that makes critical thinking more difficult – but understanding systems and being able to think critically are prerequisites for participating in a functioning democracy (Emejulu & McGregor, 2019; Ragnedda, 2020).

In education, ICT is often seen as a means to speed up or enhance learning effectiveness, economic competitiveness, and individualization (Selwyn, 2017), and there have been promises that ICT can connect people and increase possibilities for participation. However, these promises have not been delivered quite convincingly (Grünberger, 2023; Srinivasan & Bloom, 2021). Prospective teachers need to be able

to use ICT tools but also to analyze and mitigate the impact of (some of) their effects on education. However, much of the literature regarding what teachers need to know is focused on *how to use* ICT in pedagogical settings (Skantz-Åberg et al., 2022; Spante et al., 2018). As the use of ICT tools in education has far-reaching consequences, student teachers need to reflect on them (Lindberg & Haglind, 2024). A focus limited to how to use ICT tools will hamper student teachers in connecting ICT and sustainability. Thus, there is need for research with critical perspectives on ICT in education that enable students to think about and question sustainability and ICT (Selwyn, 2017; Spante et al., 2018). One such perspective is postdigital *Bildung*.

As mentioned in the introduction, the term "postdigital *Bildung*" is related to and pervaded by digital materialities and content, rather than asserting that teaching and learning are inherently digital (Weich & Macgilchrist, 2023). This implies that teachers and their pupils have to be able to critically and constructively engage with a plethora of interweaving digital materialities. Pieper et al. (2023, p. 69) state, "*Bildung* implies the active engagement of the subject with the world and thus renders the interweaving of the subject with social, political, and economic conditions visible". Hence, *Bildung* can be seen as critical and constructive ways of being in the world, where the individual is part of the social (Paulsen, 2022). Moreover, seen through the lens of *Bildung*, learning is a goal-oriented but open process – a process that does not guarantee any specified outcome (Hopmann, 2007) and where the main educational goals are self-determination, participation, solidarity, and democracy (Klafki, 2002). This view of teaching resonates somewhat with policy notions about ESD. ESD is not only about sustainability content; it also involves approaches to working with that content. These approaches empower students to take well-reasoned action (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2017).

Context and Methods

As stated in the introduction, the study was carried out using an action research approach within a teacher education program at the Norwegian University of Life Sciences. Kemmis (2009) describes action research as more or less a systematic process that animates and urges changes in practices, understandings, and the conditions of practice. He further notes that action research is a critical and self-critical process aimed at instigating such changes through individual and collective (self-)transformation. Moreover, Jacobs and Murray (2010, p. 332) state that action research entails an "epistemology in which knowledge is situated, plural and contested; and a methodology that makes use of a variety of methods and that is reflexive in nature" (p. 332). The richness of the action research process and the many layers of the studied phenomenon require that both the process and the phenomenon are made explicit. This makes it important to provide a background to situate the reflections and understandings of the practice that serves as an example for the forthcoming explorations of ICT and ESD.

The students enrolled in this five-year teacher education program are to become science and mathematics teachers in secondary or upper secondary schools. This program has an ESD vision that is implemented as part of both content and the activities

that the students are involved in. Central to this vision is that students can handle the complexity of sustainability issues in holistic ways that enable themselves and their pupils to reflect and act to make a more sustainable world. This implies that students, during their five years of study, engage with various experiences, such as place-based education, inquiry-based teaching, and dialogic approaches. They work with a range of ESD content, including phenomenon-oriented teaching and learning in nature, ESD competences, and whole-school approaches, and explore what these might mean for their future work. In 2022, the college recognized the need to connect ICT to the ESD vision, to avoid an over-optimistic view of ICT as a solution to educational and sustainability challenges. The ICT and ESD project takes place in the second semester of the teacher education program. In the first semester, students have pedagogy, didactics and practicum for three weeks (the rest of the semester is devoted to mathematics and science subjects). When the ICT and ESD project is finished, the students have two weeks of practicum.

The project took place during the second week of January in 2023 (the first cycle) and 2024 (the second cycle), and each cycle lasted approximately 10 hours. Throughout the project, the students, approximately 20 each year, were to discuss in groups and make decisions based on their analyses of an ICT tool of their own choice. Thus, the project strives to provide students with a meta-perspective that allows them to regard ICT tools critically and constructively, a meta-perspective they hopefully can transfer to other situations. To provide good teacher education within the limitations (e.g., time and students' previous teaching experiences), an action research project was designed. In this action research project, my colleagues and I planned, conducted, and reflected on actions within two cycles of the project. During the research process, the reflections were mostly descriptive, trying to capture if and how the plans and aims contributed to raising awareness among the teacher students on ICT and ESD. According to Jacobs and Murray (2010), descriptive reflections are often based on personal judgment and literature. One of my colleagues and I interviewed the student teachers after the first cycle, and their reflections gave valuable input for the second cycle, which was conducted together with another colleague.

The input from these reflections and the interviews led to a shift of allotted time for the project steps between the two cycles; Figure 1 shows it as varying step widths. However, we kept the overall structure with four main steps: 1) a general analysis of tools, 2) a discretionary analysis of the tools' positioning of pupils and knowledge, 3) an assessment of the tools from a sustainability perspective, and 4) students' presentation to staff at a mini-conference. In the second cycle, the students were explicitly asked how they thought the tools could be used in teaching 14-year-old pupils and how they wanted to make the pupils aware of sustainability issues regarding the tools. In all steps, the student groups conducted analyses, reflected, and took collective decisions.

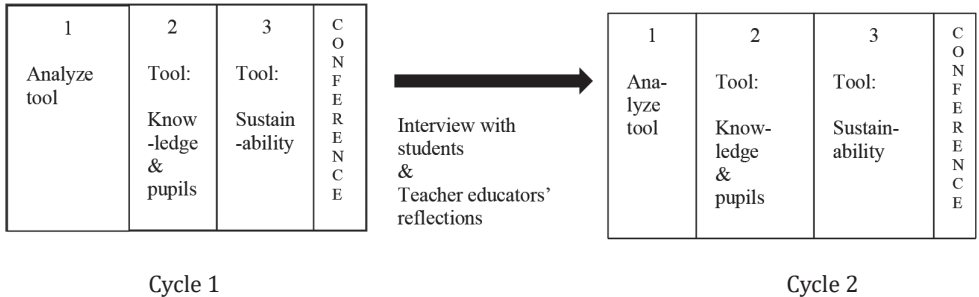
After the second cycle, I conducted a critical self-reflection by asking questions such as what values and theories underlie the choices made by the teacher educators and what is gained from these activities (cf. Jacobs & Murray, 2010). As a researcher in my own practice, there is a double edge. The researcher is an insider and knows the limitations in the particular educational situation and reasoning behind what is done; however, this may result in a skewed presentation (Spiro, 2023). My colleagues read a draft and had

no objections. Even so, a research approach relying on reflections will undoubtedly be personal in the sense of choices for what to highlight and how to express these reflections.

Figure 1

Overview of Steps in the Action Research

The widths illustrate the relative weight of each of the steps.



Results: Descriptions and Reflections on the Project

The overarching aim of the project is to contribute to the teacher students' awareness of the connections between ICT and sustainability as well as enable them to analyze and make choices regarding ICT tools. These are tools that they might use in their upcoming practicum period. For example, the students chose an artificial intelligence app that solved math problems step by step, generative artificial intelligence (chatbots), or social media apps. The students had to give a 15-minute presentation to the faculty staff at the end of the project and be prepared to answer questions concerning their presentation. They were supported during the project by short lectures, writing templates, and trial presentations. However, what they ended up presenting was very much a result of their own decisions. They worked in groups of three to five. Within the groups, the students divided work among themselves, discussed and had to reach agreement on what to present. I was present when the student groups worked and provided input to their process. My main impression was that the students participated by using each other as sounding boards and developing ideas together. There was seldom any visible disagreement among students, even if I explicitly said it to be okay. According to a central idea in *Bildung*, the students' project outcome was somewhat open. However, only a few of the students had experienced open-outcome projects before, and this caused some level of frustration. Biesta (2010) argues that the purpose of content and methods needs to be made explicit in education; the same applies to student teachers. By making clear the objectives of *Bildung* (Klafki, 2002), as well as knowledge and perspectives student teachers could transfer to their teaching, the project could have become more comprehensible for the students. However, ideas about *Bildung* are difficult to handle, and these need to be recurring themes in the program.

The first step in the project was an analytical description that made it possible for the student groups to describe the selected ICT tool both verbally and through screenshots. They used a template to describe fonts, colors, sounds, layout, and speed and made

assessments of clarity. The students chose which elements in the template to highlight. By doing this analytical description, they familiarized themselves with the tool. Getting an analytical perspective of the tool was necessary for the following two steps.

The second step involved an analysis of how the tool positioned pupils and knowledge. In *Bildung*, the interaction of knowledge – and content in general – and pupils is central, and teachers need to know how content meets the pupils and vice versa (Hopmann, 2007). Thus, it was important for the student teachers to investigate this interaction. For instance, one group studied an app that made the mathematical calculations for the pupils. The app positioned mathematics as problem-solving in a factual way by applying standard algorithms, and pupils needed to only take a photo of the problem (i.e., passive pupils). Another group investigated a social media app that allowed for different opinions on the topic of global warming. This app allowed pupils to be more active but with narrow space and time to express themselves, making compound, nuanced knowledge, and argumentation difficult to convey. As pupil engagement is vital in ESD (Jickling & Wals, 2013; UNESCO, 2017), future teachers need to reflect on the activities that ICT tools enable. Furthermore, they need to reflect on whether the tools facilitate key competences for sustainability, such as critical or systems thinking (Rieckmann, 2018). To help the student teachers describe the relation between positioning of pupils and knowledge, my colleagues and I modeled questions. Examples of such questions: “What are the pupils required to do? Do they have to go fast or slow? What are the pupils to decide?” Also, the question “Are you okay with that?” was used to elicit students’ reasoning, making them think twice. The student teachers were not used to thinking about knowledge in relation to pupils, so in the second cycle of the project, the students were given more time and support. A vital part of supporting the student teachers was to discuss various approaches to knowledge. Mills et al. (2023) argue that there is a need for an epistemic approach to knowledge when pupils work with ICT to learn some content. Pupils need to be critical and be able to synthesize information and make judgments both factually and ethically. Hence, students had to make connections between how the tool conveys information (e.g., “What does this (aesthetic) picture of global warming convey in terms of knowledge and attitudes, and what is not shown?” and “What are the pupils to do about it?”). In some circumstances, the student groups argued that the tools’ preferred knowledge mode had to be mitigated. If not actively thought about, it is easier to position pupils as rather passive consumers of knowledge and users of technology.

In the third step of the project, the students were to assess the tool from a sustainability perspective. After some input from the teacher educators, the student groups were to reflect on their tools regarding social, environmental, and economic dimensions of sustainability (Gamage & de Silva, 2022). As this is a gargantuan task and considering the dimensions may be intertwined, the student groups were to choose the one dimension they thought most important in their case. Many groups decided to assess their tool regarding energy and infrastructure, or how the tool could create (un)sustainable social relations through, for instance, exclusion or consumerism. In hindsight, this is the most challenging part of the project because there is a wide array of possibilities: what to choose to present – and how deep to go into the chosen focus – or if it is important to connect the chosen focus with other aspects. Basically, this step of

the project is meant to help the student teachers think about systems and hyperobjects. At the start of the project, digital systems were naturalized in the sense that 'they are just there', but towards the end of the project, the students talked in ways that indicated more elaborate understandings of ICT systems. The 'cloud' was no longer a 'cloud in the ether' but rather something concrete and something with impact on sustainability.

Discussion and Concluding Remarks

This study explored how the connections between ICT tools and sustainability manifested as part of a teacher education project. Based on what occurred during this project, I have critically reflected how it enables ESD. Seen through the lens of *Bildung*, I intend to draw attention to three problematic aspects of the project: 1) the dilemma between students' self-determination/the project's open-endedness and students' control, 2) the problem of unpacking the connection between the positioning of pupils and knowledge with (especially) social dimensions of sustainability, and 3) the problem of avoiding the notion that a holistic approach to ESD becomes a shallow approach.

First, two of the central ideas in the student project were aligned with core elements of *Bildung* (Hopmann, 2007): There were different possible outcomes, as the project itself was open-ended, and students' self-determination, participation, and solidarity were important for the students' opportunity to make their own decisions based on analyses. These elements were challenging for many students, as they had little experience with working collaboratively in open-ended projects. The students' lack of this kind of experience can be considered a consequence of a neoliberal educational policy emphasizing tests, competition, and a consumer attitude towards education (Blum, 2023) – an attitude that avoids critical questions about the ICT-ESD complexity (Selwyn, 2017). In mitigating this lack of experience, promoting these critical questions, and providing students with some control, several support structures helped students' progress. The project was the students' first steps towards self-determination as teachers. Thus, it is essential to clarify to students why this is important (Biesta, 2010). As professional teachers, they need to make and argue for their own choices, especially when facing future educational technology (Macgilchrist et al., 2024; Pieper et al., 2023) and to explore new ways of learning and being in the world (Jickling & Wals, 2013).

Second, in this project, support was provided for students' descriptions of how the tools position pupils and knowledge (Mills et al., 2023). However, this positioning needs to be connected to a vision of sustainability. Thus, it becomes a question of how the knowledge helps pupils relate to and exist in the world (Jickling & Wals, 2013) and how relating and being can contribute to a more just postdigital future (cf. Lindberg & Haglind, 2024; Ragnedda, 2020). Raising such questions and letting the students reflect on them can enable students to regard school, content, and pupils as interweaved with political and economic aspects of society (Pieper et al., 2023). In other words, this project underpins an understanding of education as something a teacher must continuously analyze against society and foundational values (Giroux, 2018).

Third, in the first cycle of the project, the students were tasked with analyzing their chosen tool in a sustainability perspective, and in the second cycle, this was reduced to

choosing one of the dimensions of sustainability (Gamage & de Silva, 2022). Even if the students chose the environmental or social dimension (none chose economic), their analyses of the tool in regard to their chosen dimension became somewhat shallow. In hindsight, this is not unexpected, as the dimensions are in themselves complex and are connected (Gamage & de Silva, 2022), and students had a time limit and were perhaps not provided with suitable support. To create more holistic approaches to ESD, transdisciplinary connections and deeper understandings are essential (see, e.g., Salite et al., 2024). Even if holistic is used without any philosophical underpinnings in this context (see, e.g., Pipere, 2019) it captures the aim of rising awareness of how ICT is intertwined with sustainability. To create connections and deeper understandings proved difficult in this project and there is a profound risk that the shallowness in this project provides students with “feel-good ESD”, where nothing substantial is changed (Jickling & Wals, 2013). However, if these dimensions become integrated throughout the teacher education program and there are recurrent possibilities for analyses and reflections, this project can act as a step toward a more holistic understanding of ESD.

Ultimately, the question arises of whether a project such as this actually contributes to sustainability, as ICT gadgets hardly can be argued to be environmentally friendly in themselves and ICT tools have several problematic economic and social implications. However, student teachers in Norway need to prepare for postdigital education; thus, there is a dire need for them to reflect on consequences for the environment, social relations and their pupils’ enactment of knowledge, skills, attitudes, and ethical issues – a more holistic approach to ICT within the frame of ESD. This project alone cannot claim such an achievement, but throughout the five-year program, the students have the opportunity to become aware of and reflect on ESD in different contexts. Based on my reflections on the present study, there is a further need to discuss ideas on ICT and ESD with colleagues, and through experience and research, gradually transform the program in collaboration with the students and other stakeholders. Such a transformation will be somewhat open-ended, depending on input from both scholarly and practice-based discussions. Hopefully, this study can spark a wider discussion about transforming ICT in teacher education within the frame of ESD.

Acknowledgement

A heartfelt thank you to my colleagues Nina Elisabeth Arnesen and Siv Paus Brovold for their valuable contribution to the project and for thoughtfully reading and commenting on drafts of this article.

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