Commentarii informaticae didacticae | 13

Artikel erschienen in:

Jörg Desel, Simone Opel, Juliane Siegeris (Hrsg.)

Hochschuldidaktik Informatik HDI 2021

9. Fachtagung des GI-Fachbereichs Informatik und Ausbildung/Didaktik der Informatik 15.–16. September 2021 in Dortmund

(Commentarii informaticae didacticae (CID) ; 13)

2023 – 299 S.
ISBN 978-3-86956-548-4
DOI https://doi.org/10.25932/publishup-56507

Empfohlene Zitation:
Gregor Große-Bölting; Lukas Scheppach; Andreas Mühling: The Place of Ethics in Computer Science Education, In: Hochschuldidaktik Informatik HDI 2021, Jörg Desel, Simone Opel, Juliane Siegeris (Hrsg.), Potsdam, Universitätsverlag Potsdam, 2023, S. 173–187.
DOI https://doi.org/10.25932/publishup-61598

Universitätsverlag Potsdam

The Place of Ethics in Computer Science Education

Gregor Große-Bölting[1], Lukas Scheppach[1], Andreas Mühling[1]

Abstract: Ethical issues surrounding modern computing technologies play an increasingly important role in the public debate. Yet, ethics still either doesn't appear at all or only to a very small extent in computer science degree programs. This paper provides an argument for the value of ethics beyond a pure responsibility perspective and describes the positive value of ethical debate for future computer scientists. It also provides a systematic analysis of the module handbooks of 67 German universities and shows that there is indeed a lack of ethics in computer science education. Finally, we present a principled design of a compulsory course for undergraduate students.

Keywords: ethics; diversity; social impact; bachelor; curriculum analysis; course development

1 Introduction

Topics related to computer science that appear in media and thus are made aware to the general public today very often touch on aspects of ethics, reflecting how deeply our discipline has affected and shaped our modern world. Such topics, for example, deal with the environmental impact of cryptocurrencies [Ar21], non-fungible tokens (NFTs) [Ba21] or with the rejection of AI powered automatic facial recognition technology by cities in the US, set in motion by the Black Lives Matters movement [CFK19]. Another example are GPT3's (*Generative Pre-trained Transformer 3*, a language prediction model created by OpenAI) capabilities that impress laymen and experts alike, but also engage philosophers to consider the ethical implications [Da21; MN20] and raise questions about the consequences for the human self-image [We20].

1 Kiel University, Department of Computer Science, Christian-Albrechts-Platz 4, 24118 Kiel, ggb@informatik.uni-kiel.de https://orcid.org/0000-0003-0303-1796 | stu126679@mail.uni-kiel.de | andreas.muehling@informatik.uni-kiel.de https://orcid.org/0000-0002-6396-3491

The ACM curricula for computer science have included ethics as an elective element since the 1970s and starting in the 1990s even had a (small) mandatory component. Since 2004, it is a required component of degree programs to be accredited [Qu06]. The current 2020 ACM guidelines [CC20, pp. 76] as well consider ethics to be an important and permanent part of computer science education. As a result, ethics is widely taught as part of computer science in the USA, even though the exact implementation varies widely: Sometimes students have to take ethics courses outside the department, sometimes they are provided within computer science [Re20]. There is also the possibility to spread the compulsory part over several courses and thus to teach ethics in context, e.g. in Machine Learning courses to deal with problems of data bias and in Algorithmics courses to deal with the human part in the design of algorithms [Fi21]. The latter model tends to be uncommon, as it makes it more difficult to prove that the ethics element has been incorporated. If ethics is integrated within a single course, it is also referred to as a vertical ethics offering, while if it is spread over several courses, it is referred to as a horizontal [Qu06]. Systematic evaluations of the contents of these courses can be found in Saltz [Sa19] and Garrett [GBF20].

The German Informatics Society (Gesellschaft für Informatik, GI) as well has recommendations for anchoring ethics in a bachelor's program in computer science: while the 2005 recommendations [GI05] consider ethics and responsible action as an aspect for strengthening self-competence in the sub-area of interdisciplinary key competencies, the 2016 recommendations [Zu16] list 'Computer Science and Society' as a cognitive competence area. The content addresses legal topics, data protection, professional ethics and social responsibility. Since this is only part of the ethical and social issues in connection with computer science, as will be shown in the following, a large area of ethical reflection remains neglected.

This paper offers a perspective on ethics within computer science courses in Germany in three different ways: First, we formulate a theoretical argument for the value of ethics in CS. Second, we take a look at the current state of implementation of ethics in German universities and third, we are presenting the design of a new compulsory course on ethics to be implemented at Kiel university.

2 The Value of Ethics in Computer Science Education

Competencies in dealing with ethical implications are increasingly required from computer scientists. For example, conferences in the ML and AI sectors are now beginning to require that papers submitted include an ethical or social impact statement that provides an assessment of the consequences for society of the technical design presented in the paper [AR20].

For novice scientists unfamiliar with and untrained in ethical reasoning, this can be a challenge, in particular as the epistemic approach of our discipline manifested around computational thinking, formal reasoning and problem solving, is inappropriate for solving ethical or social problems, which require negotiation, interpretation and sometimes the toleration of ambiguities. Ethical education can make an important contribution at this point, not only by enabling students to navigate their way around ethical considerations in their later professional life, but also by showing the limits of the discipline and making clear when engineers should seek the expertise of experts from other disciplines – such as trained ethicists [RSA21].

In addition, including ethics in CS curricula may also help with the lack of diversity still common in our discipline. One reason why computer science still has a problem with diversity is seen in the fact that women and minorities are particularly interested in realizing communal values through their course of study [Di10; Le19]. However, since this is not established in the discipline of computer science and thus lacks appreciation, these groups often find themselves deterred and avoid or leave the field [Di10; Le19]. In addition, it has been observed that a social or ethical orientation decreases during the course of the study of computer science: students who had idealistic goals at the beginning lose them over the course of their studies [Pe18; GSM20]. To put it bluntly, students of computer science lose their ethical and social interest. The predominant epistemic approach for CS – outlined above – has been argued to be one of the driving factors for this [Ea14; RSA21].

Besides this, from the point of view of socio-cultural learning theories, such as Lave and Wenger's Community of Practice, ethics may also help in another way. Newcomers who want to gain a foothold in a discipline do so by learning the practices of that discipline. This includes not only what to do, but how and why [LW91, p. 98]. Values play a prominent role in this, because a shared and non-explicit set of values must first be experienced and learned in order to become part of the discipline and develop a professional identity. In this context,

ethics can serve as a means of self-assurance and reflection on values and thus make implicit knowledge explicit to newcomers [Lo05].

3 Ethics in German CS Curricula: An Analysis

In order to determine the extent to which ethics plays a role in computer science at universities in Germany, we systematically examined the curricula in this regard.

As the basis of the analysis, we used the most recent CHE ranking of 2020/2021[2]. All universities listed in the ranking and offering a bachelors degree for computer science were selected. Based on this data, the CS curricula and corresponding module catalogs of these institutions were searched for any modules that deal with ethical topics. Courses that are not primarily concerned with ethical issues but have ethical components were also included: We applied an inclusive understanding of what we consider ethical content so as not to exclude any eligible courses. The main criterion was whether the course reflects the subject of computer science itself or addresses ethical or social issues in terms of content or methodology. Courses that only include this to a lesser extent (e.g. soft skills) were nevertheless considered. A distinction was made between compulsory and elective modules.

The information available in the module descriptions – in particular the topics and the learning goals – was inductively coded using qualitative content analysis [Ma04] by one of the authors, thus forming a category system (see below). Another author then deductively coded the elective modules based on the existing category system. This approach determined whether further topics were dealt with that were not covered by the categories of the compulsory modules. We also recorded the weekly hours (SWS) of each module.

3.1 Results

In total, we examined the material of 67 universities. Nine of the examined universities offer compulsory modules and 23 offer elective modules, the remaining institutions do not offer anything related to ethics. The compulsory modules have 3.38 SWS on average (SD 1.41), elective modules have an average of 2.95 SWS (SD 1.43). We were not able to determine the weekly hours for all modules.

2 CHE Ranking, accessed May 7, 2021, https://www.che.de/ranking-deutschland/.

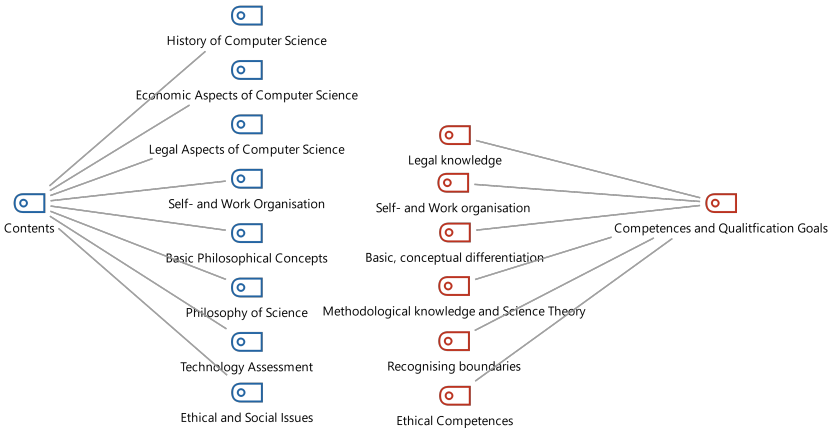

Fig. 1: Matching the contents and competencies (or qualification goals) found in the module descriptions.

The topics of the compulsory modules can be divided into the categories ‘History of Computer Science’, ‘Economic Aspects of Computer Science’, ‘Legal Aspects of Computer Science’, ‘Self- and Work Organisation’, ‘Basic Philosophical Concepts’, ‘Philosophy of Science’, ‘Technology Assessment’ and ‘Ethical and Social Issues’. The top three categories with 21, 16 and 10 appearances respectively are: ‘Ethical and societal issues’, ‘Legal aspects of Computer Science’ and ‘Self- and Work Organisation’.

Regarding the learning goals or competencies that the compulsory module descriptions state, the categories ‘Ethical competences’, ‘Recognizing boundaries’, ‘Basic, conceptual differentiation’, ‘Methodological knowledge and Science Theory’, ‘Legal knowledge’ and ‘Self- and Work organisation’ were identified. ‘Ethical competences’, ‘Self- and Work Organisation’ and ‘Methodological Knowledge’ with 19, 16 and 6 occurrences respectively were the top categories.

The examination of the elective modules did not lead to any new categories regarding the topics or learning goals.

Regarding module names, we found ‘Computer Science and Society’ to be the most frequent, occurring three times in the compulsory modules and eight times in the elective modules. Two electives modules are named ‘Soft Skills’, the remaining module names only appear once. In most module names, such as ‘Computer Science and Society’, ‘Ethics and Law in Computer Science’ or

'Technology Assessment and Evaluation', an ethical component can be identified more or less directly. For other module names, such as 'Soft Skills', 'Key Competences I & II' or 'Knowledge in Modern Society', a look at the module description is needed in order to determine that ethical topics in computer science are in fact part of the module.

3.2 Discussion

As the results show there are hardly any modules, neither compulsory nor elective, that are concerned exclusively with ethical issues; almost all modules deal with other interdisciplinary topics. They often mix ethical with legal issues and even self- and work organisation. Considering that the modules are rather minor in terms of the hours allocated to them per week (SWS) and that not only ethical issues are dealt with during this time, it can be concluded that ethics currently only plays a subordinate role in computer science degrees in Germany. Even more so, mixing ethical topics, sometimes seemingly random, with other non-core ('soft') topics fosters a devaluation of ethics as a relevant topic, especially if there is no epistemological clarification and framing [RSA21].

The frequent naming of the courses as 'Computer Science and Society', as well as the alignment of the content, suggests a strong orientation of the module authors to the GI recommendations [Zu16]. A limitation of our analysis is the consideration of only module descriptions and manuals: This makes it difficult to gain a precise insight into the actual content taught. Further research in this area could circumvent this limitation by interviewing lecturers. It is owed to the explorative nature of this study that we initially approached the analysis with an inclusive view of the topic and thus found a wide range of content taught (e.g., soft skills). The category system we developed can be used in the future to conduct further analyses with a more precise focus.

4 A Compulsory Course on Ethics

As part of a restructuring of the bachelors degree program, the Institute of Computer Science at Kiel University has opted to include ethics as a compulsory part of the curriculum. The concept of the new module is outlined below to serve as a basis for discussion.

The design of the module follows five major design goals:
(1) It deliberately focuses on ethics, not on legal issues, which are often co-covered within the same course context. However, it is important to point out that legality and legitimacy are two very different concepts. Engineers must be knowledgeable about law and the legal framework they operate in, but it is ethical awareness that enables meaningful embedding of systems within a social context.
(2) It focuses on systems that are already part of everyday life and on challenges that engineers and scientists face in the here and now. It has been observed, that in the context of AI or ML ethics, it often happens that the discussion turns to developments in the more distant future, such as speculations on the *Singularity* [Ku06], while the actual, already prevailing problems of the present are given less consideration [Co20; Lo19; Mi18].
(3) It provides students with tools for immediate use in projects. In order for students to experience their engagement with ethics as meaningful, they must be able to see its concrete practical relevance. Accordingly, problems from computer science should be taught and applicability of the methods should be a focus.
(4) It provides enough ethical knowledge to make communication with ethics experts possible. Regarding the difficult question of the amount of basic philosophical and ethical knowledge that computer scientists need to learn, Gambelin [Ga20] argues that knowledge which enables shared understanding and communication is sufficient. Thus, a shared vocabulary of basic terms and methods must be made available without expecting them to have in-depth knowledge.
(5) Finally, the course design strives to make participants aware that ethics is not in the hands of 'ethical unicorns' [RSA21] who make decisions for themselves but that as engineers they have to talk to stakeholders, or indeed to ethicists, when systems they develop affect the interests (of groups) of other people.

From these five design goals, three top-level content areas emerge quite naturally: Ethical foundations must be developed and the location of ethics in the discipline must be addressed. This is done in the first part, *Foundation*. The second part, *Context*, transfers the basic ethical concepts to specific problems that arise in the context of the development of computer science systems in particular. Finally, the third part, *Application*, tries to provide the students with the methodological tools that are necessary for an ethical development of systems.

The foundation part deals with the role of computer science ethics as a domain ethics. It discusses the epistemic means of computer science and how these differ from other sciences in order to narrow down the scope of problem solving. This part also clarifies fundamental lines of ethical reasoning: consequentialism, deontology, and virtue ethics, but also discourse ethics, justice theory, and care ethics. Key concepts of computer science ethics, as derived from a comprehensive literature review by Stahl et al. [STM16] – like agency, autonomy, freedom, identity, justice, privacy, responsibility – are introduced and their meaning is elaborated by the students. Basic techniques of philosophical argumentation are discussed as well, such as the goals and scope of ethical argumentation, thought experiments, etc., and how to read and write ethical texts.

The context part focuses on specific problems in the context of the development and use of computer systems. The individual sections are roughly based on the systematic literature review by Saltz et al. [Sa19] and the curriculum review by Garrett et al. [GBF20] respectively. One of the sections deals with responsibility, in particular with issues around the attribution of responsibility, the responsibility gap and the *problem of many hands* which occurs when a system acts 'autonomously'. Other topics include transparency and security of information systems, especially transparency of algorithms and models (in the context of ML) and ethical considerations for the security of information systems, as well as issues around the collection and dissemination of data: The emergence and consequences of systematic biases in data, monopolization and exploitation in the area of so-called ghost work [GS19]. This section will also discuss professional ethics, the ethical guidelines of the GI, ACM, IEEE, etc. and their scope and criticism (e.g. [Ha20]).

The application part focuses on the implementation of ethical tools and methods. Case studies, e.g. on autonomous weapon systems, self-driving cars and social robots, are discussed. The exploration of ethical design methods and the reflection on how existing design methods such as 'agile' contain value concepts are the key aspects of this part. Finally, specific requirements for the computer scientist as a scientist are explained and in particular ethical and social impact statements are elaborated. This should enable the students not only to evaluate the quality of impact statements, but also to write them on their own.

In accordance with the orientation of the module to impart both relevant knowledge from ethics and to specifically train students in practical skills, it will consist to equal parts of a lecture and a seminar. Within the seminar, students

will have the opportunity to discuss ethical and social problems, to practice reading and interpreting philosophical texts, and to write their own texts – such as impact statements. In addition, they will have the opportunity to try out ethical design methods by means of exemplary project tasks.

To enable the students to apply their ethical knowledge even more and to ensure a higher level of practical relevance, an ethical component will also be incorporated in the software design project that all students have to complete as part of their bachelor's degree. The project is offered in cooperation with an industry partner and should be attended directly after the ethics module. In the course of the project, one day is dedicated to an ethical reflection; the teacher of the ethics module is available to the students for questions and as a discussion partner. Finally, part of the exam performance of the ethics module is that the students develop an ethical concept for their project. Thus, ethics is not only integrated vertically but also horizontally, i.e. across at least two courses in the study program. Students can not only experience the integration of the subject matter into a practical context, but also see that the topic receives recognition and space from other teachers – a problem that otherwise often leads to a devaluation of the topic [Qu06].

4.1 Addendum: Report on the First Implementation

In the winter semester 2021/22, the module presented above was held as an elective at the computer science department at Kiel University, before being continued as a compulsory course for the first time in the coming winter semester (2022/23). 32 students took part in the course and attempted to gain admission to the examination. The elective course could be credited to students in different study programs and study regulations, so that computer science students of different semesters were represented as well as teacher training and business informatics students. This heterogeneity was a great challenge for this first test run, but helped to force the reflection about the necessary prerequisites of the course.

The module was implemented as a course with one hour per week of lecture and one hour of seminar each. Since the lecture and seminar parts alternated fluently, it was aimed at a kind of workshop character. The main content areas were implemented as discussed above, Figure 2 illustrates the structure of the course. In order to train the procedural competences of the students with regard

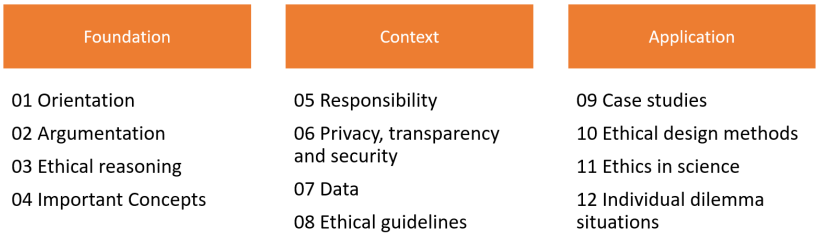

Fig. 2: Structure of the module and main content areas.

to ethical argumentation, various offerings were made: In addition to a weekly homework assignment, students were given the opportunity to (voluntarily) complete more extensive send-in assignments. Each of these assignments was a detailed case analysis, which was to be carried out according to a previously introduced method or under a specific question. The final exam of the course consisted of a similar task.

In the final session of the course, feedback was sought from students, particularly with regard to the content and surrounding conditions of the course. Students found a wide range of topics interesting; explicitly mentioned and supported by more than one participant were the following topics: Addressing dilemma situations, ethical lines of reasoning, ethical problems of data, data collection and biases, questions about the responsibility of the computer scientist, the importance of nudges, dark patterns, surveillance capitalism, and chilling effects. This confirms the observation made by others [Pr21] that computer science students are generally very interested in ethical problems. In contrast, students did not find the discussion of methodological or 'craft' issues (how to read and write ethical texts) particularly interesting. Regarding the surrounding conditions of the course, students emphasized the open implementation as positive as it contained a lot of interactivity and discussion, with a balanced mixture of input and (self-)reflection but also the comprehensibility of the slides and the examination conditions (a written examination was written as a pre-requisite for the final essay). Negative comments were made about the abundance of topics and the implementation of homework and assignments, which were perceived as too extensive.

Further development is strongly oriented towards this student feedback: The content of the methodological aspect is to be revised again so that the relevance of the skills taught – reading and writing ethical texts – becomes more apparent

to the students. In addition, the interaction of homework, assignments, and the written exam will be reconsidered. The overall aim is to ensure that these three elements are better integrated and that students are more motivated to make use of these offerings.

5 Conclusion

The Peter Parker principle – 'With great power comes great responsibility' – could already be reason enough to deal with ethics more decisively in computer science: Computer systems are part of everyday life and determine many aspects of our lives without us being aware at all times whether a decision is still made by a human or by a machine. The fact that the engineers responsible for building and using these systems are nevertheless not subject to any ethical training, that these systems themselves are hardly regulated, should be met with astonishment in a democratic society.

Nevertheless, as our analysis shows, only very few universities in Germany – nine from our sample of 67, a mere 13.43 % – include ethics as a compulsory part in their CS education programs. Even then, it is often not awarded many weekly hours and grouped together with other 'soft' topics in unspecific modules. One limitation of our analysis, however, is that horizontal approaches to teaching ethics are difficult to locate with the method presented above.

Yet, as we discussed, there is an increasing need for ethical trained computer scientists and this kind of training may not come naturally to many of them. However, including ethics in the syllabus may provide an opportunity for a more diverse group of students to feel welcome in our discipline.

Based on these considerations, a principles-driven proposal for the design of a compulsory ethics course in a bachelors degree in computer science was presented.

Further research would be necessary and helpful to substantiate the relationship between values and disciplinary identity, which is currently assumed in theory but supported only by circumstantial evidence. Overall, it would be desirable to better integrate the influence of reflection on science as part of the degree program and to research its impact. This would include an awareness not only of what computational thinking is but also of what its limitations are and what problems might be better solved with other tools.

Bibliography

[AR20] Abuhamad, G.; Rheault, C.: Like a Researcher Stating Broader Impact For the Very First Time./, 2020, arXiv: 2011.13032.

[Ar21] Aratani, L.: Electricity needed to mine bitcoin is more than used by 'entire countries', 2021, URL: http://www.theguardian.com/technology/2021/feb/27/bitcoin-mining-electricity-use-environmental-impact, visited on: 04/08/2021.

[Ba21] Barber, G.: NFTs Are Hot. So Is Their Effect on the Earth's Climate, 2021, URL: https://www.wired.com/story/nfts-hot-effect-earth-climate/, visited on: 04/08/2021.

[CC20] CC2020 Task Force: Computing Curricula 2020: Paradigms for Global Computing Education. Association for Computing Machinery, New York, NY, USA, 2020.

[CFK19] Conger, K.; Fausset, R.; Kovaleski, S. F.: San Francisco Bans Facial Recognition Technology, May 2019, URL: https://www.nytimes.com/2019/05/14/us/facial-recognition-ban-san-francisco.html, visited on: 04/08/2021.

[Co20] Coeckelbergh, M.: AI Ethics. MIT Press, 2020.

[Da21] Dale, R.: GPT-3: What's it good for? Natural Language Engineering 27/1, pp. 113–118, 2021.

[Di10] Diekman, A. B.; Brown, E. R.; Johnston, A. M.; Clark, E. K.: Seeking Congruity Between Goals and Roles: A New Look at Why Women Opt Out of Science, Technology, Engineering, and Mathematics Careers. Psychological Science 21/8, pp. 1051–1057, 2010.

[Ea14] Easterbrook, S.: From Computational Thinking to Systems Thinking: A conceptual toolkit for sustainability computing. In: 2nd International Conference on ICT for Sustainability (ICT4S 2014) (Advances in Computer Science Research, 2). Atlantis Press, pp. 235–244, 2014.

[Fi21] Fiesler, C.; Friske, M.; Garrett, N.; Muzny, F.; Smith, J. J.; Zietz, J.: Integrating Ethics into Introductory Programming Classes. In: Proceedings of the 52nd ACM Technical Symposium on Computer Science Education. SIGCSE '21, Association for Computing Machinery, Virtual Event, USA, pp. 1027–1033, 2021.

[Ga20] Gambelin, O.: Brave: what it means to be an AI Ethicist. AI and Ethics 1/1, pp. 87–91, 2020.

[GBF20] Garrett, N.; Beard, N.; Fiesler, C.: More Than "If Time Allows": The Role of Ethics in AI Education. In: Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society. AIES '20, Association for Computing Machinery, New York, NY, USA, pp. 272–278, 2020.

[GI05] GI – Gesellschaft für Informatik: Bachelor- und Masterprogramme im Studienfach Informatik an Hochschulen (Dezember 2005), 2005.

[GS19] Gray, M. L.; Suri, S.: Ghost Work: How to Stop Silicon Valley from Building a New Global Underclass. Mariner Books, 2019.

[GSM20] Große-Bölting, G.; Schneider, Y.; Mühling, A.: Beginning Students' Conceptions of Computer Science: The Effect of the First Semester. In: International Conference on Learning and Teaching in Computing and Engineering (LaTICE). 2020.

[Ha20] Hagendorff, T.: The Ethics of AI Ethics: An Evaluation of Guidelines. Minds and Machines 30/1, pp. 99–120, 2020.

[Ku06] Kurzweil, R.: The Singularity Is Near: When Humans Transcend Biology. Penguin (Non-Classics), London, 2006.

[Le19] Lewis, C.; Bruno, P.; Raygoza, J.; Wang, J.: Alignment of Goals and Perceptions of Computing Predicts Students' Sense of Belonging in Computing. In: Proceedings of the 2019 ACM Conference on International Computing Education Research. ICER '19, Association for Computing Machinery, New York, NY, USA, pp. 11–19, 2019.

[Lo05] Loui, M. C.: Ethics and the Development of Professional Identities of Engineering Students. Journal of Engineering Education 94/4, pp. 383–390, 2005.

[Lo19] Loh, J.: Roboterethik: Eine Einführung. Suhrkamp Verlag, Frankfurt am Main, 2019.

[LW91] Lave, J.; Wenger, E.: Situated learning: Legitimate peripheral participation. Cambridge University Press, 1991.

[Ma04] Mayring, P. et al.: Qualitative content analysis. A companion to qualitative research 1/2, pp. 159–176, 2004.

[Mi18] Misselhorn, C.: Grundfragen der Maschinenethik. Reclam, Stuttgart, 2018.

[MN20] McGuffie, K.; Newhouse, A.: The Radicalization Risks of GPT-3 and Advanced Neural Language Models./, 2020, arXiv: 2009.06807.

[Pe18] Peters, A.-K.: Students' Experience of Participation in a Discipline—A Longitudinal Study of Computer Science and IT Engineering Students. ACM Trans. Comput. Educ. 19/1, Sept. 2018.

[Pr21] Pretschner, A.; Zuber, N.; Gogoll, J.; Kacianka, S.; Nida-Rümelin, J.: Ethik in der agilen Software-Entwicklung. Informatik Spektrum 44/5, pp. 348–354, 2021.

[Qu06] Quinn, M. J.: On teaching computer ethics within a computer science department. Science and Engineering Ethics 12/2, pp. 335–343, 2006.

[Re20] Reich, R.; Sahami, M.; Weinstein, J. M.; Cohen, H.: Teaching Computer Ethics: A Deeply Multidisciplinary Approach. In: Proceedings of the 51st ACM Technical Symposium on Computer Science Education. SIGCSE '20, Association for Computing Machinery, Portland, OR, USA, pp. 296–302, 2020.

[RSA21] Raji, I. D.; Scheuerman, M. K.; Amironesei, R.: You Can't Sit With Us: Exclusionary Pedagogy in AI Ethics Education. In: Proceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency. FAccT '21, Association for Computing Machinery, Virtual Event, Canada, pp. 515–525, 2021.

[Sa19] Saltz, J.; Skirpan, M.; Fiesler, C.; Gorelick, M.; Yeh, T.; Heckman, R.; Dewar, N.; Beard, N.: Integrating Ethics within Machine Learning Courses. ACM Trans. Comput. Educ. 19/4, Aug. 2019.

[STM16] Stahl, B. C.; Timmermans, J.; Mittelstadt, B. D.: The Ethics of Computing: A Survey of the Computing-Oriented Literature. ACM Computing Surveys 48/4, 55:1–55:38, Feb. 2016.

[We20] Weinberg, J.: Philosophers On GPT-3 (updated with replies by GPT-3). DailyNous.com/, 2020, URL: https://dailynous.com/2020/07/30/philosophers-gpt-3/, visited on: 08/02/2023.

[Zu16] Zukunft, O.: Empfehlungen für Bachelor- und Masterprogramme im Studienfach Informatik an Hochschulen, 2016, URL: https://dl.gi.de/bitstream/handle/20.500.12116/2351/58-GI-Empfehlungen_Bachelor-Master-Informatik2016.pdf, visited on: 08/02/2023.