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FUTURES LITERACY: CONNECTIONS BETWEEN DIGITALITY AND SUSTAINABILITY IN EDUCATIONAL CONTEXTS

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Abstract

Futures Literacy is defined as the ability to imagine, understand, and prepare for possible futures, empowering individuals and organizations to act proactively in the present, specifically aiming at shaping preferable futures. This competence is regarded as one of the key qualifications of the 21st century, fostering both individual agency in managing uncertainty and collective engagement for societal transformation. This contribution explores the connection between Futures Literacy and education within a culture of Digitality, particularly against the backdrop of the VUCA world (Volatility, Uncertainty, Complexity, Ambiguity). The transformation towards a transformative education is essential to equip learners for the challenges of rapid technological change and complex societal demands. The integration of Digitality and Futures Literacy necessitates a systematic anchoring in teacher education, a critical digital professionalization, and a shift towards a participatory and collaborative teaching culture. Future research should focus on the epistemological foundations, empirical application in digital contexts, and the ethical implications

of technological components like Artificial Intelligence and Big Data in anticipation processes. The overarching goal of futures education is to question and disrupt the way we anticipate the future, making the verification of paradigms a key strategy for overcoming the crises of the Anthropocene.

Keywords:
Futures Literacy, Media Literacy, Digitality, Transformative Education, VUCA World (Volatility, Uncertainty, Complexity, Ambiguity)

1. Introduction

What is futures literacy and how does it relate to education in a culture of digitality? What does it mean to be futures literate in a culture of digitality, how do the concepts complement each other, how do they influence each other, and what contradictions can be identified? This article will explore these questions.

Futures literacy refers to the ability to imagine possible futures, understand them and prepare for them. This enables individuals and organisations to act with foresight in the present and aims in particular to shape preferable futures. The concept is becoming increasingly important in various areas such as education, policy-making and technological development (UNESCO, 2021). The importance of futures literacy is particularly evident in two key aspects. Firstly, futures literacy strengthens individuals' ability to act by enabling them to cope with uncertainty and make informed decisions for the future (Aranda Muñoz et al., 2023). Second, it contributes to social transformation by promoting collective engagement and encouraging cooperation to actively shape desirable futures (Sippl, 2024).

A wide range of planning horizons and methods can be combined with seemingly absurd imagination. Futures literacy enables us to become aware of the sources of our hopes and fears. It allows us to recognise the diversity of the world and to better assess the consequences of the decisions we have to make. That is why futures literacy is considered one of the key skills of the 21st century (UNESCO, 2021). While education for sustainable development aims to promote competencies for sustainable, equitable and future-proof action, futures literacy broadens this perspective by strengthening the ability to imagine and understand different possible futures and to derive options for action in the present from them. The combination of these two approaches results in an educational approach that not only imparts knowledge about sustainable development, but also empowers learners to design desirable futures and actively shape them.

The application of futures literacy extends across various contexts. In the field of education, initiatives such as the UNESCO Chair focus on integrating futures literacy into teacher training in order to create participatory learning environments (Sippl, 2024). In addition, artistic interventions, such as workshops that combine speculative thinking and artistic methods, have helped to strengthen futures literacy. Such approaches encourage people to critically question existing ideas about technology and future scenarios and to develop new perspectives (Bergheim,

2020). Enabling imagination and anticipation are key competencies for the Anthropocene. Enabling imagination refers to making alternative and novel futures beyond ingrained patterns of thought conceivable in order to overcome the reductionism of deterministic forecasts. Our task is not only to prepare children for a future we do not know, but also to guide them in imagining different futures (Bartosch et al., 2023, p. 112). Previous efforts to think about the future have mostly been attempts to overcome uncertainty and make sense of complexity, "to colonise tomorrow with the ideas of today" (Larsen et al., 2020). Experts were consulted in this task, who derived possible and desirable future scenarios based on historical or current developments. However, this approach leads to a narrowing of assumptions about the future:

"They have limited our ability to imagine outside predefined paradigms, or to sense and make sense of phenomena that may not belong to pre-existing models. Imagined futures that do not arise from efforts to address what is currently deemed probable or desirable have no place in mainstream thinking" (Larsen et al., 2020).

A central goal of this futurology is therefore to overcome this reductionism and make novel, previously invisible phenomena tangible. Anchoring future studies in formal school education is therefore a key concern.

2. Current Discourses

2.1 Challenges of the VUCA World

The question arises as to how futures literacy can be linked to education in the context of digitality. There are several connections here. The first question that comes to mind is what kind of world we should be preparing learners for and, by extension, which skills will be particularly important in the future. The concept of the VUCA world describes a future characterised by volatility (rapid, unpredictable change), uncertainty (lack of knowledge about the occurrence of events), complexity (numerous, interrelated factors) and ambiguity (ambiguity and uncertainty of situations). This concept describes an environment that was originally introduced by the US military to analyse the post-Cold War era. In order to prepare learners for this VUCA world, education must also evolve to integrate digital literacy and futures literacy (Höfler et al., 2023, p. 346). This development towards transformative education is essential to enable learners to go beyond mere adaptability to the responsible co-creation they need to cope with rapid technological change and complex social demands and to actively shape desirable futures (Dumbuya, 2024; Tarmann, 2024). Nevertheless, these efforts are often hampered by rigid educational structures

that make it difficult to integrate innovative teaching methods and thus fail to adequately address the skills relevant to life in the 21st century. While the integration of digital literacy and futures literacy is crucial, it is also important to consider the potential disadvantages of technology use, such as the risk of excessive dependence on technology, which can impair basic interpersonal skills and critical thinking (Filk, 2020; Dadaczynski et al., 2025).

2.2 Education in a Culture of Digitality

Digital skills are a fundamental ability that enables learners to use technology effectively and navigate the digital world successfully (Sari et al., 2024). They are considered essential for participation in the social and professional life of the future, which is why the European Commission emphasises the need to teach these skills early on in order to ensure equal opportunities (European Commission, 2022). Accordingly, digital competence models have been and continue to be developed for students, teachers and citizens in general (Brandhofer, 2022; Carretero et al., 2017; Ehlers et al., 2023; Ferrari, 2013; Redecker, 2017). It should be noted that digital competences are perceived comprehensively in relation to the culture of digitality. The use of digital media in the teaching and learning process, learning with digital media, is only one aspect of formal education. The perspective broadens when teaching and learning about digital media is included (Brandhofer et al., 2019; Döbeli Honegger, 2016, p. 43). This includes both media and IT education, which encompass engagement with the digitalised world and the development of reflective skills in dealing with digital media. Another relevant aspect is learning through digital media, which refers to various forms of adaptive learning systems. At the same time, however, they also represent a distraction – through constant availability, digital stimuli and the fear of missing out (Kroll, 2018, p. 236; Wampfler, 2018, p. 111). Therefore, the ability to avoid distractions and focus attention, learning despite digital media, is one of the key competencies of the 21st century (Allmers et al., 2022, p. 102).

Education and training under the conditions and contexts of digitality encompasses these four perspectives and goes far beyond them (Brandhofer & Wiesner, 2023a). The formal characteristics of referentiality, communality and algorithmisation characterise all cultural processes under the conditions of digitality (Meder, 2004, p. 46; Stalder, 2016, p. 95). This approach requires a reorientation of educational content and methods.

This includes educational institutions developing concepts that anchor digital skills not in isolation, but in the context of future-oriented competencies. Digital competence represents the

fundamental ability to use technology effectively and participate, while the importance of critical media literacy for future-oriented thinking forms a crucial, reflective extension. Critical media literacy, as the ability to critically reflect on the use of digital media and its social impact on future ideas, is, in this sense, the necessary ability to critique media. Learners must be able to evaluate digital information and reflect on its influence on ideas about the future (Parveen et al., 2024).

2.3 Digital Applications as Enablers for Future Thinking

The transformation of leading media brings with it a multitude of new learning opportunities (Brandhofer & Wiesner, 2023a). Digital media open up new horizons for learning and experience. Digital simulations, virtual reality (VR) and other technologies therefore enable learners to explore and experience different future scenarios. This promotes systematic reflection on possible, probable and desirable futures – a core aspect of futures literacy. The use of digital media also goes hand in hand with the establishment of new learning formats. Hybrid and virtual learning environments can be seen as an opportunity to make futures literacy tangible. For example, virtual scenario workshops, serious games and hybrid learning environments are used to make futures literacy tangible and to support engagement with different future perspectives (Miller, 2007). Collaborative online projects also enable learners to develop and discuss future scenarios together. In this sense, digital applications facilitate collaboration and exchange between students (Rau & Rieckmann, 2023; Tolks & Sailer, 2021).

In the context of futures literacy, digital media support the core processes of future-oriented thinking: learners can visualise different possible and desirable futures, question assumptions, explore alternative courses of action and assess their potential consequences. Collaborative online tools such as Miro or Padlet allow scenarios to be created, discussed and iteratively developed together. Simulations or VR environments make complex interrelationships immediately tangible and enable reflections that would only be possible to a limited extent in purely analogue teaching. In this way, digital media specifically expand the didactic approaches to future education and promote active, reflective engagement with future developments on the part of learners (Hauck-Thum et al., 2023).

2.4 Computational Thinking

Making alternative futures conceivable is a central concern of futures literacy. Computational thinking (CT) as an approach can be an important building block in this endeavour.

Like futures literacy, computational thinking is also dedicated to making things conceivable and anticipating them. Computational thinking is a problem-solving approach based on concepts from computer science, but it can be applied in various disciplines. It involves a systematic process in which problems are broken down into manageable parts, patterns are identified, essential details are abstracted, and algorithms are designed to solve them. This approach has gained considerable attention in education and professional development because it promotes analytical and critical thinking skills (Antonitsch & Hanisch, 2014; Brandhofer & Tengler, 2023; Computer Science Teachers Association, 2014). Re-examining paradigms and deeply rooted patterns of thinking and abandoning them where necessary is becoming an essential strategy for addressing the crises of the Anthropocene. CT goes beyond pure programming and encompasses a systematic approach to problem solving that can also be used in non-technical contexts. A particular strength of CT lies in its narrative component, which makes it possible to explain complex issues in an understandable way through the structured presentation of problems and solutions in the form of comprehensible step-by-step sequences (Lavigne & Wolsky, 2021). This narrative form helps learners to formulate problems clearly, recognise cause-and-effect relationships and develop possible solution strategies logically. By depicting problem-solving processes narratively, CT not only promotes analytical thinking, but also the ability to communicate actions and decisions in a comprehensible manner. In this sense, CT contributes significantly to systematically addressing challenges and designing transparent solutions.

2.5 Learning Paradigms and Computational Empowerment

In order to meet the challenges associated with sustainability issues, innovative educational approaches are needed in addition to those that use digital media as enablers. One such approach is computational empowerment (CE), which takes up the ideas of computational thinking and expands them to include school administrative, pedagogical and didactic aspects. Computational empowerment refers to the ability and process by which individuals and communities gain control over technological tools and digital infrastructures to meet their own needs and goals. This concept encompasses not only the teaching of programming and computer skills, but also the promotion of a deep understanding of the ethical, social and political implications of technology (Tissenbaum et al., 2017, p. 1706). Computational empowerment enables people to think critically about the use of technology, develop innovative solutions and actively participate in shaping a more equitable and sustainable digital society. For example,

simple applications can be programmed in class that address and visualise energy consumption in schools and at home. In doing so, students discuss not only the technical implementation, but also ethical issues such as fairness and environmental sustainability. In this sense, CE aims to reduce the digital divide and strengthen the autonomy and capacity for action of marginalised groups by providing them with the means and knowledge to act and shape the digital world. Computational empowerment is therefore not only concerned with the what of digital education, but also with the how (Iversen et al., 2018). Self-determination, participation and solidarity are important components of the concept, which are of particular significance in the transition from a book culture to a network culture (Brandhofer & Wiesner, 2023b; Göbl et al., 2023; Stalder, 2018). Project-based learning as a building block of CE has proven to be an effective method, as it actively involves students in real-world projects, thereby promoting their problem-solving skills and teamwork (Tiandem-Adamou, 2024). The digital transformation and the examination of futures literacy also require a change in the learning culture (Hauck-Thum & Franz, 2023), a change that is envisaged in the CE concept. By taking varying practices into account and encouraging collaborative exchange, children's knowledge can be used to make alternative futures tangible.

These discourses illustrate the close link between digitality and futures literacy in education and underscore the need to adapt education systems to the challenges and opportunities of an increasingly digitalised and uncertain future.

3. Research Perspectives

The previous chapter attempted to present the current discourses on the topic in a structured manner. Many of these approaches are exploratory, which is not surprising given the topic of futures literacy. This also opens up numerous research perspectives, including both theoretical and application-oriented questions. In particular, the interactions between digital technologies and the ability to anticipate and shape future developments are increasingly becoming the focus of scientific analysis (Cuhls & Kuwahara, 2020; Mazé, 2020). A central research approach lies in the in-depth theoretical reflection on the epistemological foundations of futures literacy in a culture of digitality. This raises the question of the extent to which digital technologies not only provide new tools for anticipating the future but also change our understanding of the future itself. The investigation of the role of digital narratives, algorithmically generated futures

and the dynamics of collective imagination in virtual spaces is of particular relevance here (Jenkins, 2006).

In addition to theoretical foundations, empirical research on the application of futures literacy in digital contexts is needed. Qualitative and participatory methods that analyse the practice of shaping the future in digital environments are particularly relevant here. Research questions may relate, for example, to the role of actor networks, the use of immersive technologies for visualising the future, or the effectiveness of digitally supported future processes. Investigating how different social groups use digital applications to design and discuss alternative future scenarios also offers a promising field of research.

Another important area is the technological dimension of futures literacy. The increasing link between anticipation processes and artificial intelligence, big data and algorithmic decision-making systems raises questions about the potential, but also the limitations, of these technologies (Sfetcu, 2024). This presents the challenge of rethinking human future skills in the context of machine learning and data-driven forecasts, thereby counteracting the risk of restricting the scope for action. The ethical and social implications of digital futures must also be critically reflected upon. After all, another relevant topic is the consumption of resources by digital technologies in general and the operation of AI systems in particular (OECD, 2022; Ligozat et al., 2022). In doing so, it is important to consider mechanisms for ensuring transparency, participation and fairness in digital future processes. Finally, these perspectives also open up opportunities for interdisciplinary collaboration. Linking futures literacy with media and communication studies, design research, social sciences and technology assessment can provide new methodological and conceptual impetus.

4. Professionalisation Needs in Teacher Training

Advancing digitalisation and the growing importance of futures literacy require a reorientation of teacher training in order to meet future challenges. Teachers are faced with the task of not only using digital technologies competently but also promoting future-oriented ways of thinking that enable a reflective and critical examination of future developments. This gives rise to specific professionalisation needs that must be addressed at both the conceptual and methodological-didactic levels.

A key requirement is the systematic anchoring of futures literacy as an integral part of teacher training. Teachers must be empowered to develop and impart future skills that enable them to prepare pupils for complex and uncertain developments. Against the backdrop of global challenges such as climate change, resource scarcity and social inequality, which are central dimensions of education for sustainable development, a curricular adaptation of teacher training and continuing education programmes is necessary.

The aim is to systematically integrate future thinking, scenario techniques and creative anticipation methods into educational practice. Closely linked to this is the need for digital professionalisation. Teachers must not only acquire basic digital skills, but also develop a critical understanding of the social and epistemic implications of digital technologies. This includes reflection on algorithmic decision-making processes, the influence of artificial intelligence on educational processes and the role of digital platforms in shaping the future. Professional development programmes should therefore increasingly incorporate interdisciplinary perspectives in order to enable a holistic examination of the digitality of the future.

A further need for professionalisation arises from the necessity for a participatory and collaborative teaching culture. Future-oriented educational processes require new forms of cooperation between teachers, learners and other actors from science, business and society. Teachers must therefore not only be enabled to use digital applications for collaboration and networking, but also to develop innovative pedagogical concepts based on openness, interdisciplinarity and co-creation.

Finally, the changing educational landscape requires increased reflection on the ethical and social implications of future education in digital contexts. Teachers need strategies for dealing with normative issues and anchoring critical thinking about possible, probable and desirable futures in their educational work. This also implies professionalisation in the areas of values education, democracy promotion and critical media education.

In summary, it is clear that comprehensive adjustments are needed in teacher training in order to meet the requirements of a digital and future-oriented educational world.

5. Conclusion

The goal of futures literacy is to give meaning to thinking by questioning and disrupting the way we anticipate the future. Examining paradigms and ingrained patterns of thinking and, if

necessary, abandoning them will be an important strategy for coping with the crises of the Anthropocene. Digitality, in turn, shapes our society and changes how we learn and work. Futures literacy is becoming increasingly important in this digital world, and digital media offer new opportunities for innovative learning methods, helping us to understand complex issues and develop alternative courses of action.

References

Allmers, S., Magnussen, C., & Trautmann, M. (2022). *On the way to new work: Wenn Arbeit zu etwas wird, was Menschen stärkt*. Vahlen.

Antonitsch, P., & Hanisch, L. (2014). *Computational Thinking im Unterricht der Primarstufe*. IMST.

Aranda Muñoz, Á., Bozic Yams, N., & Carlgren, L. (2023). Co-designing technological explorations in developing futures literacy through speculative design and an artistic intervention. *Proceedings of the Design Society*, *3*, pp. 957–966. https://doi.org/10.1017/pds.2023.96

Bartosch, R., Adone, D., Hoydis, J., Junker, K., Kumar, S., & Rigby, K. (2023). Zukunftsgestaltungskompetenz im Angesicht der Katastrophe: Ecological literacy als mehrdimensionale Herausforderung. In *Futures Literacy. Zukunft lernen und lehren* (pp. 111–122).

Bergheim, S. (2020). *Zukünfte – Offen für Vielfalt: Das Handbuch für den klugen Umgang mit dem Später* (2nd edition). epubli.

Brandhofer, G. (2022). Digi.kompP. Digitale Kompetenzen für personalisiertes Lernen. *on. Lernen in der digitalen Welt*, *11*, pp. 7–9.

Brandhofer, G., Baumgartner, P., Ebner, M., Köberer, N., Trültzsch-Wijnen, C., & Wiesner, C. (2019). Bildung im Zeitalter der Digitalisierung. In S. Breit, F. Eder, K. Krainer, C. Schreiner, A. Seel, & C. Spiel (Eds.), *Nationaler Bildungsbericht Österreich 2018, Band 2: Fokussierte Analysen und Zukunftsperspektiven für das Bildungswesen* (pp. 307–362). Leykam. https://www.bifie.at/nbb2018/

Brandhofer, G., & Tengler, K. (2023). Mit Computational Thinking zu Futures Literacy. In C. Sippl, G. Brandhofer, & E. Rauscher (Eds.), *Futures Literacy Zukunft lernen und lehren* (1. Auflage, pp. 61–71). Studien Verlag.

Brandhofer, G., Tengler, K., & Schrammel, N. (2023). Lernen trotz Corona. Evaluierungsergebnisse und Erkenntnisse aus der Phase des Lernens zu Hause. In S.

G. Huber, C. Helm, & N. Schneider (Eds.), *COVID-19 und Bildung – Studien und Perspektiven* (pp. 471–492). Waxmann.

Brandhofer, G., & Wiesner, C. (2023a). Wirkmächtige Mediendidaktik. In G. Brandhofer & C. Wiesner (Eds.), *Didaktik in einer Kultur der Digitalität. Wirkmächtige Mediendidaktik, zukunftsorientierte Pädagogik* (pp. 17–38). Julius Klinkhardt.

Brandhofer, G., & Wiesner, C. (2023b). Zukunftsorientierte Pädagogik – Die Leitmedientransformation als Auslöser der Neuorientierung. In G. Brandhofer & C. Wiesner (Eds.), *Didaktik in einer Kultur der Digitalität. Wirkmächtige Mediendidaktik, zukunftsorientierte Pädagogik* (pp. 9–16). Julius Klinkhardt.

Burchert, J., & Burchert, M. (2018). Berufsbezogenes Lernen mit Twitter und YouTube: Social Media als amorpher Raum für Vernetzung und für die Bildung von Lerngemeinschaften. *MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung*, *30*, pp. 36–49. https://doi.org/10.21240/mpaed/30/2018.02.28.X

Carretero, S., Vuorikari, R., Punie, Y., European Commission, & Joint Research Centre. (2017). *DigComp 2.1. The digital competence framework for citizens with eight proficiency levels and examples of use.*

Computer Science Teachers Association. (2014). *CSTA - Computational Thinking*. Computational Thinking. https://csta.acm.org/Curriculum/sub/CompThinking.html

Cuhls, K., Dönitz, E., Erdmann, L., Gransche, B., Kimpeler, S., Schirrmeister, E., & Warnke, P. (2024). Foresight: Fifty years to think your futures. In *Systems and innovation research in transition: Research questions and trends in historical perspective* (pp. 73-106). Cham: Springer Nature Switzerland.

Dadaczynski, K., Kaman, A., Ravens-Sieberer, U., & HBSC-Studienteam. (2025). Problematische Nutzung digitaler Medien und Gesundheitskompetenz von Schülerinnen und Schülern in Deutschland: Befunde der HBSC-Studie 2022. *Bundesgesundheitsblatt - Gesundheitsforschung - Gesundheitsschutz, 68*, 302-312. https://doi.org/10.1007/s00103-025-04008-6

Döbeli Honegger, B. (2016). *Mehr als 0 und 1* (1. Aufl.). hep verlag.

Dumbuya, E. (2024). Developing a framework for revising the curriculum to incorporate future skills such as digital literacy, critical thinking and adaptability, while aligning with global standards. *International Journal of Science and Research Archive, 13*(2), pp. 2807–2810. https://doi.org/10.30574/ijsra.2024.13.2.2483

Ehlers, U.-D., Lindner, M., Sommer, S., & Rauch, E. (2023). AICOMP - Future Skills in a World Increasingly Shaped By AI. *Ubiquity Proceedings*. https://doi.org/10.5334/uproc.91

Europäische Kommission. (2022, Juni 18). *Empfehlung des Rates zu Schlüsselkompetenzen für lebenslanges Lernen—European Education Area*. European Education Area. https://education.ec.europa.eu/de/focus-topics/improving-quality/key-competences

Ferrari, A. (2013). *DIGCOMP a framework for developing and understanding digital competence in Europe.* Publications Office of the European Union.

Filk, C. (2020). „Die Maschinen werden zu einer einzigen Maschine".: Eine technikphilosophische Reflexion auf ‚Computational Thinking', Künstliche Intelligenz und Medienbildung. *Medienimpulse, 58*(1), https://doi.org/10.21243/mi-01-20-18

Göbl, B., Guenther, E. A., Kayali, F., & Frauenberger, C. (2023). Situating computational empowerment in formal education: A multi-perspective view. *International Journal of Child-Computer Interaction*, *38*, 100604. https://doi.org/10.1016/j.ijcci.2023.100604

Hauck-Thum, U., & Franz, F. (2023). ‹Ich nenn' sie einfach Rotzilator›: Multimodale Textbegegnung als Bildungschance für Kinder mit heterogenen Lernvoraussetzungen im Lese- und Literaturunterricht der Grundschule. *MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung*, *52*, pp. 64–84. https://doi.org/10.21240/mpaed/52/2023.02.04.X

Heidegger, M. (2006). *Sein und Zeit* (19. Aufl.). De Gruyter.

Höfler, E., Sippl, C., Brandhofer, G., & Rauscher, E. (Eds.). (2023). Connectivism, VUCA und Futures Literacy. Versuch einer Synthese. In *Futures Literacy. Zukunft lernen und lehren* (pp. 343–352). Studienverlag. https://doi.org/10.53349/oa.2022.a2.170

Iversen, O. S., Smith, R. C., & Dindler, C. (2018). From Computational Thinking to Computational Empowerment: A 21st Century PD Agenda. *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1*, 7:1-7:11. https://doi.org/10.1145/3210586.3210592

Jenkins, H. (2006). *Convergence culture: Where old and new media collide.* New York University Press.

Kroll, M. (2018). *achtsam lernen: Psychische Gesundheit systemisch bilden*. Logos Verlag Berlin GmbH.

Lavigne, H., & Wolsky, M. (2021). *Using stories to support computational thinking*. Edutopia. https://www.edutopia.org/article/using-stories-support-computational-thinking/

Larsen, N., Kæseler Mortensen, J., & Miller, R. (2020). What Is 'Futures Literacy' and Why Is It Important? *Scenario*. https://medium.com/copenhagen-institute-for-futures-studies/what-is-futures-literacy-and-why-is-it-important-a27f24b983d8

Ligozat, A.-L., Lefevre, J., Bugeau, A., & Combaz, J. (2022). Unraveling the Hidden Environmental Impacts of AI Solutions for Environment Life Cycle Assessment of AI Solutions. *Sustainability*, *14*(9), 5172. https://doi.org/10.3390/su14095172

Mazé, R. (2020). Design and Other Ways of Knowing the Future. In: Glückler, J., Garschagen, M., Panitz, R. (Eds.) *Placing the Future. Knowledge and Space*, vol 20. Springer, Cham. https://doi.org/10.1007/978-3-031-76841-5_12

Meder, N. (2004). Der Sprachspieler: Der postmoderne Mensch, oder, das Bildungsideal im Zeitalter der neuen Technologien. Königshausen & Neumann.

Miller, R. (2018). *Transforming the future: Anticipation in the 21st century.* Routledge/UNESCO.

OECD (2022). *Measuring the environmental impacts of artificial intelligence compute and applications* (OECD Digital Economy Papers). OECD Publishing. https://doi.org/10.1787/7babf571-en

Parveen, A., Bashir, F., Nazir, A., Zimik, P. N., & Jan, S. (2024). Pedagogical Strategies for Developing Digital Literacy. In K. B. Prager & N. Bilge (Eds.), *Advances in*

Educational Technologies and Instructional Design (pp. 255–274). IGI Global. https://doi.org/10.4018/979-8-3693-2591-9.ch011

Rau, F., & Rieckmann, M. (2023). Bildung in einer Kultur der Nachhaltigkeit und Digitalität: Eine vergleichende Betrachtung grundlegender Diskurse und Konzepte. *MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung*, *52*, pp. 21–46. https://doi.org/10.21240/mpaed/52/2023.02.02.X

Redecker, C. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu* (Y. Punie, Eds.). Publications Office of the European Union.

Sari, D. N., Soamole, A., & Marsella, P. E. (2024). Preparing student's competencies to face the challenges of the vuca (volatility, uncertainty, compexity, ambiguity) era. *Journal of Development Economics and Digitalization, Tourism Economics*, *1*(3), pp. 181–190. https://doi.org/10.59407/jdedte.v1i3.926

Sfetcu, Nicolae. (2024). The Ethics of Artificial Intelligence. *SSRN Electronic Journal*. 10.2139/ssrn.4957094.

Simanowski, R. (2021). *Digitale Revolution und Bildung: Für eine zukunftsfähige Medienkompetenz* (1. Aufl.). Beltz Juventa.

Sippl, C. (2024). Denkraum Zukünfte I: Zukünfte lernen und lehren im Anthropozän. *#schuleverantworten*, *4*(2), pp. 173–178. https://doi.org/10.53349/schuleverantworten.2024.i2.a435

Stalder, F. (2016). *Kultur der Digitalität* (original edition). Suhrkamp Verlag.

Stalder, F. (2018). *The Digital Condition* (V. A. Pakis, translator). Polity Press.

Tarmann, P. R. (2024). Transformative Bildung. In J. Jakob & P. R. Tarmann (Eds.), *Begriffe und Diskurse zu Nachhaltigkeit*.

Tiandem-Adamou, Y. M. (2024). Navigating the Digital Era and Future Workplaces: Cultivating Critical Skills for Success in the 21st Century. In G. Huzooree & H. Chandan (Eds.), *Advances in Higher Education and Professional Development* (pp. 1–36). IGI Global. https://doi.org/10.4018/979-8-3693-3856-8.ch001

Tissenbaum, M., Sheldon, J., Seop, L., Lee, C., & Lao, N. (2017). *Critical computational empowerment: Engaging youth as shapers of the digital future*. pp. 1705–1708. https://doi.org/10.1109/EDUCON.2017.7943078

Tolks, D., & Sailer, M. (2021). Gamification als didaktisches Mittel in der Hochschulbildung. In Geschäftsstelle beim Stifterverband (Eds.), *Digitalisierung in Studium und Lehre gemeinsam gestalten* (pp. 515–532). Springer Fachmedien Wiesbaden. https://doi.org/10.1007/978-3-658-32849-8_29

UNESCO. (2021). *Futures Literacy*. UNESCO. https://en.unesco.org/futuresliteracy/about

Wampfler, P. (2018). *Generation »Social Media«: Wie digitale Kommunikation Leben, Beziehungen und Lernen Jugendlicher verändert*. Vandenhoeck & Ruprecht.