CRITICAL BILDUNG: SOCIETY AS 'ALGORITHMIC SOCIAL MACHINE'? MACHINE METAPHORS FOR THE DIGITAL ENLIGHTENMENT

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Focus Topics: Explanatory Models, Learning Material

Images for critical orientation

The digital transformation is realigning the triangle of interactions between the individual, social and technological worlds. But how can educational practice connect to current issues of datafication and algorithmic regulation, which are increasingly influencing society and everyday life? How can appropriate orientation knowledge be imparted that goes beyond individual tool use in dealing with digital technologies and includes *socio-technical and societal dimensions*? Can working with metaphors and images be pedagogically useful here?

The metaphorical-conceptual image of society as an 'algorithmic social machine' proposed here opens projection and reflection surfaces for questioning phenomena and processes of datafication. If this machine image is deconstructed, normative-ethical questions arise about the underlying image of humanity and the idea of the social world as a 'machine' - questions that not only concern computer science education, but also political, cultural, linguistic and ethical education.

Datafication and Digital Enlightenment

The datafication of everyday life and the use of AI and algorithms in social processes are increasingly shaping the world we live in and our society as a socio-technical system (Schuilenburg/Peeters 2020). From relevant perspectives, such as communication studies, critical data studies and science and technology studies, "the increasingly tight coupling between algorithmic processes, social structures, and subjectivities" (Burrell/Fourcade 2021, p. 213) is being intensively researched. This has led to a whole series of socio-technical analyses of phenomena and images of society in which the significance of progressive datafication is addressed and questions are raised about the governance function of algorithms (Cristianini/Scantamburlo 2020; Yeung 2017). Furthermore, critical diagnoses of society address the asymmetries of information and power through corporations in the digital economy (Zuboff 2018) and the limitations of data protection, privacy and self-determination as well as the dangers of algorithmic discrimination (O'Neil 2016). For some years now, various discourses have been calling for "digital enlightenment" and the promotion of reflection and critical self-determination for all citizens in the digital society (see, for example, the Digital Enlightenment Yearbooks 2012-2014 or Helbing 2019). In addition to application skills, numerous concepts in the discourse also bundle these critical educational dimensions, such as "critical (big) data literacy", "data infrastructure literacy", "critical datafication literacy" etc. (Sander 2024 and bigdataliteracy.net/glossary – in German).

Critical Awareness and Systemic Levels of Datafication

These critical and evaluative approaches are also relevant in the school context. Under the heading "Computer science, people and society" in the core curricula for computer science for grades 5-6 in the state of NRW, Germany (Kernlehrplan 2021, p. 14, transl. HG), for example, it says: "IT systems interact intensively with individuals and society and thus have a special significance for the living and working world. Progress in the field of digital processing of personal data is of great benefit, but also harbours dangers. The development of a critical awareness enables orientation in this field of tension." But how can this "critical awareness" be fostered for orientation in the digital world? How can critical conceptualizations be developed "that *place critical thinking and reflection at their core* and focus on promoting a broader critical reflection of the *structural and systemic levels of datafication* that are becoming deeply engrained into today's societies and *how to effectively challenge them*" (Sander 2024, p. 46). How can a corresponding orientation knowledge, which goes beyond individual tool use and includes systemic-societal and socio-technical dimensions, be outlined in more detail for educational purposes?

Digital Social Machines

As a contribution to answering these questions, the image and conceptual metaphor of society as a digital Social Machine will be presented and discussed. The machine metaphor has a centuries-old radius of thought, which has received a strong new impetus in the digital age through "social physics" (Pentland 2014) and neo-cybernetic ways of thinking. The term "social machine" relevant here is not clearly defined and is the subject of typologies (Shadbolt et al. 2019), and can be applied to socio-technical systems of different scopes, such as collaborative web applications (Berners-Lee/Fischetti 1999), smart cities (Ahlers et al. 2016) or to society as a whole: "Society as a digital social machine?" asks the sociologist Lamla (2020) and reconstructs an "infrastructural development from the platform economy to the cybernetic control society". In her theory of surveillance capitalism, Zuboff (2018, p. 121) illustrates the digital creation of value from human behavior with the help of a gear-driven machine and concludes with the critical subversive call "Be sand in the gears". In her blog entry, Hasselbalch (2015), a member of the EU's High-Level Expert Group on AI, presents another type of digital social machine, drawing on metaphors from the industrial age: "The Destiny Machine". "We live in a society run by Destiny Machines. A Destiny Machine is one that uses machine readable people to produce destinies. It is an 'industrial metaphor' that mines and processes the "new oil" of today. The cause and the effect is the material of the machine. The destiny is the product" (Hasselbalch 2015).
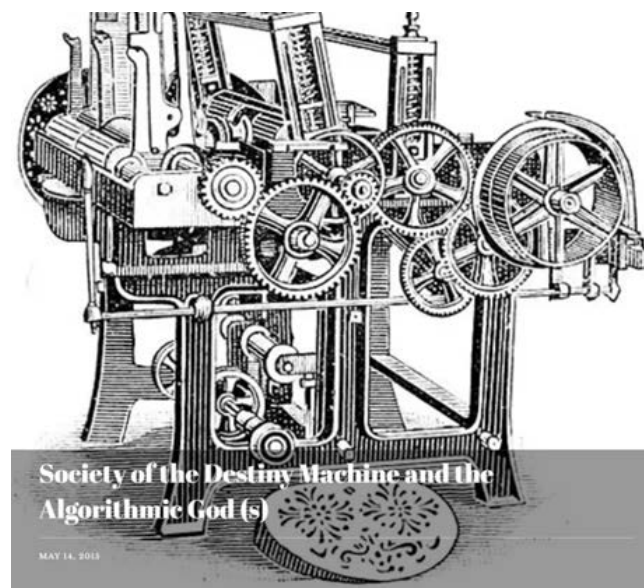
**Figure 1: "Society of the Destiny Machine and the Algorithmic God(s)",
source: Hasselbalch (2015)**

The "Algorithmic Social Machine" in School?

The metaphorical concept of the "Algorithmic Social Machine" (ASM) as a brief visual description of today's society opens a variety of projection and reflection surfaces for critical educational practice (Gapski 2023, 2025). In this contribution, metaphorical ways of speaking (Wyatt 2021) and exemplary visual concepts in the digital-social context of the classical machine metaphor will be presented and a pedagogically work-in-progress visualization design for an algorithmic social machine will be put up for discussion. This design should help to relate individual phenomena of the digital world to each other and link them to scientifically grounded lines of explanation. Central to the explanatory power of the "Algorithmic Social Machine" is the understanding of a data-driven control chain that leads from any action to the necessarily generated data, to the evaluating algorithms, and finally to an output with social effects. Reflection questions can be asked for each element of this control chain in an

educational context. This central control chain is linked to two *feedback loops*: The individual feedback loop of behavior control, in which lies the individual's meaningful lifeworld with its social media posts and likes as well as the unconsciously generated observation, connection and metadata. The second loop can be interpreted as 'social systems engineering feedback'. The socio-technical systems of companies and authorities are integrated into this feedback loop as actors with their "data infrastructures" (Gray et al. 2018: 3). The individual and the sociotechnical system interact between the data infrastructure and the target values contained therein in comparison with the actual values of the collected, analyzed and evaluated data. This is where the "algorithmic regulation" of population groups comes into play, which is influenced or dynamically controlled in their current and future behavior in the cybernetic three-step process of "information gathering and monitoring", "standard-setting" and "behavior modification" (Yeung 2017). With regard to use in schools, it will be necessary to discuss how this reflection process can be didactically designed with the help of this machine metaphor in order to make the "structural and systemic levels of datafication" understandable. This can also be done using existing learning resources, for example those collected in the database of the Critical Big Data and Algorithmic Literacy Network (www.bigdataliteracy.net/database).

The Generator of Critical Questions

The digital transformation requires new educational efforts and new insights into the socio-technological 'machine room' in order to understand how, for example, psychometric micro-targeting, the digital surveillance economy and machine learning interact when using the smart phone every day. Several fields of expertise and knowledge domains - computer science, media education, economy, psychology, ethics and politics - must be brought together in a new way. Our life in algorithmic social machines is giving rise to a concept of education that goes far beyond the teaching of "digital skills". While the concept of skills fits into the algorithmic social machine, the concept of critical education, in particular "Bildung", transcends and questions techno-totalitarian boundaries.

It is about target values such as self-determination, freedom, the underlying image of humanity and technological questions of meaning: Why are (certain) algorithmic social machines ethically questionable? What values beyond a culture of ubiquitous measuring and quantifying are appropriate? What perspectives on the world beyond datafication and measurement should be preserved and promoted? If the suggestion of the predictability of individual behavior promotes self-adaptation to algorithmic specifications, if predictive analytics narrows future individual scope for action in advance, or if decisions are made under pressure, even against the supposed rationality of AI systems, then resistant and non-conformist, sometimes subversively acting strong subjects are needed to throw sand in the gears of the machinery of digital surveillance capitalism. Ultimately, the reflection function leads to critically questioning and deconstructing the appropriateness of the idea of sociality as a machine and the associated image of humanity. As a contribution to digital enlightenment, the image offers a possible view into the largely opaque 'machine room' and at the same time serves as a 'generator' for digital ethical and post-humanistic questions.

These allusions and analogies to the digital social machine can be used to construct a metaphorical and modelling figure of reflection that balances between two poles: a position that is critical of culture and technology and sometimes seems dystopian due to the loss of control and prevailing power asymmetries, and a position characterized by optimism for a future, renegotiated coexistence of man, machine and society. Critical education and "Digital Bildung" (Gran et al. 2019; Sjöström et al. 2017) must mediate between the two poles: How do we want to live in the future?

References

Ahlers, D., Driscoll, P., Löfström, E., Krogstie, J. & Wyckmans, A. (2016). Understanding Smart Cities as Social Machines. *WWW '16 Companion: Proc. of the 25th Int. Conf. Companion on WWW.* 759–764. DOI: 10.1145/2872518.2890594

Burrell, J. & Fourcade, M. (2021). The society of algorithms. *Annual Review of Sociology, 47*, 213-237. https://doi.org/10.1146/annurev-soc-090820-020800

Digital Enlightenment Yearbook (2012/2013/2014). Netherlands, IOS Press, 2012, 2013, 2014.

Berners-Lee, T. & Fischetti, M. (1999). Weaving the Web: The Original Design and the Ultimate Destiny of the World Wide Web by its inventor. Orion Business.

Cristianini, N. & Scantamburlo, T. (2020). On social machines for algorithmic regulation. *AI & Soc 35* 645–662. https://doi.org/10.1007/s00146-019-00917-8

Gran, L., Petterson, D., & Mølstad, C. E. (2019). Digital Bildung: Norwegian Students' Understanding of Teaching and Learning with ICT. *Nordic Journal of Digital Literacy, 14*(1–2), 23–36. https://doi.org/10.18261/issn.1891-943x-2019-01-02-03

Gray, J., Gerlitz, C. & Bounegru, L. (2018). Data infrastructure literacy. *Big Data & Society, 5*(2), 2018, 1-13. DOI: 10.1177/2053951718786316.

Gapski, H. (2023). Politische Bildung in der „algorithmischen Sozialmaschine" und die neue digitale Aufklärung. *Wochenschau. Politik und Wirtschaft unterrichten. Sek. I+II.* Sonderausgabe. Lehrerheft, 74(23s), 58–62. https://doi.org/10.25656/01:27100

Gapski, H. (2025). Gesellschaft als „algorithmische Sozialmaschine"? Visuell-metaphorische Maschinenbilder für digitale Aufklärung. In Visual Literacy. Bildkompetenzen in den digitalin Medien: Bd. W. Reißmann, R. Venema, U. Autenrieth&N. Brüggen (Hrsg.). S. 162-185. Herbert von Halem. https://doi.org/10.1453/2025_9783869627014

Hasselbalch, G. (2015, May 14). Society of the Destiny Machine and the Algorithmic God(s). https://mediamocracy.wordpress.com/2015/05/14/society-of-the-destiny-machine-and-the-algorithmic-god-s/

Helbing, D. (2019). Towards Digital Enlightenment. Essays on the Dark and Light Sides of the Digital Revolution. https://doi.org/10.1007/978-3-319-90869-4

Kernlehrplan Klasse 5 und 6 Informatik Sekundarstufe I, RdErl. d. Ministeriums für Schule und Bildung, v. 09.06.2021, https://www.schulentwicklung.nrw.de/lehrplaene/lehrplan/260/si_kl5u6_if_klp_2021_07_01.pdf

Lamla, J. (2020). Gesellschaft als digitale Sozialmaschine? Infrastrukturentwicklung von der Plattformökonomie zur kybernetischen Kontrollgesellschaft. Mensch - Technik - Umwelt: Verantwortung für eine sozialverträgliche Zukunft, hrsg. von A. Hentschel, G. Hornung, S. Jandt. S. 475 – 496. DOI: 10.5771/9783748910770-475

O'Neil, C. (2016). Weapons of math destruction: How big data increases inequality and threatens democracy. London: Allen Lane, Penguin Books.

Sander, I. (2024). Critical Datafication Literacy. A framework and practical approaches. Bielefeld, transcript. https://www.transcript-verlag.de/978-3-8376-7378-4

Schuilenburg M. & Peeters R. (Ed) (2020). The Algorithmic Society: Technology, Power, and Knowledge. London. Routledge. DOI: 10.4324/9780429261404

Sjöström, J., Frerichs, N., Zuin, V.G., & Eilks, I. (2017). Use of the concept of Bildung in the international science education literature, its potential, and implications for teaching and learning. *Studies in Science Education, 53*(2), 165–192. https://doi.org/10.1080/03057267.2017.1384649

Shadbolt, N., O'Hara K., De Roure D. & Hall W. (2019). The Theory and Practice of Social Machines. Lecture Notes in Social Networks. Springer.

Wyatt, S. (2021). Metaphors in critical Internet and digital media studies. *New Media & Society, 23*(2), 406–416. DOI: 10.1177/1461444820929324

Yeung, K. (2017). Algorithmic regulation: A critical interrogation. *Regulation & Governance, 12*(4), 2017, S. 505-523. DOI: 10.1111/rego.12158

Zuboff, S. (2018). The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power. Profile Books.