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Frankfurt Triangle for Education in the Digital World

An Interdisciplinary Model

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Abstract

Contemporary communication and social interaction are being increasingly influenced by media and technology, systems, and platforms that are based on digital principles and artificial intelligence. To date, there has been no clear set of interdisciplinary theories or models that go beyond the academic discourses within the individual disciplines. There has therefore been no framework within which to classify the current opportunities, challenges and responsibilities facing a digital society and how to approach education from a theoretical and conceptual perspective. In recognition of the fact that digitalization and AI cannot be viewed from a single disciplinary perspective, a group of authors from Germany, Austria and Switzerland – consisting of scholars from computer science, media education and media studies – developed the Frankfurt Triangle (Brinda et al. 2020). The Frankfurt Triangle *is the result of intensive interdisciplinary discussion. Its goal is to develop a collaborative theoretical and conceptual model on which to base the perspectives and dimensions of education in a digital world. The initial impetus for this augmentation of the* Dagstuhl Declaration *from 2016 came from two workshops took place in Frankfurt am Main, Germany. Incorporating a threefold perspective on a) structures and functions of technology and media, b) interrelations with culture and*

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society, and c) interaction in terms of use, agency and subjectification, the model provides an orientational framework for the analysis, reflection and active creation of artifacts and phenomena in a world shaped by digital media, technology, systems, and platforms. The model was originally developed in German and has not yet been translated into other languages. Furthermore, scientists have repeatedly pointed out at international conferences and in academic exchanges that no attempts have yet been made in other language areas to develop a comparable interdisciplinary model. Hence, in order to make the approach accessible to international scholars, the model and accompanying text have been translated into English. This paper describes the model, its function and usage, and outlines possible additional developments and future connections. The introductory text also briefly describes the context in which the model was developed, and its development since its inception.

Frankfurt-Dreieck zur Bildung in der digital vernetzten Welt. Ein interdisziplinäres Modell

Zusammenfassung

Kommunikation und soziale Interaktion werden zunehmend von Medien und Technik, von Systemen und Plattformen beeinflusst, die auf digitalen Prinzipien und KI beruhen. Bislang gab es keine interdisziplinären Theorien oder konzeptionelle Modelle, die über die akademischen Diskurse einzelner Disziplinen hinausgehen. Es gab daher bisher keinen überfachlichen Orientierungsrahmen, in dem die aktuellen Chancen, Herausforderungen und Verantwortlichkeiten einer digitalen Gesellschaft eingeordnet werden können und entsprechend auch kein theoriebasiertes interdisziplinäres Modell zur «digitalen Bildung». Da Digitalisierung nicht aus der Perspektive von Einzeldisziplinen betrachtet werden sollte, hat eine Gruppe von Autor:innen aus Deutschland, Österreich und der Schweiz – bestehend aus Wissenschaftler:innen aus der Informatik, der Medienwissenschaft und der erziehungswissenschaftlichen Medienpädagogik – das Frankfurter Dreieck *entwickelt (Brinda et al. 2020). Das Modell ist Ergebnis einer intensiven interdisziplinären Diskussion. Ziel des Modells ist es, einen gemeinsamen theoretischen und konzeptionellen Orientierungsrahmen zu entwickeln, der die unterschiedlichen Perspektiven und Dimensionen von Bildung in einer digitalen Welt beschreibt und begründet. Die Initialzündung für diese Erweiterung der* Dagstuhl-Erklärung *aus dem Jahr 2016 entstand in zwei Workshops in Frankfurt am Main. In der dreifachen Perspektive auf a) Strukturen und Funktionen von Technik und Medien, b) Wechselbeziehungen mit Kultur und Gesellschaft und c) sozialer Interaktion bietet das theoretische Modell einen Orientierungsrahmen für die Analyse, Reflexion und Gestaltung von Artefakten und Phänomenen in einer von digitalen Medien, Technik, Systemen und Plattformen geprägten Welt.*

Das theoretisch-konzeptionelle Modell wurde ursprünglich in deutscher Sprache verfasst und wurde bisher nicht in andere Sprachen übersetzt. Die Autor:innen wurden auf internationalen Konferenzen und im akademischen Austausch immer wieder darauf hingewiesen, dass in anderen Sprachräumen bisher noch keine vergleichbaren interdisziplinären Modelle entwickelt wurden. Um das Frankfurt Dreieck internationalen Wissenschaftlern zugänglich zu machen, wurde das theoretisch-konzeptionelle Modell sowie dessen Begleittexte ins Englische übersetzt. Das vorliegende Papier beschreibt das Modell, deren Funktion und Anwendung und skizziert abschliessend mögliche Weiterentwicklungen und zukünftige Verbindungen. Der einleitende Text beschreibt auch kurz den Kontext, in dem das Modell entstanden ist sowie seine Genese seit seiner Erstveröffentlichung in deutscher Sprache.

1. The development and genesis of the model

The *Frankfurt Triangle* was developed in response to the desideratum that social phenomena such as digitalization cannot be viewed from a single disciplinary perspective (Brinda et al. 2020). Academic discourse on mediatization, digitalization and AI has so far primarily been conducted in somewhat closed academic discourse bubbles. The first meeting to try and amend this state of affairs took place between computer scientists and media educators in 2016 at Dagstuhl Manor, Germany. This meeting resulted in the *Dagstuhl Declaration* (GI 2016a), which was primarily aimed at political decision-makers. The Frankfurt Triangle described in this text is a continuation and extension of the *Dagstuhl Triangle* contained in the Dagstuhl Declaration; it is now primarily aimed at researchers, teachers and practitioners who deal with education in the context of digital change in a reflective and theoretical manner (Brinda et al. 2020). Both models take an interdisciplinary approach to education in the digital world, but the models focus on different aspects: while the Dagstuhl Triangle focuses more on computer science competencies and social reflection in the context of digitalization, the Frankfurt Triangle, on the other hand, focuses on *subject-related interaction* as well as the critical-reflective and creative appropriation, and critical use of media. The Frankfurt Triangle also takes into account the media studies perspective on educational aspects in addition to the computer science and (media) educational science perspectives. Compared to the Dagstuhl Triangle, the Frankfurt Triangle was expanded to include greater consideration of individuals' lifeworlds and their active creative participation and critical reflection on media and technology. With the additional perspective on *interaction in terms of use, agency and subjectification*, the Frankfurt Triangle takes a closer look at the use, active creation and critical engagement with media in the everyday lives of individuals. The lifeworld orientation is central to educational processes at school and helps to systematically promote and develop media literacy – ideally actively and creatively

as well as critically and reflectively. In the Dagstuhl Triangle, the individual is primarily understood as a *user*. Users usually do not create or critically engage with media, technology, or their social consequences. For this reason, the Frankfurt Triangle is particularly suitable for curriculum and educational plan development because it offers a comprehensive, education-oriented and socially relevant approach to media and computer science education. Curricula based on the Frankfurt Triangle emphasize in particular the critical, action-oriented and creative engagement («interaction») of the individual with technology and media and, not least for this reason, could also be well integrated into numerous subjects and school types. Accordingly, the Frankfurt Triangle underlines the political goals of the Dagstuhl Declaration. The Frankfurt Triangle supplements the conceptual goals of the Dagstuhl Declaration and broadens them to include extracurricular educational contexts.

The initial inspiration for this theoretically and conceptionally expanded version of the Dagstuhl Declaration arose out of two workshops that took place in Frankfurt am Main in 2017 and 2018. The Frankfurt Triangle was then published in German in 2020 after further intensive discussions and editorial loops, and has since shaped discourse in computer science, media studies and media education in the German-speaking regions. This initiative is intended to make the model compatible with international discourse in academia and in practice. The model also aims to stimulate further theoretical interdisciplinary discourses between computer science, media studies and media education.[1]

1 The *Frankfurt Triangle* was translated by Thomas Knaus. The additional framing text for this article was also written by Thomas Knaus and discussed with the authors of the original version.
I would like to thank my colleagues from Australia and the US as well as the German-speaking co-authors of the original text for their helpful discussion of key terms and suggestions for improvement. Special thanks go to Robert John Murphy for his meticulous proofreading and his very helpful corrections and improvements.

2. Function and usage of the interdisciplinary reflection framework

The function of this model is to provide an interdisciplinary orientation and reflection framework for educational processes engaged in digital change, and to incorporate as many relevant perspectives from the disciplines involved as possible. The collaborative model is based on the Dagstuhl Triangle (GI 2016a). The aim of the Frankfurt Triangle – as an additional development – is to describe the phenomena of a digital world and identify the ensuing educational needs that individuals require to operate in this digital world. It draws on the disciplinary perspectives of computer science, computer science didactics, media studies, media education and media literacy education. With its broad-based approach, it seeks to develop a common basis for defining the competencies necessary for participation in a digital world.

One challenge for the group of authors in the discussion process was that there was no established understanding of the key terms relating to the topics of digitalization – and certainly none that was agreed between the disciplines involved. For example, in public discourse and reporting, the adjective «digital» is often used as a synonym for «new». It originally describes the representation of data and indirectly also information in a way that enables automatic processing by computers, and «digitization» thus describes the conversion of analogue into discrete values, which is essentially realized by binary signals. «Digital education» [«digitale Bildung»] is another frequently used buzzword, sometimes with an understanding limited to teaching and learning with digital media, sometimes including the basics of computer science or even as an exclusive educational task of computer science. Digitalization is therefore one of the three basic principles of computer science alongside automation and networking, but is often mentioned as a substitute for these. Digitalization has created the conditions for the universal compatibility of data and information and at the same time the conditions for the integration of previously separate practices, social structures, and technologies, which have been having a lasting impact on traditional spatial and temporal distinctions as well as social inclusion and exclusion (GI 2016a). Today, the term digitalization is used in political and social contexts primarily to describe current technologically induced societal transformation processes (Brinda et al. 2020).

We assume that mediatization, digitalization, datafication and AI are having a significant impact on today's societies, cultures, infrastructures and, accordingly, ongoing discourses on technological developments, and we therefore speak of *digital change*. Participation in political, cultural, and economic processes within society requires individuals to be able to analyze, reflect on and actively create digital artifacts. This requires knowledge of the basics of computer science as well as media studies, and the approaches and discourses surrounding (media) educational research.

Based on the Dagstuhl Triangle, the model differentiates between three perspectives that education for and about digital change must address (GI 2016a). In the Frankfurt Triangle, these are referred to as the perspective on *structures and functions of technology and media*, the perspective on *interrelations with culture and society* and the perspective *on interaction in terms of use, agency and subjectification*. These perspectives are each assigned the three processes of *analysis*, *reflection* and *active creation*, through which learners should transit with the aim of enabling them to participate in a world shaped by digital change. At the same time, a comprehensive analysis, reflection and creative shaping of digital change can only succeed if all three perspectives are adopted systematically and repeatedly. The center of the triangle provides space for the respective object of consideration, i.e., digital artifacts, social networks, intentional disinformation («fake news») and related phenomena. These objects and phenomena can then be analyzed from the three perspectives mentioned above, including their associated processes.

Based on this model, specifics can be developed with regard to fields of action such as schools, extracurricular educational contexts such as child and youth education, cultural education and adult education, higher education, teacher training and the initial and further training of educational professionals. These may then be enhanced in further steps in order to develop competence models and tackle didactic and media-didactic issues and, in particular, to further develop existing teaching concepts and educational recommendations made by professional associations (GI 2008; LKM 2008; GfM 2013; LKM 2015; GI 2016b; GfM 2016; DGfE 2017; Knaus, Meister, and Tulodziecki 2017; GI 2019 and others).

2.1 Structures and functions of technology and media

We associate the technological-media perspective with the ability of individuals to think critically about the structures and their modes of function in a world shaped by digitalization and AI, and thus to question and reflect on them. By encouraging this questioning and reflecting, we seek to enable individuals to become active creators of such artifacts. To this end, the approach deals with conceptual questions, in particular with the technological and medial functional principles of digital systems, the technological and media-related forms of structuring used to create them, the technological analysis and processing possibilities that result from them, and the cultural, political, or personal inscriptions that are usually not visible on the «outer shell».

This perspective identifies two aspects that are inextricably linked:

1. From a computer science perspective, individuals can critically question and evaluate the technical functionality of digital artifacts that make up the digital world, as well as related phenomena. By analyzing and revealing the underlying functional principles and structures of digital artifacts, individuals are given opportunities to autonomously create and expand the function of digital systems, taking into account computer science-related problem-solving strategies on the one hand, and the creative and reflective handling of digital systems on the other. The basis for this is provided by the theoretical and practical foundations of computer science, especially in the areas of digitalization, automation and networking and their application to current and socially relevant topics (such as big data or AI), statements on the practical and theoretical limits of computability or automation, concepts for communication between computer systems (e.g. networks, protocols, encryption), prioritization in these networks (especially network neutrality), and systematic process models for creating digital artifacts and systems.

2. Digital artefacts are created through the modelling of sections of the world using methods and tools adopted from computer science and engineering, and shaped both by cultural inscriptions such as the selection of training data for AI, normative algorithms, et cetera), and the personal perspectives of developers and system or platform operators. As socio-technological computer systems with characteristic properties, aesthetics and forms, these artifacts influence human perception and therefore also require critical examination from a media perspective. The developers of digital artifacts such as software, systems, or platforms explicitly and sometimes for reasons of self-interest, lack of reflection, or simply due to cultural conventions, determine what is visible or perceptible, as well as what fades into the background. This determines the individual's interaction with such systems and, in particular, the repertoire of possibilities for human expression and communication. Using these characteristic principles and imprints, technology inscribes itself into the cultural and social forms it enables, not only through its artifacts themselves, but also through their history and genesis. Social structures are therefore inherent in digital artifacts; what is archived and given historical weight is inscribed within them, as is what is overlooked and forgotten.

It should also be noted that the technologies used in each case require individuals to possess specific competencies for their use. Conversely, if individuals know about and can reflect on these relations of determination, and if these considerations are then included in the construction of digital artifacts, individuals will also be able to use technologies in an autonomous and confident manner. It is therefore essential to *analyze*, *reflect on* and *actively create* the structures, principles, and functions of digital (media) systems from the perspective of computer science and media studies, and to be able to relate these views to each other. This kind of in-depth and interlinked knowledge of media and computer systems can be helpful for

understanding technological and media phenomena. This extended understanding of computer and media systems provides the basis for developing problem-solving strategies; it is the foundation for individuals to participate thoughtfully and critically in a digital world.

2.2 Interrelations with culture and society

Digital change is shaping the conditions of social communication and human interaction as well as the political organization of societies. But at the very least, it is also creating cultural spaces of opportunity that can be explored, used and shaped by communities. The same applies to the economic reproduction of societies. For example, generative and communicative AI enables new working conditions, production methods and exchange conditions. This changes the roles of societal actors and the dynamics of change within media societies: they are creating norms and rules for the use and deployment of technologies that structure the role and influence of digital technology. For example, social negotiation processes determine the conditions of privacy and publicity, create or limit opportunities for interaction, and regulate access to technical systems. Societies shape educational institutions and regulate the public's understanding and social use of digital technologies and techniques through educational programs for the acquisition of corresponding competencies. The degree to which technologies are socially integrated and the role they perform in society is therefore largely determined by the education system. The degree to which digital media and technologies are enculturated also determines the role of a digital culture in society and its relationship to non-digital cultural artifacts.

From a socio-cultural perspective, scholars therefore analyze and reflect upon the interactions between individuals, society, and digital systems against the backdrop of media cultural and digital change. The focus is on the changes to which individuals and society are being subjected; this focus also encompasses the analysis and evaluation of opportunities and problems arising from digital change. These include the opportunities for economic, ecological, sustainable, and political action afforded by media and digital literacy. Also included is the individual's sense of responsibility, the data traces of individuals resulting from the use of digital systems, and associated profiling for commercial or ideological purposes. In addition, for individuals working within digital infrastructures, recognizing and evaluating media or technological influences and actively participating in social and cultural developments is becoming more demanding. Individuals require background knowledge and specific competencies, such as the ability to assess information or form opinions. Contradictory tendencies can be observed here: whilst increased opportunities for participation increase the potential influence of individuals, the growing complexity of a digitally influenced culture and the closed nature of autonomous or

self-learning systems in turn make individual and social access more difficult. This raises a fundamentally new question about the opportunities that exist for helping individuals to create a digital culture. At the same time, digital technologies can produce or reinforce social inequalities, which means that questions of social justice and social equality must be asked again and again.

Another aspect is the historical and political as well as societal impacts of information and communication technologies. This requires studies to identify which norms and rules are effective in media-supported social processes, how and by whom they are shaped, and which power structures are inscribed in them. This also includes the economic implications of digital media and technologies: issues such as the ownership of data, personal rights, the maturity of individuals, informational self-determination, civil disobedience towards increasingly autonomous technical systems and social participation must be analyzed from an ethical perspective.

2.3 Interaction in terms of use, agency and subjectification

The interactional perspective focuses on individuals. Here, the following questions are crucial: how do individuals use digital media depending on their *technological-medial* and *socio-cultural* environment? What digital media and systems do individuals use – and why and for what purpose? To what extent can individuals participate in digital change and actively create it? And to what extent do they constitute themselves as subjects capable of taking action through the thoughtful, critical, responsible, and participatory use of media? From an interactional perspective, the aspects of *use*, *action* and *subjectification*, which are described in the following section, are therefore important.

Use refers to the functional application of digital media and systems, for example for receptive, creative, communicative, problem-solving, and organizational purposes. These options, which are perceived, selected, and possibly also changed by individuals or groups of people, relate to digital artifacts and the opportunities they afford.

These opportunities are integrated into different social practices in the context of *actions*. In the process, culturally traditional forms of interaction and communication are both adopted and transformed. A conscious appropriation of these usage options always requires the individual user to have certain motives for their action, as well as the ability to engage in reflection and analysis of the technological and media functional principles and potentials they are dealing with. They must also conceive of a frame for socio-cultural practices – this applies equally to the use of educational media and technology for teaching and learning. This shows the potential for creating and designing (with) digital artifacts. Such options for action also form the horizon for the development of individual skills.

Firstly, *subjectification* refers to the fact that the interaction between digital media and systems as part of human actions can also create, enable, or hinder the formation and development of individuals' identity. This takes place on several levels: specifically, it refers firstly to forms of self-thematization that are enabled and suggested in and via digital media and systems. For example, social networks tend to inscribe certain calls to action based on how one shows oneself and behaves in these services, thereby constituting oneself at the same time. From the perspective of interaction, it is interesting to see which image of humanity is constituted by these forms of possible self-thematization. Secondly, a more abstract question presents itself: how and against the background of which cultural inscriptions are subjects represented and addressed in the respective media, for example in the form of interest profiles in recommendation and filter systems, or at the level of interfaces and interaction possibilities? Thirdly, in the face of data analytics and artificial intelligence, for example, concepts traditionally related to subjects such as autonomy and authenticity must also be examined from a media-technological perspective.

From this interaction perspective, it is possible to reflect on how and why individuals select and use digital media and systems as tools for specific projects. Here, it is necessary to adequately locate the discussion within the existing possibilities and functional scope of common media and tools, their respective application domains as well as their safe handling. It is also important to address the users' knowledge of the social, political, and economic interests represented by providers of digital tools, systems and platforms. Individuals' own actions always raise the question of what other alternative options for action might be individually and socially desirable and feasible. From this perspective, it is always necessary to reflect on the subject positions that are created on the level of technological-medially and socio-culturally, and how subjects constitute themselves within this framework and, finally, to what extent subjectivity is transformed in the face of autonomous (AI) systems.

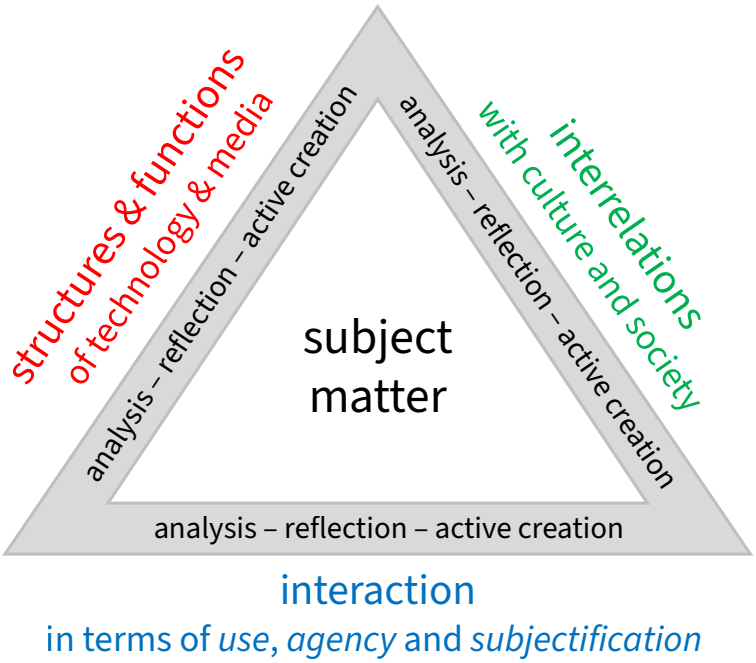

Fig. 1: Frankfurt Triangle.

3. Connections

The three sides of the *Frankfurt Triangle* each describe different perspectives for the *analysis*, *reflection* and *active creation* of artifacts and phenomena in a digital world – a world that is shaped by digital media and technology, systems, and platforms. This includes different approaches to the observation and explanation of digital artifacts and the phenomena associated with them. The theoretical-conceptual model provides conceptual and structural common ground for bringing together the discourses of computer science, computer science didactics, media studies, media education and media literacy education. The aim is to enter into a productive interdisciplinary polylogue and to promote the development of compatible theories for the specification, differentiation, and concretization of the phenomena of a digital world.

For educational concepts that address digital media and systems, including the associated phenomena and their foundations, and are intended to enable participation in the world shaped by them, the *Frankfurt Triangle* stipulates that both the technological and medial structures and functions, the socio-cultural interrelations as well as the modes of use, action and subjectification in interactions with digital media and systems must be included. The overarching goal must be the ability to

analyze, *reflect* on and *actively create* digital artifacts and the phenomena associated with them in the confluence of these three perspectives, and thus be able to explain and assess them.

With a view to these educational concepts, it is important to rethink and continue developing competency requirements in dialogue with educational policy and practice, and to develop subject-related and interdisciplinary didactic scenarios and learning materials in cooperation with experts from computer science, computer science didactics, media studies, media education and media literacy education, which enable the development and expansion of these competencies in educational institutions. This framework can be adapted for all fields of practice and action in educational contexts and pedagogical work: for general education in schools, universities, teacher training, and also for extracurricular educational contexts such as child and youth work and adult education. In the long term, this will result in a comprehensive, interdisciplinary, and scientifically sound catalog of objectives and measures for educational concepts in a world shaped by technology, computer systems, platforms, and digital media.

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