Fair media technologies: innovative media devices for social change and the good life

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Efforts to produce social change are often connected to the aim of creating the good life. Against the background of the current ecological crisis and climate change as well as exploitive globalization processes, I argue in this article that the good life is currently connected to sustainability, which not only implies ecological aspects but also economic and social ones. In this article, the research question looks at how both companies and users of media technologies can contribute to social change in general and sustainability in particular through media innovation. To answer this question, the results of a qualitative study are discussed in which the Fairphone was analyzed as a case study for media innovation. The Fairphone is a smartphone which is supposed to be produced under fair working conditions using sustainable resources. Putting the focus on the Fairphone, innovative production and appropriation processes that materialize in fair media technology are taken into account. The article contributes to research in the field of media innovation (in technology, production and appropriation) in general and media innovation with respect to social change, the good life and sustainability in particular.

Keywords

INTRODUCTION

Research analyzing media innovations deals with alterations in media technologies and formats as well as practices and organizations. Whatever is new with regard to media content, production and appropriation can become an object of media innovation research. With this focus on newness, transformations in the processes of media production (that is the production of media technologies and content) as well as appropriation are acknowledged. Changes in media technologies, organizations, content and practices point to social transformations, while also driving social change. Efforts to produce social change are often connected to the aim of creating the good life – as the case study discussed in this article shows. Against the background of the current ecological crisis and climate change as well as exploitive globalization processes, I argue that the question of the good life, which had already been asked in ancient times, is currently connected to sustainability, which again not only implies ecological aspects but also economic and social ones. How media innovations contribute to social change and the good life in general and sustainability in particular is not sufficiently researched. In this article, the results of a qualitative study are discussed in which an innovative media technology, i.e. the Fairphone, was analyzed from the perspective of media and communication studies. The production and appropriation of this technology aims at social change in general and sustainability in par-

ticular. The Fairphone is a smartphone produced by the Dutch company Fairphone, and is supposed to be produced under fair working conditions with sustainable resources. It is sold through a crowd-funding process, meaning that a certain number of consumers buy the smartphone before its production. Since the first generation of Fairphones came onto the market in 2013, this smartphone technology has been improved also with regard to the number of fair resources that are used within the device. Thus, in 2015 the second generation of the Fairphone became available and in 2019 the third generation entered the smartphone market.

The research interest presented in this article touched both the production and the appropriation of the Fairphone. The research question posed in this article is: How can both companies and users of media technologies contribute to social change and the good life in general and sustainability in particular through media innovation? The focus on the Fairphone facilitates the analysis of a new media technology in which innovative production and appropriation processes materialize.

The study shows how actors aim to change society to become more sustainable through the production and use of innovative media technologies.[1] To unfold this argument, the article is structured as follows: first, a theoretical framework is introduced in which

relevant theories and studies from the research fields of media innovations as well as the good life and sustainability in media and communication studies are presented. Then, the methods of the study are described. In a third part, the main results of the study are presented and discussed, while paradoxes in the practices and aims of the actors can be revealed. In the conclusion, I consider whether and how fair media technologies as media innovations can foster social change in general and sustainability in particular. Therefore, the article contributes to the research field of media innovation (in technology, production and appropriation) in general and media innovation with respect to social change, the good life and sustainability in particular.

MEDIA INNOVATIONS AND SOCIAL CHANGE: THE GOOD LIFE AND SUSTAINABILITY

Innovation, from Latin *innovare*, means something new. Media innovation then means something new regarding media – the novelty can occur in every dimension of media: media technology, media organization, media systems, media content, media content production, media law, and media appropriation. These dimensions are interlinked: whenever an innovation is introduced in one of these dimensions, it affects the other dimensions. For example, if an innovative technology is introduced to the market, it

affects the way media content is produced as well as the content itself. It might make an adaption of media law necessary, and it might change media organizations and the media system as a whole. The invention of the internet as an infrastructure, for example, allowed different online media to be developed. It revolutionized not only media organizations, content, content production and appropriation processes but also provoked changes in media law – due to transnational communication processes. Media innovation, in whichever media dimension, not only affects other media dimensions but society as a whole as "media innovation is societal innovation" (Bruns, 2014, p. 13): "Changes to the practices of media both reflect and promote societal changes" (Bruns, 2014, p. 13).

Dogruel (2014, pp. 54-61) distinguishes between media innovations as objects of research and as processes, and develops eight characteristics for media innovations from which the eighth characteristic, since it points to societal change, is the most relevant regarding the analysis presented in this article: "Media innovations contribute to economic and social change processes, and meet the attributes of both economic as well as social innovations" (Dogruel, 2014, p. 58).

Changing media technologies, organizations, practices etc. are accompanied by the transformation of social practices and relations as well as orga-

nizational structures and attitudes and norms. At the same time, social transformations might change media in all dimensions. Therefore, studying media innovation in whichever dimension also means studying social change. "Media reflect society not only in their content, but also in their organisational and technological structures. [...] In a very direct sense, therefore, when we examine media innovations we are really investigating one of the processes of societal innovation." (Bruns, 2014, p. 14).

Research explicitly analyzing media innovations deals with changes in journalism (e.g. English, 2016; Steensen, 2009; Bierhoff, Deuze & De Vreese 2000), media organizations (e.g. Baumann, 2013; Dal Zotto & van Kranenburg, 2008), and media technologies (Lievrouw, 2002; Tuomi, 2002) among others (for an overview of the field see e.g. Dogruel 2014; Storsul & Krumsvik, 2013). Nevertheless, the interdependence of media innovation and social change is under-researched (Ní Bhroin & Milan, 2020). Moreover, the way in which media innovation can contribute to the good life in general and sustainability in particular has not been sufficiently researched.

The good life is an ancient concept. In media and communication studies the concept of the good life became prominent not least because the conference of the International Communication Association in 2014 focused explicitly on the good life (Wang, 2015).

But still research examining the good life in relation to media and communication is rare and mainly deals with questions of well-being (e.g. Chan, 2015; Jeffres, Neuendof & Atkin, 2015; Jin & Park, 2013).

Given the background of the ecological crisis, climate change, and exploitive globalization processes, I argue that the question of the good life is nowadays connected to sustainability (see above). Sustainability in this article relates to the traditional definition of sustainable development, which is perceived as "a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs" (World Commission on Environment and Development, 1987). Although sustainability theory and research stress that sustainability cannot be reduced to the ecological dimension (e.g. Raworth, 2017), within media and communication studies, the focus is still on environmental and climate communication (e.g. Hansen, 2019; Olausson & Bergelez, 2017; Pompper, 2017). The relationship between media technologies and sustainability as well as how actors can contribute to a sustainable society using media technologies is rarely analyzed (see for exceptions van der Velden, 2016 and 2018; Kannengießer, 2020).

This article brings the research fields of media

innovation, the good life and sustainability together when discussing the results of the study which analyzed the Fairphone as a case study for media innovations that can contribute to the good life and social change.

METHODS AND CASE STUDY

The research question posed in this article is: How can companies and users of media technologies contribute to social change and the good life in general and sustainability in particular through media innovation? To answer this research question, the Fairphone was used as a case study. The Fairphone is an object of different research areas. Design studies, for example, discuss the Fairphone from a perspective of "participatory design" (Velden, 2014) and a "critical design alternative for sustainability" (Joshi & Pargman, 2015). In materials research the actual materiality of the Fairphone is studied. In this context, it is stressed that only a few resources integrated into the Fairphone can actually be labelled fair (Dießenbacher & Reller, 2016, p. 287). Here the scholars of materials research point to the symbolic relevance the Fairphone has, which I will also discuss in this article.

From an economic perspective, the Faiphone company itself is analyzed and defined as a "social entrepreneur" which not only contributes to a sustainable society but also puts media technology companies

under pressure to deal with sustainability (Lin-Hi & Blumberg, 2015; Akemu, Whiteman & Kennedy, 2016). In law, the Fairphone company is discussed as an example for acting against violations of human rights in the production processes of mobile phones (Hagemann, 2017, p. 67).

While these studies focus on the smartphone itself and the company, there are also studies in psychology which analyze the use of the Fairphone. Meier and Mäschig (2016) studied the attitudes of the Fairphone users and tried to reconstruct their perspectives through an automated analysis of the forum which is integrated in the online platform of the company. The authors point to the shortcomings of their method. A reconstruction of the perspective of the users was not actually possible in this study.

This is where one of the research interests of the study presented here lay: I reconstructed the perspective of the users of the Fairphone and of the company by examining why the company actually produces this smartphone and what encourages the users to buy it. To analyze the case study of the Fairphone, I followed the Grounded Theory research process (Strauss & Corbin, 2008). This allowed me to approach the field both openly and theoretically using the above described theoretical concepts of the good life and sustainability.

I combined different qualitative methods to gather relevant data: To analyze the production and appropriation side of the Fairphone, I conducted a virtual ethnography (Hine, 2000) on the online platform of the Fairphone company as well as the on its Facebook and Twitter accounts. Moreover, I conducted a content analysis of six interviews which the founder of the Fairphone company, Bas van Abel, gave to German newspapers. To analyze the users' perspective, I conducted semi-structured interviews (Hopf, 2004) with 14 people who owned and used the Fairphone. Regarding the sample of the interviewees, I searched for people with different gender, age groups, and educational backgrounds. However, I found mainly academics who owned the Fairphone. This may be an outcome of the way I searched for interview partners, as I started my search through a university website. Nevertheless, I also searched through an online forum integrated into an online platform which was hosted by a city administration. My thesis is that the Fairphone is a product mainly used by academics. The Fairphone users I interviewed were of different gender and ages, working in different professions, and earning different incomes.

Data was gathered until a point of theoretical saturation was reached, when interview partners and online sources did not present new aspects. After collecting the data, I analyzed it using the three-step coding process of Grounded Theory (Corbin & Strauss, 2008). The categories developed allowed for the empirical material to be structured and compared and subject to an in-depth analysis.

In the following, some of the core results of this analysis are presented. This enables the research question to be answered. To structure the presentation of the results, the findings of some of the core categories which were developed through the coding-process are presented. These are: actors, technologies, practices, and motives. The findings are discussed with regard to media innovation.

THE FAIRPHONE: INNOVATIVE ACTORS, TECHNOLOGIES, PRACTICES, AND MOTIVES

In the following, findings regarding the actors, technologies, practices and motives involved in the Fairphone case are presented and analysed from the perspective of media innovation research.

The actors involved in this media innovation are, on the one side, the Dutch company Fairphone, and on the other side, the consumers who buy the smartphone. Fairphone aims at contributing to sustainability in the production process of the smartphone and through the design of the devices. The company tries to shape the production process of the smartphone in a more sustainable way by integrating resources which have been extracted in conflict-free areas under fair working-conditions: "We want to source ma-

terials that support local economies, not armed militias. We're starting with conflict-free minerals from the DR Congo" (Fairphone, 2015a, p. 1). The Fairphone is certified by Max Havelaar, a Dutch foundation, which certifies products with a Fairtrade label in the Netherlands, according to the international fair trade standards regarding e.g. working conditions and pricing (Fairtrade, 2011). "The term Fair Trade defines a trading partnership, based on dialogue, transparency and respect, that seeks greater equity in international trade. It contributes to sustainable development by offering better trading conditions to, and securing the rights of, marginalized producers and workers – especially in developing countries" (Fairtrade, 2011, p. 1).

Nevertheless, regarding the resources integrated in the smartphone the Fairphone is not really fair as only four of the resources used in the smartphones are actually extracted under fair working conditions. But the company is transparent regarding this circumstance and admits that a "100% fair phone is in fact unachievable" (Fairphone, 2015d, p. 2). Nevertheless, the company is trying to make its future products fairer (Fairphone, 2015d, p. 2).

For the production process of the devices, the company rents production sites in China and tries to make sure that people work under fair conditions (Fairphone, 2015a, 7): "We want to improve working conditions in the heart of the electronics sector, including health and safety, worker representation and working hours" (Fairphone, 2019c). Therefore, the company is also building partnerships with local non-governmental organizations. By producing under fair conditions with sustainable resources extracted in conflict-free areas, the Fairphone company aims at providing an alternative on the media technology market (Fairphone, 2015a and d). Making the production process fairer is one of the core aims for people who buy the Fairphone, as a woman explains in an interview: "I read that it is only a small percentage of fair resources, which they [the Fairphone company] implement in the smartphones. But the perspective is to invest in something which will become fairer, to invest in an idea."[2] Users of the Fairphone are aware of the shortcomings regarding the fairness of the resources used; still, they believe in and want to support Fairphone's ambition to expand the number of fair resources: "I invest in a company which invests in the development of sustainable products and fair trade production," explains another Fairphone user.

Besides a fair production process, the company aims at contributing to sustainability through the design of the technology: they developed a modular smartphone that is designed to be repairable (Fairphone, 2015a and d). Thereby, the company aims at prolonging the life-span of the materiality of the digital devices to make them more sustainable: "We're designing the Fairphone to extend its usable lifespan, enable reuse and support safe recycling" (Fairphone, 2015b). The Fairphone company claims that the devices they produce are "Built to last" (Fairphone, 2019a). To enable people to repair the smartphones, the Fairphone company not only produces a modular phone but also sells spare parts for the devices they produce.

But regarding the possibilities of repair, there are some paradoxes which have to be acknowledged. Owing to concerns about the cost and lack of profit, the company stopped producing spare parts for the first Fairphone generation in 2017, only four years after they were delivered. Therefore, the first Fairphone generation is (at least with spare parts produced by the company) not repairable anymore. After announcing the abandoning of spare part production, the founder of the company, Bas van Abel, claimed in media interviews that durability was not the focus of the company (Tricarico, 2017). But my analyses of the website in 2015 showed that repairability was advertised as being one of the key features of the Fairphone.

Furthermore, the possibility of repair is one of the core motives of people buying the Fairphone. Many customers of the Fairphone are aware that the smartphone can be repaired to prolong the life-span of the

device, and this is one of the reasons for them to buy the Fairphone, as one of the users explains: "I heard that there is a repair manual that exists and that one can repair some parts on one's own. The longevity was definitely something, which made me buy [the Fairphone]." Another user states: "Fairphone is great because you can open it. And if you open it you are pointed to: 'This is your battery'. And if the battery is empty you should send and exchange it." "Change is in your hands," are the words stamped on batteries which Fairphone sells through its online platform (Fairphone, 2019b).

Users who favor a repairable phone nevertheless reveal some paradoxes in their practices. People stress that they bought a repairable smartphone to contribute to sustainability by prolonging the life-span of the technologies they own. Yet at the same time, many people using the Fairphone have a big media repertoire (Hasebrink & Domeyer, 2012). Media repertories are defined here as the set of media technologies people use; meaning that they own a large number of media technologies, and buy innovations frequently – which might conflict with their ambitions regarding sustainability.

Opening, exchanging and repairing are not only important to the users because they help them prolong the life-span of their devices, but also because many users are interested in and enjoy opening their smartphone to explore it. Users do not only want to empower themselves by being able to engage with and repair the technology they use but also by knowing how the devices are produced and which materials are integrated into the smartphones. People using the Fairphone are keen to know where the media technologies they use come from. They appreciate the transparency which the Fairphone company provides regarding the supply chain of the smartphone, as one of the Fairphone users stresses: "[I like] the approach of transparency and also the credible communication, that they [the Fairphone company] say: 'okay, we say what we work on, where our core areas are, what we want to improve', this is what I liked."

Fairphone does not only explain how their smartphone is produced on the company's online platform and profiles on Facebook and Twitter, they also educate people regarding the harmful production and disposal processes of regular media technologies. The company points to these harmful processes in the online media it uses and describes one of its key objectives as being to "improve consumer awareness of responsible mining […] and the connections with the electronics industries'" (Fairphone, 2016b).[3] Through their criticism, the Fairphone company is trying to influence the discourse on media technologies and fair consumer goods – bringing the fair trade approach into the market of media technologies (Fairphone, 2015a and d).

Also people using the Fairphone have learned about the harmful production and disposal processes of media technologies through mass media and criticize them. They are aware that many resources included in digital media technologies are extracted under circumstances which harm people and the environment. By buying a phone which promises to consist (at least partly) of fair resources, users try to strengthen a market of fair media technologies. But buying the Fairphone also provides them peace of mind, as one of the users explains explicitly in the interview.

At the same time, people using the Fairphone do so because it serves as a symbol of a certain lifestyle. Many users describe themselves as critical consumers, who reflect on current social problems and contribute to sustainability. The Fairphone reflects these user attitudes. Some people using the Fairphone try to provoke discussions about fair media technologies: they use the Fairphone as a symbol and say that they are often asked by others about the phone and their motives for using it. As one user describes it: "When I got it [the Fairphone], people asked [about it] because they were skeptical […] and then we started talking about it." So using the Fairphone provokes discussions about fair technologies and harmful production and disposal processes of media devices in

which the Fairphone users spread their knowledge and attitudes.

While some Fairphone users stumbled on the Fairphone as an alternative, others were actively seeking for alternatives – often because they also consumed fair trade products in other fields, like clothes or food. For some, the Fairphone was an entry to the smartphone market – they had maintained old mobile phones before but then perceived the Fairphone as a good and, from their point of view, unproblematic option.

So, what is innovative regarding the the Fairphone? First, there are some aspects which make the Faiphone company special as an actor within smartphone production. The Fairphone company describes itself as a "social enterprise that is building a movement for fairer electronics" (Fairphone, 2015a). "Social" for them means that the company is not profit-oriented: They make the costs for the production of a Fairphone transparent and claim that nine Euros profit per device are saved for unexpected costs or additional investments (Fairphone, 2015b). This transparency together with the ambition to shape the media technologies market into a more sustainable one, make the company special and innovative in a sense that they are developing something new, although the Fairphone company is not the only organization producing fair media technologies (another example

would be a fair computer mouse developed and produced by a German non-governmental organization, see Kannengießer, 2016).

The users of the Fairphone are also innovative, in the sense of new and non-mainstream. They think about the consumption of media technologies and the way these devices are produced and disposed of. By buying the Fairphone, they are trying to do something different from mainstream consumers. Their purchase supports the emergence of a fair media technology market.

Regarding the technology, i.e. the Fairphone itself, aspects of media innovation can also be identified: The newness does not lie in any new software options but in the materiality of the media technology itself. It is supposed to contain sustainable resources and employ people working under fair conditions. The fairness is inscribed into the materiality of the media technology. Nevertheless, the modular way in which the smartphones are built is innovative although it is not the only modular option on the smartphone market.

Producing and using the Fairphone are innovative practices. It is not the use of a smartphone technology that is new but the use of a fair smartphone technology. As the production and use of this fair device are undertaken consciously, these media practices of use and production can be characterized as innovative.

Moreover, the Fairphone company aims at building a Fairphone community and a movement striving for a fair media technology market. It has integrated a forum into its online platform and uses online media such as Facebook and Twitter as well as Instagram to build this community. People are invited to become part of the "Fairphone movement" (Fairphone, 2015e) by either buying the device and/or becoming part of the social networks used by the company: "Buy a phone, join a movement", (Fairphone, 2015c). The Fairphone community is constructed in Max Weber's sense (1972, p. 21) by inviting people who share the aim of sustainability and by constructing a feeling of belonging: "#WeAreFairphone" (Fairphone, 2015e).

Although a small sample, the results of the interview data show that this community or movement is not of major importance to the users. Nevertheless, the virtual ethnography of the relevant online data reveals that there are many people contributing to and supporting the discourse on fair media technologies. Through their communication in the online forum of the company's platform or its online networking sites they become part of the "Fairphone community". Connecting the purchase and use of a certain media technology to a certain community or movement is rather innovative although it has to be stressed that the motive for community building that the Fairphone company has does not only have political im-

plications but can also imply commercial motives. People might buy the Fairphone because they would like to become part of this community or movement.

Regarding the motives of the company producing the Fairphone and the people buying it, it can be stated that the overall aim of the production and appropriation process is to provoke social change and transform society into a more sustainable one. These motives are innovative as they are rather new on the commercial media technology market, whereas such motives have a longer tradition regarding other consumer goods such as coffee or clothes.

To sum up the characteristics of media innovation regarding the case of the Fairphone, it can be stated that aspects of innovation can be identified regarding the actors, technology, practices and motives, whereby all these dimensions are intertwined: The company can be characterized as rather innovative in its way of being a "social entrepreneur" as well as with regards to its practice of producing a fair and modular media technology and its motives for contributing to sustainability by producing media technologies. Furthermore, the users of the Fairphone can be characterized as innovative as they aim to contribute to sustainability through buying media technologies which are supposed to be produced under fair working conditions. The practice of using a smartphone is not new but the conscious consumption of a certain device for the purpose of social change which aims at sustainability is.

DISCUSSION

Drawing from research in the fields of media innovations, the good life and sustainability, the results of a qualitative study which analyzed the Fairphone as an example of media innovation were presented in this article. In doing so, the characteristics of media innovation regarding the actors, technology, practices and motives in this case study were presented.

The actors involved in the media innovation described here are, on the one hand, the Dutch company Fairphone, which developed the smartphone, and on the other hand, the users who buy the media device and strive to change society through their consumption. The innovative technology is the Fairphone itself, although the smartphone itself is not a media innovation (smartphones were being produced by other companies before). However, the production process in this case is innovative since it is designed to be fair and sustainable. The innovation materializes in the media technology. Moreover, the technological innovation is the modular way in which the smartphone is designed, although the Fairphone is not the first and only modular smartphone. Through the fair production process and the modular design, the company is trying to challenge the mainstream market of media technologies. Thereby, the company and the users of its phones confront the circumstances under which media technologies are produced in current globalized production processes which have disastrous effects on people and the environment. The Fairphone company and the users of its phones are trying to change these production processes and thereby trying to provoke social change and a transformation towards sustainability.

The case of the Fairphone shows that different media dimensions are interlinked regarding innovation: Fairphone describes itself as a social entrepreneur and for that reason follows a rather innovative business model. It has developed an innovative production process which aims to be fair and sustainable. The smartphone itself is a media innovation which materializes this new production process. Further, the motives for producing and using the Fairphone are new in so far as they acknowledge exploitive globalization processes and the ecological crisis.

The Fairphone company wants to offer a smartphone which is both produced under fair working conditions with sustainable resources and built with a modular design to enable its customers to repair it. These aspects are also key motives for people buying the smartphone, who, moreover identify with a certain lifestyle which is embodied by the Fairphone. They also aim at empowering themselves by gaining

knowledge about the materiality of the smartphone that they use and by being able to repair it. Moreover, the Fairphone company is trying to build a "Fairphone-community" with the aim of constructing a movement and market for fair media technologies.

But the study also revealed ambivalences within this media innovation which do not question the innovative character within the different dimensions, but which do hint at paradoxes that can be identified regarding the practices and motives of the actors involved. Those paradoxes include the complex media repertoires of some Fairphone users, who regularly replace technologies as a result of ongoing technological innovations. This contradicts the ambition of contributing to sustainability by using the Fairphone. Having said that, it must be stressed that when analyzing media innovations in any media dimension, the innovative practices, technologies and motives need to be viewed critically.

With regard to its degree of novelty (Storsul & Krumsvik, 2013, p.16), the Fairphone does not revolutionize the media technologies market but is at least trying to make a difference and promotes sustainability by using fair production processes and by raising awareness.

CONCLUSION

In this article, the research question asked how companies and the users of media technologies can contribute to social change and the good life in general and sustainability in particular through media innovation. To answer this question, the results of a qualitative study were discussed in which the Fairphone was analyzed as a case study for media innovation. Against the background of the current ecological crisis and climate change as well as exploitive globalization processes, I argued that the question of the good life, which was already being asked in ancient times, is currently connected to sustainability, which again not only implies ecological aspects but also economic and social ones.

The results show that the media innovation in this case can be identified in different dimensions: The Fairphone company is described as an innovative company that is developing smartphone technologies according to new production processes. This innovative character is also identified in the motives of the company. Both producers and consumers in this case acknowledge the current context, which is characterized by the exploitive globalization processes and harmful production and disposal processes of media technologies. They aim at realizing a good life for people who are involved in the production and disposal of media technologies, thereby shaping those processes in a more sustainable way.

The study revealed several ambivalences and constraints regarding the aims and practices of production and appropriation. These ambivalences question the integral ambitions of the producers and users of the Fairphone because they contradict the aim of contributing to sustainability. Nonetheless, the Fairphone can be characterized as an innovative media technology with which actors are trying to provoke social change, aiming in particular at supporting good lives and sustainability.

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NOTES

1. Following this thesis, the production of the Fairphone had previously been analysed as political participation (Kannengießer, 2016). Moreover, the relevance of the materiality of the Fairphone was taken into account (Kannengießer, 2019).
2. The interviews were conducted in German and were translated by the author.
3. For an analysis of the harmful production process of media technologies see e.g. Bleischwitz, R., Dittrich, M. & Pierdicca, 2012; Chan & Ho, 2008; Maxwell & Miller, 2012; for the problematic of e-waste see Bily, 2009; Gabrys, 2011; Kaitatzi-Whitlock 2015.

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