This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

Why We Need More Research Measuring the Effects of Tech Ethics Education

Emily Foster-Hanson, *Member, IEEE*, Steven Kelts, *Member, IEEE*, Tania Lombrozo, and Kerem Oktar

***Abstract*—Education offers a key opportunity to shift ethical culture around the social implications of technology. It could improve students' anticipation of potential tech harms, increase use of reasoning to address harms proactively, and change how people weigh values against other competing goals within complex systems. Yet, of the empirical measurements that have been developed to assess the efficacy of tech ethics education, most focus only on measuring the quality of students' abstract reasoning, not their ability to foresee problems or their intended strategies to address them in complex environments. Drawing on evidence from the human psychology of belief and behavior change, our recent research developed and tested the REGAIN framework for measuring the effects of tech ethics coursework. Here we briefly describe this framework and highlight its theoretical and practical implications as part of a broader research agenda focused on developing more empirical measurement of tech ethics education. We outline areas of future research needed to capitalize on the opportunity of education to produce responsible citizens and technology that enhances, rather than hinders, human social connectedness and well-being across the lifespan.**

***Index Terms*—Ethics education, empirical measurement, cognitive mechanisms, psychology.**

I. Introduction

OVER the next few years, 42% of companies expect to prioritize jobs using AI and big data [1]. How is education preparing our future citizens to engage ethically with these increasingly complex technologies? The past decades of rapid growth in the web, social media, and artificial intelligence have seen new technologies often exacerbating existing social problems and causing new ones. Researchers, policy-makers, and consumers have leveled criticisms that new tech entrenches racial and other biases [2], [3], weakens data privacy protections [4], [5], undermines user autonomy [6], and more. In the current paper, we propose that future research should address these harms proactively by developing and empirically testing tech ethics education strategies focused on the social implications of technology. In particular, we suggest that empirical measurement grounded in psychology research can help to develop education strategies that produce responsible citizens [7], [8] who are better equipped as both consumers of technology and designers of technology that enhances, rather than hinders, social connectedness and well-being across the lifespan [9]. We begin by focusing on higher education coursework, which is currently students' primary source of tech ethics education, and we describe our REGAIN framework designed to test the effects of college level tech ethics education. We conclude by offering suggestions from cognitive, social, and developmental psychology for how future research could develop more evidence-based strategies for teaching tech ethics to children and adolescents.

University courses offer a special opportunity to shift ethical culture: students buy in (choose these classes themselves), commit to a whole semester (allowing extended interventions), and may be more receptive to behavioral interventions than people already working in the field because they have less deeply ingrained habits and are in a state of transition [10]. But there is limited evidence about whether and which strategies are effective. Recent research across both industry and education has aimed to elicit more ethical behavior [11], [12], [13], [14], [15], [16], but such research rarely empirically examines the efficacy of instruction (see below for a few notable exceptions). Students in engineering may even become *less* concerned about ethics across their education [17], suggesting that existing efforts at promoting ethical development are failing to capitalize on a major opportunity to shift ethical culture. However, despite numerous recent calls to action, there are currently no standards for tech ethics education even in college level computer science or engineering programs [18], [19], [20], [21], [22], [23].

College level tech ethics courses may be extra difficult to study because they vary substantially in both structure and content [18], [24], [25], [26], [27], [28], and because tech ethics students are typically not yet in a position to make many measurable workplace decisions about technology development and design (see [29]). To address this, courses often use "case studies" of development gone wrong, and there are important field reports of the effects of case studies [30], [31]. For example, Kumar and Levis used qualitative interviews and surveys to assess student engagement with engineering ethics [31]. However, the cognitive skill of reflecting and passing judgment on known actions and their consequences is not the same as the skill of anticipating how the one leads to the other,

Received 14 October 2025; revised 18 May 2026; accepted 25 September 2026. This work was supported in part by Google. An earlier version of this paper was presented in part at the 2025 IEEE International Symposium on Ethics in Engineering, Science, and Technology (ETHICS) [DOI: 10.1109/ETHICS65148.2025.11098444]. *(Corresponding author: Emily Foster-Hanson.)*

This work involved human subjects or animals in its research. Approval of all ethical and experimental procedures and protocols was granted by Princeton University Institutional Review Board.

Emily Foster-Hanson was with Princeton University, Princeton, NJ 08544 USA. She is now with Swarthmore College, Swarthmore, PA 19081 USA (e-mail: fosterhanson@swarthmore.edu).

Steven Kelts was with Princeton University, Princeton, NJ 08544 USA. He is now with Georgetown University, Washington, DC 20057 USA (e-mail: steven.kelts@georgetown.edu).

Tania Lombrozo and Kerem Oktar are with Princeton University, Princeton, NJ 08544 USA (e-mail: lombrozo@princeton.edu; oktar.research@gmail.com).

Digital Object Identifier 10.1109/TTS.2026.3740348

© 2026 The Authors. This work is licensed under a Creative Commons Attribution 4.0 License.
For more information, see https://creativecommons.org/licenses/by/4.0/

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

and few specific measures have been developed to disaggregate students' moral judgments from their ability to anticipate consequences and to assess the separate effects of tech ethics courses on both. Even fewer have been developed to measure which cognitive and decision-making processes might underlie or be important correlates of students' ability to anticipate the long-term ethical consequences of their decisions [32]. But focusing on the ability to anticipate ethical consequences might be key for effective tech ethics instruction. For example, deceptive designs such as infinite scroll have exploited users' time and attention and amplified the addictive effects of social media [33]. Yet designers such as Aza Raskin—credited with the invention of infinite scroll—often report that these downstream consequences were unanticipated, unforeseen, and unintended at the time of development [34]. Urgent work has begun on how researchers might better anticipate consequences, and how to understand claims about "unintended" effects [35], [36].

In a recent paper, Foster-Hanson et al. [37] developed and empirically tested a strategy to measure the effects of tech ethics coursework, to shed light on which strategies might be most effective in shaping students' reasoning—and why. Key to this REGAIN framework is a focus on the basic psychological mechanisms expected to be (a) susceptible to instruction, and (b) generalizable across contexts. Accordingly, the instruction in the tech ethics class evaluated focused on teaching students to anticipate the downstream moral implications of technology development decisions.

This empirical study was intended as a proof of concept for the REGAIN framework, and the results provide preliminary support for this focus. We compared responses on the measures in the framework from a group of 67 undergraduate students who had just completed a course on technology ethics to a control group of 315 students that was similar to the test group in terms of majors and demographic factors. Students in the course on tech ethics showed higher moral awareness about ethical considerations in technology decision-making: They both perceived more ethical danger when presented with scenarios about technology development decisions, and they used more ethical terms in their free responses about those scenarios. However, there were no significant differences between tech ethics students and those in the control condition on measures of moral awareness when the ethical harms were not made explicit in the scenarios, so there was no evidence that the students were better at anticipating harms that were not explicitly labeled for them. Of course, the limited sample size of tech ethics students in this single study might have been too small to detect an effect. It is also possible, however, that a single college level course is not sufficient to make students with little real-world experience sufficiently aware of the ethical implications of their decisions.

Future empirical research will be needed to answer these open questions. For example, incorporating ethical content into curricula more deeply could result in more systematic changes. It's also unclear which aspect(s) of the course were responsible for the changes in judgments, so examining the consequences of ethics education across multiple courses could enable factorial experiments that examine these aspects individually (for instance, by placing substantial weight on thought experiments in one group of classes, and very little in others). Conducting these studies would contribute not only to our understanding of the psychological processes underlying ethical change, but would also have direct implications for the design of effective (and efficient) tech ethics courses.

II. Cognitive Reasoning About Ethical Decisions

The REGAIN framework [37] (fig. 1) measured more than students' awareness of moral issues, however. Drawing on evidence from the human psychology of belief and behavior change, the framework focuses on measuring cognitive processes that decades of psychology research suggest are important for moral decision-making, with an eye towards processes that could generalize across contexts and individuals. For example, the framework measures students' reasoning about ethical decisions, including how much they report relying on deliberation vs. intuition. Despite common lay beliefs that moral judgments arise through deliberation, and philosophers' focus on moral deliberation as the key to changing moral judgment (e.g., [38]), growing empirical evidence suggests that intuition and emotion also play a key role in driving decision-making [39]. In some cases, deliberating about information and evidence can influence people's views (e.g., [40]), but many day-to-day moral judgments are driven by intuition [41], [42], and people often favor using intuition when making certain decisions (e.g., [43]).

To illustrate why intuition and deliberation matter in the case of tech ethics, consider that some have argued that claims of "unintended consequences" are a political dodge, used by developers evading responsibility [23]. For instance, among Facebook's many troubling episodes, there's the example of Andrew Bosworth's memo, "The Ugly Truth." More than a year after Facebook's executives were informed that their platform was being used to organize violence against Rohingya Muslims in Myanmar, Bosworth wrote to the company that their overarching goal to "connect" people overrode any negative consequences. As he put it, "Maybe it costs a life by exposing someone to bullies. Maybe someone dies in a terrorist attack coordinated on our tools. And still we connect people" [44]. To many outside the company, this seemed like a failure to properly weigh normative goods (social connection) against serious bads (including human life).

Some recent meta-analyses of ethics education have found that content focused on reasoning and "cognition" can systematically alter moral judgments (e.g., [45], [46]), but it is unclear from these studies which aspects of cognitive reasoning underlie the observed effects. In one recent study looking at how ethics courses affect cognitive change, Oktar et al. [47] found that students taking a course in ethics did change their beliefs about some key ethical controversies (e.g., eating meat), but this change in ethical judgments was predicted by *lower* reported reliance on intuition over the course of the semester, and not by more reported reliance on deliberation (which was associated with higher confidence). These findings raise the fear of "ethics washing," especially when students are faced with difficult-to-anticipate social effects of tech, because tech ethics courses could lead

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

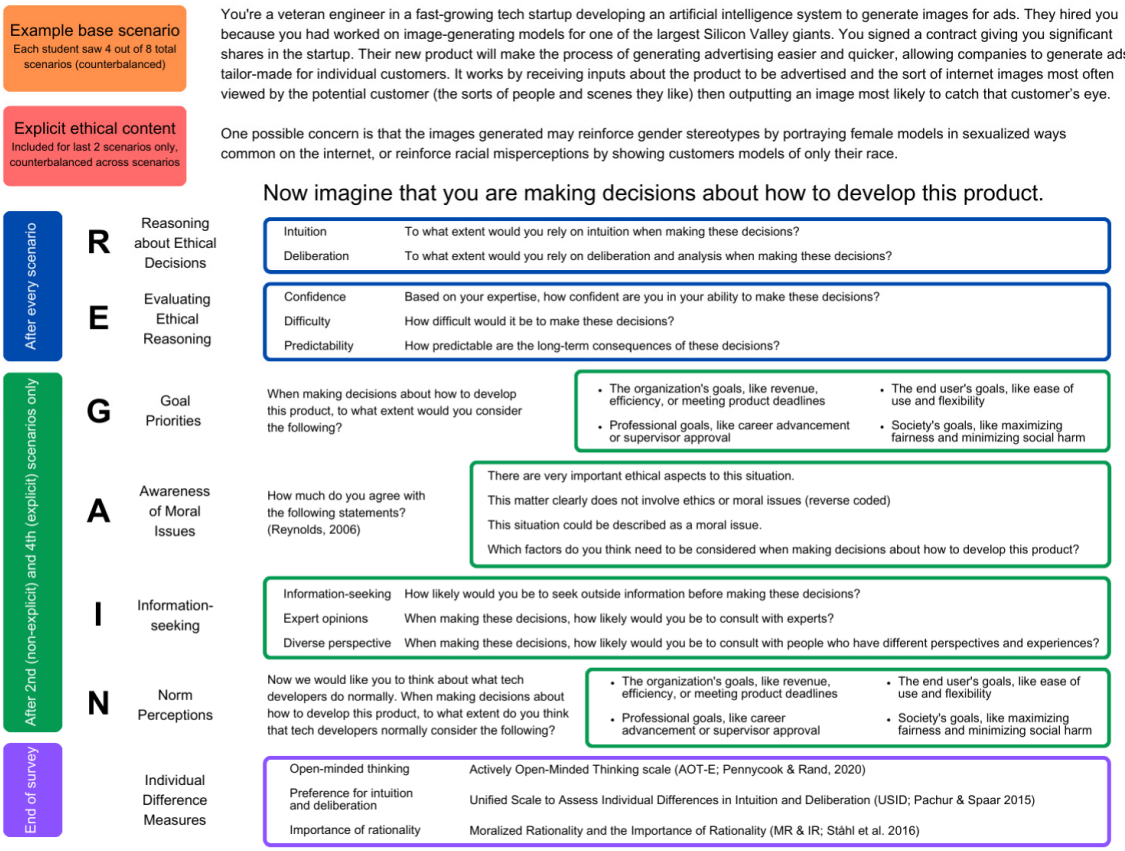


Fig. 1. General psychological mechanisms and the questions measuring them in the REGAIN framework.

students to deliberate more but have no effect on their ethical judgments. Alternatively, coursework might shift judgments by lowering reliance on intuition. The empirical study reported by Foster-Hanson et al. [37] provided some support for *both* of these ideas—students in the tech ethics course reported deliberating more *and* relying on intuition less. And both more deliberation and less reliance on intuition predicted more awareness of moral issues.

Reflections about one's own reasoning, or *metacognitive* evaluations [48], [49], can also capture important aspects of reasoners' decision-making processes, such as confidence in the ability to make decisions and appreciation for the limits of understanding about complex and unpredictable systems. Many existing strategies for teaching tech ethics focus on careful deliberation about the long-term and downstream consequences of technology development decisions (e.g., through role-play; [30], [50]). The goal is to help students think more about the macro-scale, structural consequences of individual actions within a complex system like human-computer interaction; this type of *systems thinking* is important for building more accurate representations of these complex systems [51], [52].

Foster-Hanson and Venkatagiri [32] suggested that interventions aimed at encouraging technologists to think more broadly about the systemic social effects of their actions (including interventions targeting moral imagination [53] or moral awareness [54]) could ultimately make students more hesitant to make quick judgments, leading to more careful decisions. There is extensive literature on the importance of systems thinking for ethical technology development, such as reasoning about the system's affordances [55]. Similarly, research on sociotechnical systems highlights how designing socially responsible technical systems requires understanding the complex ways humans interact with them [56], [57]. Thinking about interconnections across a sociotechnical system could help technologists confront its complexities and unpredictability, heightening sensitivity to potential unforeseen consequences. For example, viewing technologies like vaccines or genetically modified foods as intervening in complex and unpredictable systems can make people more cautious about using those technologies [58], [59]. In a similar way, viewing technology development as complex and unpredictable could make designers more cautious and lead them to seek out additional information [60] and consider diverse perspectives before deciding [54]. Such cognitive changes would achieve the most sought-after goals of development frameworks like Value Sensitive Design [61].

Despite the importance of systems thinking, however, people are often motivated to justify their existing beliefs, and the process of deliberation can itself provide an opportunity for post-hoc rationalization [62], [63], [64] and even lead to overconfidence [65]—an open invitation for "ethics washing" [13]. However, when people are less confident in their ability to make decisions, they are often more likely to seek out additional information before deciding [60]. They must also decide *whose* information matters: Experts in the field can

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

provide guidance, but so can input from people with diverse perspectives [54], [66].

Foster-Hanson et al. [37] found that, compared to students in the control condition, students in the tech ethics course thought it was more difficult to make decisions about scenarios with obvious moral implications, and they thought the consequences of their decisions were more unpredictable. They were also more likely to say they would seek out more information before deciding, both from experts and from people who hold diverse perspectives. Tech ethics students did *not* report feeling more confident—a promising indication that ethics coursework need not just result in "ethics washing."

III. The Social Nature of Decision Making

While changes in the cognitive processes described above can lead to downstream shifts in ethical judgments [47] and decisions [67], future research is needed to measure how the cognitive processes targeted in tech ethics education relate to ethical behavior in practice. What happens when students become employees in organizations whose incentive structures do not center ethical considerations? Human cognition is deeply social [68], yet the social aspects of tech ethics education may be the most difficult to measure and incorporate into the classroom [30].

To illustrate, consider the case of Frances Haugen, the Facebook whistleblower. As she reports, many people inside Facebook knew that what the company was doing was wrong (in the various scandals she exposed to the Wall Street Journal [69]). Yet even if they articulated that wrong to themselves and others, their attitude was that it wasn't their responsibility to do anything about it [70], reflecting the well-documented social psychology phenomenon of people in a group assuming that *someone else* is responsible for taking action [71]. Haugen also reports that it took enormous strength to summon the courage to act because she knew that she was likely to lose her job, face court battles with the company, and maybe even suffer the slings and arrows of public opinion [70]. The incredibly complex systems of production in the tech sector lead to many competing goals, between and even within individuals, making the prospect of ethical action that much harder. In this way, ethical decisions entail deciding *whose* ethics to prioritize, because different stakeholders may hold different—or even competing—goals and values. For this reason, ethics education should ultimately seek to shift the social norms around ethical behavior [32], [72] because people tend to conform to the social norms within their groups [68], [73], [74].

As a first step towards measuring the social impact of tech ethics coursework, the REGAIN framework measures students' own goal priorities (including how they would value organizational goals vs. society's goals for fairness and equity) and their perceptions of social norms among typical tech developers. Compared to students in the control condition, students in the tech ethics course expected developers to prioritize their own career goals more when making decisions. One interpretation of this result is that learning about the many social harms resulting from technology development, as well as ethical blind spots, institutional failures, and the difficulty of ethical decision making in complex work environments, may have left students feeling generally pessimistic about the current social norms surrounding ethical behavior in the tech industry. However, when students rated their *own* goal priorities, tech ethics students reported valuing the goals of the organization less, and the goals of society more, than students in the control condition. These results paint a somewhat rosier picture, suggesting that tech ethics coursework can inspire students to want to rewrite the social norms around ethical tech development in their own future careers.

But it's unclear whether students who say they would prioritize society's goals, or seek information from people who hold diverse perspectives and experiences, will actually do so when they become employees with bills to pay. Future research should target ethics education among people who are actively making decisions about technology design and development, to examine what might happen when these students become employees in organizations whose incentive structures and social norms are at odds with those very ethical values they say they will uphold. For example, researchers might measure the effect of courses that have applied, internship- or project-based components to examine the extent to which changes in responses to hypothetical scenarios predict changes in actual software development decisions (e.g., [29].

Future empirical research should also start tackling ethical questions at the level of institutional structures [32], [75], [76], [77]. The REGAIN framework—like most similar research across moral psychology—focuses on the decisions and judgments of specific individuals. But institutions like corporations and governments are also responsible for the harms produced by individuals acting within their systems [78], [79]. What enables groups to form institutional structures that place ethical considerations at the heart of their organization? Which kinds of educational practices can facilitate an understanding of the importance of these structures at the institutional level? Which individuals and timepoints might be the most advantageous for interventions to shift ethical norms? Addressing these questions in future work—both theoretical and empirical—will help to center the social nature of human decision making.

IV. Implications for Children and Adolescents

One key factor that could explain the limited impact of college level tech ethics coursework is the general absence of moral literacy instruction in K-12 education [7]. As technology becomes more deeply enmeshed in daily life both in and outside of school [80], [81], [82], [83], [84], children and adolescents are forming habits and beliefs about technology long before they enroll in college level tech ethics classes. These very habits and beliefs may comprise the intuitive barriers to be overcome in college level ethics coursework [39], [41], [42], [47]. Just as higher education offers unique opportunities to shift ethical culture through early impact, children are actively building their identities and understanding of technology, with lifelong consequences for their decisions and behaviors [10], [85]. At the same time, the education technology (or "EdTech") industry has permeated all levels of education with largely untested promises of learning benefits, from more personalization to greater accessibility [86], [87]. For these reasons, future research should build on existing tools like the REGAIN framework to develop and empirically

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

test tech ethics education strategies targeting children and adolescents.

However, researchers and educators have flagged several barriers to implementing tech ethics education for younger learners [88], [89]. For example, despite growing numbers of K-12 students using technologies like AI for schoolwork [90], teachers currently lack resources to effectively teach children about their potential harms [91], [92], [93]. Some researchers have begun developing curricula focused on the social implications of technology (and AI in particular) for high school [94], [95], [96] and middle school students [97], [98]. But elementary school students have largely been ignored in these efforts, even though elementary school teachers are more likely than middle or high school teachers to allow technologies like AI in classrooms, less likely to discuss ethical considerations, and more unsure about risk-benefit tradeoffs [99], [100], [101]. We propose that future research should build on decades of research in developmental psychology to design and empirically test the efficacy of tech ethics education for learners of all ages.

Building on our REGAIN framework, empirical measurement of K-12 education strategies might focus on assessing students' ability to anticipate ethical consequences, not just their awareness of moral harm. Teaching children about the many ways in which technology is not currently designed to support human flourishing could also help them to build more accurate causal models of the technology systems they interact with in daily life [51], [102], [103], [104]. For example, one recent education strategy used computer games to teach adolescents about deceptive design practices [105]. Children are deeply motivated to explain and understand the world around them, so future work should help them to build accurate working mental models to guide their learning and behavior [51], [106], [107], [108], [109].

Educators may be hesitant to teach elementary school students about sociotechnical systems, however, because they assume that these structural causes are too complex for young children to understand. Similar reasoning has been a barrier to teaching young children about other complex systems, like structural racism [110]. However, recent research suggests that children as young as age five can understand structural causes when framed appropriately [111], [112], [113], [114]. Future research is needed to identify which strategies are most effective at building sociotechnical systems understanding for children of different ages.

Tech ethics education for children and adolescents should also capitalize on the immense power of social norms in shaping developing behaviors [73], [115], [116]. In particular, efforts to build moral character [54] could help students prioritize social goals using values-aligned strategies, which activate identity-relevant motivations and frame behaviors as responses to systems rather than as personal failings [117]. Values-aligned interventions offer evidence-based tools for building digital literacy, for example by increasing motivation to limit social media use [118], and they have even been successful at shaping teacher behavior and educational outcomes [119]. However, this work has mainly focused on adolescents and adults, so further work is needed to explore how values-aligned strategies could be adapted for younger children who may hold different value priorities than adolescents.

K-12 education might also capitalize on the social nature of ethical decisions by focusing on digital citizenship [20], [99], [120], [121], which can be incorporated into existing social studies education [122]. For example, students should build critical thinking skills and learn how to apply them to detecting misinformation [123], [124] so that they can be more informed consumers of digital media. Digital citizenship approaches are aligned with core findings from developmental psychology research showing that even young children understand that people need to work together as members of social groups [125], [126], [127]. These approaches also incorporate sociotechnical systems thinking, by emphasizing how institutions like corporations and governments share responsibility for the harms produced by individual actors within their systems [77], [78], [79].

Shifting the locus of responsibility onto structural causes could also foster social change by mitigating family tension and parental stress about childhood tech use [80], [128], [129]. Public discourse about children and technology frequently focuses on screen time limits or app restrictions, framing struggles as issues with control that leave parents feeling stressed out and guilty [130], [131]. To help families scaffold children's tech ethics understanding at home [81], [132], schools should include families by providing resources and educational opportunities like in-person workshops. Building parents' understanding of sociotechnical systems could also foster community dialog by leading people to seek out more information and diverse perspectives [54], [60], which would help to undermine inaccurate social norms that constrain behavior [133], [134]. Human development is shaped by the complex ecological systems children grow up in, including schools and families as well as the relationships between them [135]. For these reasons, future research should develop and test strategies to build digital literacy into multiple levels of children's ecosystems throughout development [136], [137].

V. Conclusion

In the current paper, we outlined an agenda for future work using research from cognitive, social, and developmental psychology to build and empirically test tech ethics education for learners of all ages. We describe challenges and opportunities of incorporating psychologically-informed ethics education into college coursework as well as K-12 education, and we offer concrete suggestions and open questions to be addressed in future work. Despite the challenges, we hope that embedding moral literacy in the development of habits and beliefs about technology from the start can help our education system to produce more informed and socially responsible citizens, consumers of technology, and future designers of technology that can enhance, rather than hinder, human flourishing.

References

[1] A. Battista et al., "Future of jobs report 2023," *World Econ. Forum*, Geneva, Switzerland, Tech. Rep., 2023. [Online]. Available: https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf

[2] R. Benjamin, *Race After Technology: Abolitionist Tools for the New Jim Code*, 1st ed., Cambridge, U.K.: Polity, 2019.

[3] A. Birhane, "Algorithmic injustice: A relational ethics approach," *Patterns*, vol. 2, no. 2, Feb. 2021, Art. no. 100205, doi: 10.1016/j.patter.2021.100205.

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

[4] A. Narayanan and V. Shmatikov, "How to break anonymity of the Netflix prize dataset," 2007, *arXiv:cs/0610105*.

[5] L. Sweeney, "Only you, your doctor, and many others may know," *Technol. Sci.*, Sep. 2015, Art. no. 2015092903.

[6] J. Orlowski. (2020). *The Social Dilemma—More About the Film*. Accessed: Jan. 15, 2025. [Online]. Available: https://thesocialdilemma.com/the-film/

[7] N. Tuana, "Conceptualizing moral literacy," *J. Educ. Admin.*, vol. 45, no. 4, pp. 364–378, Jul. 2007, doi: 10.1108/09578230710762409.

[8] G. S. Carretero, R. Vuorikari, and Y. Punie, "DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use," Publications Office Eur. Union, Luxembourg, Tech. Rep. JRC106281, 2017.

[9] A. Bozkurt et al., "The manifesto for teaching and learning in a time of generative AI: A critical collective stance to better navigate the future," *Open Praxis*, vol. 16, no. 4, pp. 487–513, Nov. 2024.

[10] H. Dai, K. L. Milkman, and J. Riis, "The fresh start effect: Temporal landmarks motivate aspirational behavior," *Manage. Sci.*, vol. 60, no. 10, pp. 2563–2582, Oct. 2014.

[11] M. J. Casañ, M. Alier, and A. Llorens, "Teaching ethics and sustainability to informatics engineering students, an almost 30 years' experience," *Sustainability*, vol. 12, no. 14, p. 5499, Jul. 2020, doi: 10.3390/su12145499.

[12] R. Ferreira and M. Y. Vardi, "Deep tech ethics: An approach to teaching social justice in computer science," in *Proc. 52nd ACM Tech. Symp. Comput. Sci. Educ.*, Mar. 2021, pp. 1041–1047.

[13] B. Green, "The contestation of tech ethics: A sociotechnical approach to technology ethics in practice," *J. Social Comput.*, vol. 2, no. 3, pp. 209–225, Sep. 2021.

[14] B. J. Grosz et al., "Embedded EthiCS: Integrating ethics across CS education," *Commun. ACM*, vol. 62, no. 8, pp. 54–61, Jul. 2019.

[15] R. Reich, M. Sahami, J. M. Weinstein, and H. Cohen, "Teaching computer ethics: A deeply multidisciplinary approach," in *Proc. 51st ACM Tech. Symp. Comput. Sci. Educ.*, Feb. 2020, pp. 296–302.

[16] J. Weinstein, R. Reich, and M. Sahami, *System Error: Where Big Tech Went Wrong and How We Can Reboot*. London, U.K.: Hachette, 2021.

[17] (2014). *Culture of Disengagement in Engineering Education?—Erin A. Cech*. Accessed: Feb. 10, 2025. [Online]. Available: https://journals.sagepub.com/doi/full/10.1177/0162243913504305

[18] J. Lajoie, A. Orchard, and H. A. Love, "Ethical tech pedagogy for public good: A review of educational initiatives and approaches," in *Proc. IEEE Int. Symp. Technol. Soc. (ISTAS)*, Nov. 2020, pp. 29–32, doi: 10.1109/ISTAS50296.2020.9462181.

[19] C. M. Gray and E. Boling, "Inscribing ethics and values in designs for learning: A problematic," *Educ. Technol. Res. Develop.*, vol. 64, no. 5, pp. 969–1001, Oct. 2016, doi: 10.1007/s11423-016-9478-x.

[20] A. Yadav, M. Heath, and A. D. Hu, "Toward justice in computer science through community, criticality, and citizenship," *Commun. ACM*, vol. 65, no. 5, pp. 42–44, Apr. 2022, doi: 10.1145/3527203.

[21] D. Bairaktarova and A. Woodcock, "Engineering ethics education: Aligning practice and outcomes," *IEEE Commun. Mag.*, vol. 53, no. 11, pp. 18–22, Nov. 2015, doi: 10.1109/MCOM.2015.7321965.

[22] J. R. Herkert, B. K. Jesiek, J. Hess, and M. Cheong, "In this special issue: Ethics in the global innovation helix," *IEEE Trans. Technol. Soc.*, vol. 5, no. 3, pp. 289–292, Sep. 2024, doi: 10.1109/TTS.2024.3437588.

[23] N. Brown, B. Xie, E. Sarder, C. Fiesler, and E. S. Wiese, "Teaching ethics in computing: A systematic literature review of ACM computer science education publications," *ACM Trans. Comput. Educ.*, vol. 24, no. 1, pp. 1–36, Jan. 2024, doi: 10.1145/3634685.

[24] M. Bouville, "On using ethical theories to teach engineering ethics," *Sci. Eng. Ethics*, vol. 14, no. 1, pp. 111–120, Mar. 2008, doi: 10.1007/s11948-007-9034-5.

[25] E. Burton, J. Goldsmith, S. Koenig, B. Kuipers, N. Mattei, and T. Walsh, "Ethical considerations in artificial intelligence courses," *AI Mag.*, vol. 38, no. 2, pp. 22–34, Jun. 2017, doi: 10.1609/aimag.v38i2.2731.

[26] A. Colby and W. M. Sullivan, "Ethics teaching in undergraduate engineering education," *J. Eng. Educ.*, vol. 97, no. 3, pp. 327–338, Jul. 2008.

[27] C. Fiesler, N. Garrett, and N. Beard, "What do we teach when we teach tech ethics?: A syllabi analysis," in *Proc. 51st ACM Tech. Symp. Comput. Sci. Educ.*, Feb. 2020, pp. 289–295, doi: 10.1145/3328778.3366825.

[28] J. L. Hess and G. Fore, "A systematic literature review of U.S. engineering ethics interventions," *Sci. Eng. Ethics*, vol. 24, pp. 551–583, Apr. 2017.

[29] D. Horton, D. Liu, S. A. McIlraith, S. Coyne, and N. Wang, "Do embedded ethics modules have impact beyond the classroom?" in *Proc. 55th ACM Tech. Symp. Comput. Sci. Educ.* New York, NY, USA: Association for Computing Machinery, Mar. 2024, pp. 533–539, doi: 10.1145/3626252.3630834.

[30] A. Johri and A. Hingle, "Learning to link micro, meso, and macro ethical concerns through role-play discussions," in *Proc. IEEE Frontiers Educ. Conf. (FIE)*, Oct. 2022, pp. 1–8.

[31] S. Kumar and M. Levis, "Reengineering ethics education for deeper student engagement through the creation of roleplaying and decision-making games [WIP paper, student experiences]," in *Proc. ASEE Annu. Conf. Expo.*, Jun. 2023. [Online]. Available: https://peer.asee.org/reengineering-ethics-education-for-deeper-student-engagement-through-the-creation-of-roleplaying-and-decision-making-games-wip-paper-student-experiences

[32] E. Foster-Hanson and S. Venkatagiri, "Promoting ethical technology design practices by leveraging human psychology," in *Proc. ACM Designing Interact. Syst. Conf.*, Jul. 2024, pp. 157–161.

[33] A. M. Roffarello, K. Lukoff, and L. De Russis, "Defining and identifying attention capture deceptive designs in digital interfaces," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, Apr. 2023, pp. 1–19.

[34] R. Botsman. (May 24, 2022). *Tech Leaders Can Do More to Avoid Unintended Consequences*. Accessed: Jan. 21, 2025. [Online]. Available: https://www.wired.com/story/technology-unintended-consequences/

[35] K. Do, R. Y. Pang, J. Jiang, and K. Reinecke, "'That's important but': How computer science researchers anticipate unintended consequences of their research innovations," in *Proc. CHI Conf. Hum. Factors Comput. Syst.*, 2023, pp. 1–16.

[36] N. Parvin and A. Pollock, "Unintended by design: On the political uses of 'unintended consequences,'" *Engaging Sci., Technol., Soc.*, vol. 6, pp. 320–327, Aug. 2020.

[37] E. Foster-Hanson, K. Oktar, T. Lombrozo, and S. Kelts, "Psychological measurement of technology ethics education using the REGAIN empirical framework," in *Proc. IEEE Int. Symp. Ethics Eng., Sci., Technol. (ETHICS)*, Jun. 2025, pp. 1–10, doi: 10.1109/ETHICS65148.2025.11098444.

[38] D. Parfit, *On What Matters*. London, U.K.: Oxford Univ. Press, 2011.

[39] J. Greene, *Moral Tribes: Emotion, Reason, and the Gap Between Us and Them*. Baltimore, MD, USA: Penguin, 2014.

[40] Z. Horne, D. Powell, and J. Hummel, "A single counterexample leads to moral belief revision," *Cognit. Sci.*, vol. 39, no. 8, pp. 1950–1964, Nov. 2015, doi: 10.1111/cogs.12223.

[41] J. Haidt, "The emotional dog and its rational tail: A social intuitionist approach to moral judgment," *Psychol. Rev.*, vol. 108, no. 4, pp. 814–834, 2001, doi: 10.1037/0033-295x.108.4.814.

[42] J. Herec et al., "Reflection and reasoning in moral judgment: Two preregistered replications of paxton, ungar, and greene (2012)," *Cognit. Sci.*, vol. 46, no. 7, p. e13168, Jul. 2022, doi: 10.1111/cogs.13168.

[43] K. Oktar and T. Lombrozo, "Deciding to be authentic: Intuition is favored over deliberation for self-reflective decisions," in *Proc. Annu. Meet. Cogn. Sci. Soc.*, 2021, vol. 43, no. 43. [Online]. Available: https://www.buzzfeednews.com/article/ryanmac/growth-at-any-cost-top-facebook-executive-defended-data

[44] R. Mac, C. Warzel, and A. Kantrowitz, "Growth at any cost: Top Facebook executive defended data collection in 2016 memo—and warned that Facebook could get people killed," *BuzzFeed News*, 2018.

[45] E. P. Waples, A. L. Antes, S. T. Murphy, S. Connelly, and M. D. Mumford, "A meta-analytic investigation of business ethics instruction," *J. Bus. Ethics*, vol. 87, no. 1, pp. 133–151, Jun. 2009, doi: 10.1007/s10551-008-9875-0.

[46] L. L. Watts, K. E. Medeiros, T. J. Mulhearn, L. M. Steele, S. Connelly, and M. D. Mumford, "Are ethics training programs improving? A meta-analytic review of past and present ethics instruction in the sciences," *Ethics Behav.*, vol. 27, no. 5, pp. 351–384, Jul. 2017, doi: 10.1080/10508422.2016.1182025.

[47] K. Oktar, A. Lerner, M. Malaviya, and T. Lombrozo, "Philosophy instruction changes views on moral controversies by decreasing reliance on intuition," *Cognition*, vol. 236, Jul. 2023, Art. no. 105434.

[48] R. Cheruvalath, "Does studying 'Ethics' improve engineering students' meta-moral cognitive skills?" *Sci. Eng. Ethics*, vol. 25, no. 2, pp. 583–596, Apr. 2019.

[49] P. R. Pintrich, "The role of metacognitive knowledge in learning, teaching, and assessing," *Theory Into Pract.*, vol. 41, no. 4, pp. 219–225, Nov. 2002.

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

[50] A. Hingle, H. Rangwala, A. Johri, and A. Monea, "Using role-plays to improve ethical understanding of algorithms among computing students," in *Proc. IEEE Frontiers Educ. Conf. (FIE)*, Oct. 2021, pp. 1–7.

[51] D. Cabrera and L. Cabrera, "What is systems thinking?" in *Learning, Design, and Technology: An International Compendium of Theory, Research, Practice*. Cham, Switzerland: Springer, 2023, pp. 1495–1522.

[52] B. Richmond, "Systems thinking: Critical thinking skills for the 1990s and beyond," *Syst. Dyn. Rev.*, vol. 9, no. 2, pp. 113–133, Jun. 1993, doi: 10.1002/sdr.4260090203.

[53] P. H. Werhane, *Moral Imagination and Management Decision-making*. London, U.K.: Oxford Univ. Press, 1999.

[54] J. Rest, M. Bebeau, and J. Volker, "An overview of the psychology of morality," in *Moral Development: Advances in Research and Theory*. New York, NY, USA: Praeger, 1986, pp. 1–27.

[55] J. L. Davis, *How Artifacts Afford: The Power and Politics of Everyday Things*. Cambridge, MA, USA: MIT Press, 2020.

[56] P. Carayon, "Human factors of complex sociotechnical systems," *Appl. Ergonom.*, vol. 37, no. 4, pp. 525–535, Jul. 2006, doi: 10.1016/j.apergo.2006.04.011.

[57] R. Cooper and M. Foster, "Sociotechnical systems," *Amer. Psychologist*, vol. 26, no. 5, pp. 467–474, May 1971, doi: 10.1037/h0031539.

[58] G. D. Salali and M. S. Uysal, "COVID-19 vaccine hesitancy is associated with beliefs on the origin of the novel coronavirus in the U.K. and Turkey," *Psychol. Med.*, vol. 52, no. 15, pp. 3750–3752, Nov. 2022.

[59] P. Rozin et al., "Preference for natural: Instrumental and ideational/moral motivations, and the contrast between foods and medicines," *Appetite*, vol. 43, no. 2, pp. 147–154, Oct. 2004.

[60] K. Desender, A. Boldt, and N. Yeung, "Subjective confidence predicts information seeking in decision making," *Psychol. Sci.*, vol. 29, no. 5, pp. 761–778, May 2018.

[61] B. Friedman and D. G. Hendry, *Value Sensitive Design: Shaping Technology With Moral Imagination*. Cambridge, MA, USA: MIT Press, 2019.

[62] F. Cushman, "Rationalization is rational," *Behav. Brain Sci.*, vol. 43, p. 28, Jan. 2020, doi: 10.1017/s0140525x19001730.

[63] E. Schwitzgebel and F. Cushman, "Philosophers' biased judgments persist despite training, expertise and reflection," *Cognition*, vol. 141, pp. 127–137, Aug. 2015.

[64] E. L. Uhlmann, D. A. Pizarro, D. Tannenbaum, and P. H. Ditto, "The motivated use of moral principles," *Judgment Decis. Making*, vol. 4, no. 6, pp. 479–491, Oct. 2009.

[65] M. L. Stanley, A. M. Dougherty, B. W. Yang, P. Henne, and F. De Brigard, "Reasons probably won't change your mind: The role of reasons in revising moral decisions," *J. Experim. Psychol., Gen.*, vol. 147, no. 7, pp. 962–987, Jul. 2018.

[66] L. Kohlberg, "Moral stages and moralization: The cognitive-developmental approach," in *Moral Development and Behavior: Theory, Research and Social Issues*, vol. 1976. New York, NY, USA: Rinehart and Winston, pp. 31–53.

[67] E. Schwitzgebel, B. Cokelet, and P. Singer, "Do ethics classes influence student behavior? Case study: Teaching the ethics of eating meat," *Cognition*, vol. 203, Oct. 2020, Art. no. 104397.

[68] R. B. Cialdini and N. J. Goldstein, "Social influence: Compliance and conformity," *Annu. Rev. Psychol.*, vol. 55, no. 1, pp. 591–621, Feb. 2004.

[69] (2021). *The Facebook Files*. Accessed: Oct. 13, 2025. [Online]. Available: https://www.wsj.com/articles/the-facebook-files-11631713039

[70] F. Haugen. (2022). *The Power of One: How I Found the Strength To Tell the Truth and Why I Blew the Whistle on Facebook*. Brown and Co. Accessed: Sep. 22, 2025. [Online]. Available: https://www.hachettebookgroup.com/titles/frances-haugen/the-power-of-one/9780316475228/

[71] J. M. Darley and B. Latane, "Bystander intervention in emergencies: Diffusion of responsibility," *J. Personality Social Psychol.*, vol. 8, no. 4, pp. 377–383, 1968, doi: 10.1037/h0025589.

[72] I. Jung, "Ethical judgments and behaviors: Applying a multidimensional ethics scale to measuring ICT ethics of college students," *Comput. Educ.*, vol. 53, no. 3, pp. 940–949, Nov. 2009, doi: 10.1016/j.compedu.2009.05.011.

[73] D. T. Miller and D. A. Prentice, "Changing norms to change behavior," *Annu. Rev. Psychol.*, vol. 67, no. 1, pp. 339–361, Jan. 2016, doi: 10.1146/annurev-psych-010814-015013.

[74] S. M. Constantino et al., "Scaling up change: A critical review and practical guide to harnessing social norms for climate action," *Psychol. Sci. Public Interest*, vol. 23, no. 2, pp. 50–97, Oct. 2022, doi: 10.1177/15291006221105279.

[75] S. J. Ali, A. Christin, A. Smart, and R. Katila, "Walking the walk of AI ethics: Organizational challenges and the individualization of risk among ethics entrepreneurs," in *Proc. ACM Conf. Fairness, Accountability, Transparency*. Chicago, IL, USA: ACM, Jun. 2023, pp. 217–226, doi: 10.1145/3593013.3593990.

[76] N. Chater and G. Loewenstein, "Where next for behavioral public policy?," *Behav. Brain Sci.*, vol. 46, 2023, Art. no. e181, doi: 10.1017/S0140525X23002091.

[77] A. Madva, M. Brownstein, and D. Kelly, "It's always both: Changing individuals requires changing systems and changing systems requires changing individuals," *Behav. Brain Sci.*, vol. 46, 2023, Art. no. e168.

[78] J. N. Fahlquist, "Moral responsibility for environmental problems—Individual or institutional?" *J. Agricult. Environ. Ethics*, vol. 22, no. 2, pp. 109–124, Apr. 2009, doi: 10.1007/s10806-008-9134-5.

[79] D. Risi, L. Vigneau, S. Bohn, and C. Wickert, "Institutional theory-based research on corporate social responsibility: Bringing values back in," *Int. J. Manage. Rev.*, vol. 25, no. 1, pp. 3–23, Jan. 2023, doi: 10.1111/ijmr.12299.

[80] S. M. Livingstone and A. Blum-Ross, *Parenting for a Digital Future: How Hopes and Fears About Technology Shape*. Oxford Univ. Press, 2025. [Online]. Available: https://books.google.com/books?hl=enlr=id=ATjpDwAAQBAJoi=fndpg=PP1dq=Livingstone

[81] J. Marsh, P. Hannon, M. Lewis, and L. Ritchie, "Young children's initiation into family literacy practices in the digital age," *J. Early Childhood Res.*, vol. 15, no. 1, pp. 47–60, Mar. 2017, doi: 10.1177/1476718x15582095.

[82] S. Mann, A. Calvin, A. Lenhart, and M. B. Robb, *The Common Sense Census: Media Use by Kids Zero to Eight*. San Francisco, CA, USA: Common Sense Media, 2025. [Online]. Available: https://www.commonsensemedia.org/research/the-2025-common-sensecensus-media-use-by-kids-zero-to-eight

[83] V. Rideout, A. Peebles, S. Mann, and M. B. Robb, *Common Sense Census: Media Use by Tweens and Teens, 2021*. San Francisco, CA, USA: Common Sense Media, 2022. [Online]. Available: https://www.commonsensemedia.org/research/the-common-sense-census-media-useby-tweens-and-teens-2021

[84] N. Iivari, S. Sharma, and L. Ventä-Olkkonen, "Digital transformation of everyday life—How COVID-19 pandemic transformed the basic education of the young generation and why information management research should care?" *Int. J. Inf. Manage.*, vol. 55, Dec. 2020, Art. no. 102183, doi: 10.1016/j.ijinfomgt.2020.102183.

[85] V. Delaney and J. J. Chen, "Developmental considerations and practical recommendations for parents and early childhood educators in the age of AI," *Policy Brief*, 2025, doi: 10.13140/RG.2.2.14603.20000.

[86] B. Williamson, "Big EdTech," *Learn., Media Technol.*, vol. 47, no. 2, pp. 157–162, Apr. 2022, doi: 10.1080/17439884.2022.2063888.

[87] P. Jandrić and J. Knox, "The postdigital turn: Philosophy, education, research," *Policy Futures Educ.*, vol. 20, no. 7, pp. 780–795, Oct. 2022, doi: 10.1177/14782103211062713.

[88] W. Holmes et al., "Ethics of AI in education: Towards a community-wide framework," *Int. J. Artif. Intell. Educ.*, vol. 32, no. 3, pp. 504–526, Sep. 2022, doi: 10.1007/s40593-021-00239-1.

[89] A. D. Hu and A. Yadav, "How K-12 CS teachers conceptualize CS ethics: Future opportunities and barriers to ethics integration in K-12 CS," in *Proc. 54th ACM Tech. Symp. Comput. Sci. Educ*. New York, NY, USA: Association for Computing Machinery, Mar. 2023, pp. 910–916, doi: 10.1145/3545945.3569775.

[90] O. S. Gottfried Eugenie Park and Jeffrey. *About a Quarter of U.S. Teens Have Used ChatGPT for Schoolwork—Double the Share in* 2023. Accessed: Jun. 13, 2025. [Online]. Available: https://www.pewresearch.org/short-reads/2025/01/15/about-a-quarter-of-us-teens-have-used-chatgpt-for-schoolwork-double-the-share-in-2023/

[91] W. Yang, "Artificial intelligence education for young children: Why, what, and how in curriculum design and implementation," *Comput. Educ., Artif. Intell.*, vol. 3, Jan. 2022, Art. no. 100061, doi: 10.1016/j.caeai.2022.100061.

[92] J. Su, D. T. Kit Ng, and S. K. W. Chu, "Artificial intelligence (AI) literacy in early childhood education: The challenges and opportunities," *Comput. Educ., Artif. Intell.*, vol. 4, Jan. 2023, Art. no. 100124, doi: 10.1016/j.caeai.2023.100124.

[93] M. H. Kaspersen, K.-E.-K. Bilstrup, M. Van Mechelen, A. Hjort, N. O. Bouvin, and M. G. Petersen, "High school students exploring machine learning and its societal implications: Opportunities and challenges," *Int. J. Child-Comput. Interact.*, vol. 34, Dec. 2022, Art. no. 100539, doi: 10.1016/j.ijcci.2022.100539.

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.

This article has been accepted for inclusion in a future issue of this journal. Content is final as presented, with the exception of pagination.

[94] J. Everson, R. Landesman, F. M. Kivuva, and A. J. Ko, "Dreaming of difference: Imagining the future of CS education pedagogy with secondary students," in *Proc. ACM Conf. Int. Comput. Educ. Res. V.*1. New York, NY, USA: Association for Computing Machinery, Aug. 2025, pp. 394–406, doi: 10.1145/3702652.3744203.

[95] J. J. Ryoo, "Pedagogy that supports computer science for all," *ACM Trans. Comput. Educ.*, vol. 19, no. 4, pp. 1–23, Jul. 2019, doi: 10.1145/3322210.

[96] W. Park and H. Kwon, "Implementing artificial intelligence education for middle school technology education in republic of Korea," *Int. J. Technol. Design Educ.*, vol. 34, no. 1, pp. 109–135, Mar. 2024, doi: 10.1007/s10798-023-09812-2.

[97] I. Lee, S. Ali, H. Zhang, D. DiPaola, and C. Breazeal, "Developing middle school students' AI literacy," in *Proc. 52nd ACM Tech. Symp. Comput. Sci. Educ*. New York, NY, USA: Association for Computing Machinery, Mar. 2021, pp. 191–197, doi: 10.1145/3408877.3432513.

[98] W. Gelder, X. Yu, D. Touretzky, C. Gardner-McCune, and J. Uchidiuno, "From lecture Hall to homeroom: Co-designing an AI elective with middle school CS teachers," *Int. J. Artif. Intell. Educ.*, vol. 35, no. 4, pp. 1749–1792, Dec. 2025, doi: 10.1007/s40593-024-00449-3.

[99] L. Li, J. P. M. Valdez, and Y. Du, "Digital citizenship education at the early childhood level: How is it implemented? A systematic review," *Int. J. Child Care Educ. Policy*, vol. 19, no. 1, p. 13, Aug. 2025, doi: 10.1186/s40723-025-00153-2.

[100] Y. B. Kafai et al., "What does it mean to be literate in the time of AI? Different perspectives on learning and teaching AI literacies in K-12 education," in *Proc. 18th Int. Conf. Learn. Sci.—ICLS* (International Society of the Learning Sciences), R. Lindgren, T. I. Asino, E. A. Kyza, C. K. Looi, D. T. Keifert, and E. Suárez, Eds., 2024, pp. 1856–1862. [Online]. Available: https://repository.isls.org/handle/1/10828

[101] P. C. Kumar, M. Chetty, T. L. Clegg, and J. Vitak, "Privacy and security considerations for digital technology use in elementary schools," in *Proc. CHI Conf. Hum. Factors Comput. Syst*. New York, NY, USA: Association for Computing Machinery, May 2019, pp. 1–13, doi: 10.1145/3290605.3300537.

[102] V. R. Bhargava and M. Velasquez, "Ethics of the attention economy: The problem of social media addiction," *Bus. Ethics Quart.*, vol. 31, no. 3, pp. 321–359, Jul. 2021, doi: 10.1017/beq.2020.32.

[103] K. Renaud et al., "'We're not that gullible!' revealing dark pattern mental models of 11–12-year-old Scottish children," *ACM Trans. Comput.-Hum. Interact.*, vol. 31, no. 3, pp. 1–41, Jun. 2024.

[104] R. Schäfer, S. Sahabi, A. Brocker, and J. Borchers, "Growing up with dark patterns: How children perceive malicious user interface designs," in *Proc. Nordic Conf. Hum.-Comput. Interact.*, Oct. 2024, pp. 1–17.

[105] N. Khan, H. Eiraj Daud, and S. Shahid, "Mind the dark: A gamified exploration of deceptive design awareness for children in the digital age," 2025, *arXiv:2506.23017*.

[106] A. Gopnik, C. Glymour, D. M. Sobel, L. E. Schulz, T. Kushnir, and D. Danks, "A theory of causal learning in children: Causal maps and Bayes nets," *Psychol. Rev.*, vol. 111, no. 1, pp. 3–32, 2004.

[107] D. Kuhn, "The development of causal reasoning," *Wiley Interdiscip. Rev. Cogn. Sci.*, vol. 3, no. 3, pp. 327–335, 2012.

[108] C. H. Legare, "Exploring explanation: Explaining inconsistent evidence informs exploratory, hypothesis-testing behavior in young children," *Child Develop.*, vol. 83, no. 1, pp. 173–185, Jan. 2012, doi: 10.1111/j.1467-8624.2011.01691.x.

[109] T. Lombrozo, "Explanatory preferences shape learning and inference," *Trends Cognit. Sci.*, vol. 20, no. 10, pp. 748–759, Oct. 2016, doi: 10.1016/j.tics.2016.08.001.

[110] C. S. Brown and R. S. Bigler, "Children's perceptions of discrimination: A developmental model," *Child Develop.*, vol. 76, no. 3, pp. 533–553, May 2005, doi: 10.1111/j.1467-8624.2005.00862.x.

[111] J. Amemiya and L. Bian, "Why are there no girls? Increasing children's recognition of structural causes of the gender gap in STEM," *Cognition*, vol. 245, Apr. 2024, Art. no. 105740.

[112] R. A. Leshin and M. Rhodes, "Structural explanations for inequality reduce children's biases and promote rectification only if they implicate the high-status group," *Proc. Nat. Acad. Sci. USA*, vol. 120, no. 35, Aug. 2023, Art. no. 2310573120, doi: 10.1073/pnas.2310573120.

[113] N. Vasil, M. Srinivasan, M. E. Ellwood-Lowe, S. Delaney, A. Gopnik, and T. Lombrozo, "Structural explanations lead young children and adults to rectify resource inequalities," *J. Experim. Child Psychol.*, vol. 242, Jun. 2024, Art. no. 105896, doi: 10.1016/j.jecp.2024.105896.

[114] M. Y. Zhang, J. N. Sullivan, E. M. Markman, and S. O. Roberts, "Children's structural thinking about social inequities," *Child Develop. Perspect.*, vol. 18, no. 1, pp. 19–25, Mar. 2024, doi: 10.1111/cdep.12493.

[115] D. B. M. Haun and M. Tomasello, "Conformity to peer pressure in preschool children," *Child Develop.*, vol. 82, no. 6, pp. 1759–1767, Nov. 2011, doi: 10.1111/j.1467-8624.2011.01666.x.

[116] C. Capuano and P. Chekroun, "A systematic review of research on conformity," *Int. Rev. Social Psychol.*, vol. 37, no. 1, Jul. 2024, doi: 10.5334/irsp.874.

[117] C. J. Bryan, D. S. Yeager, and C. P. Hinojosa, "A values-alignment intervention protects adolescents from the effects of food marketing," *Nature Hum. Behav.*, vol. 3, no. 6, pp. 596–603, Apr. 2019, doi: 10.1038/s41562-019-0586-6.

[118] B. M. Galla, S. Choukas-Bradley, H. M. Fiore, and M. V. Esposito, "Values-alignment messaging boosts Adolescents' motivation to control social media use," *Child Develop.*, vol. 92, no. 5, pp. 1717–1734, Sep. 2021, doi: 10.1111/cdev.13553.

[119] C. A. Hecht, C. J. Bryan, and D. S. Yeager, "A values-aligned intervention fosters growth mindset-supportive teaching and reduces inequality in educational outcomes," *Proc. Nat. Acad. Sci. USA*, vol. 120, no. 25, Jun. 2023, Art. no. 2210704120, doi: 10.1073/pnas.2210704120.

[120] M. Duran, "Digital citizenship," in *Learning Technologies: Research, Trends, and Issues in the U.S. Education System*. Cham, Switzerland: Springer, 2022, pp. 145–159, doi: 10.1007/978-3-031-18111-5_8.

[121] M. Ribble, "Nine elements: Nine themes of digital citizenship," Tech. Rep., 2017.

[122] Ş. M. Pala, "Reflections of digital citizenship on social studies course: Teachers' perceptions," *Int. J. Curric. Instr. Stud.*, vol. 13, no. 2, pp. 297–324, 2023, doi: 10.31704/ijocis.2023.013.

[123] J. Roozenbeek and S. van der Linden, "Fake news game confers psychological resistance against online misinformation," *Palgrave Commun.*, vol. 5, no. 1, p. 65, Jun. 2019, doi: 10.1057/s41599-019-0279-9.

[124] J. Breakstone, S. McGrew, M. Smith, T. Ortega, and S. Wineburg, "Why we need a new approach to teaching digital literacy," *Phi Delta Kappan*, vol. 99, no. 6, pp. 27–32, Mar. 2018, doi: 10.1177/0031721718762419.

[125] M. Tomasello, "The moral psychology of obligation," *Behav. Brain Sci.*, vol. 43, p. e56, Jan. 2020, doi: 10.1017/s0140525x19001742.

[126] E. Foster-Hanson and M. Rhodes, "Normative social role concepts in early childhood," *Cognit. Sci.*, vol. 43, no. 8, p. e12782, Aug. 2019, doi: 10.1111/cogs.12782.

[127] M. Rhodes and L. Chalik, "Social categories as markers of intrinsic interpersonal obligations," *Psychol. Sci.*, vol. 24, no. 6, pp. 999–1006, Jun. 2013, doi: 10.1177/0956797612466267.

[128] I. Beyens and K. Beullens, "Parent–child conflict about children's tablet use: The role of parental mediation," *New Media Soc.*, vol. 19, no. 12, pp. 2075–2093, Dec. 2017, doi: 10.1177/1461444816655099.

[129] L. Teichert, "Negotiating screen time: A mother's struggle over 'no screen time' with her infant son," *J. Early Childhood Literacy*, vol. 20, no. 3, pp. 524–550, Sep. 2020, doi: 10.1177/1468798420926623.

[130] S. M. Coyne et al., "'I've let screens take over': Maternal guilt about media and relations to children's problematic media use," *Social Sci. Res. Netw.*, Rochester, NY, USA, Tech. Rep., Sep. 26, 2025, doi: 10.2139/ssrn.5529557.

[131] L. N. Wolfers, R. L. Nabi, and N. Walter, "Too much screen time or too much guilt? How child screen time and parental screen guilt affect parental stress and relationship satisfaction," *Media Psychol.*, vol. 28, no. 1, pp. 102–133, Jan. 2025, doi: 10.1080/15213269.2024.2310839.

[132] E. S. Bae, L. R. Shariyf, and E. Foster-Hanson, "Social norms and explanations in family technology use rules," in *Proc. Annu. Meet. Cogn. Sci. Soc.*, vol. 48, 2026. [Online]. Available: https://escholarship.org/uc/item/39f6b897

[133] D. A. Prentice and D. T. Miller, "Pluralistic ignorance and the perpetuation of social norms by unwitting actors," in *Advances in Experimental Social Psychology*. Amsterdam, The Netherlands: Elsevier, 1996, pp. 161–209.

[134] D. A. Prentice and D. T. Miller, "Pluralistic ignorance and alcohol use on campus: Some consequences of misperceiving the social norm," *J. Personality Social Psychol.*, vol. 64, no. 2, pp. 243–256, Feb. 1993.

[135] U. Bronfenbrenner, "Ecological models of human development," *Int. Encycl. Educ.*, vol. 3, no. 2, pp. 37–43, 1994.

[136] S. Schneider, M. Beege, S. Nebel, L. Schnaubert, and G. D. Rey, "The cognitive-affective-social theory of learning in digital environments (CASTLE)," *Educ. Psychol. Rev.*, vol. 34, no. 1, pp. 1–38, Mar. 2022, doi: 10.1007/s10648-021-09626-5.

[137] J. M. Zosh and B. Hassinger-Das, "Studying children's digital world within the family ecosystem: Seeing the forest and the trees, but what about the biome?" *J. Appl. Res. Memory Cognition*, vol. 12, no. 4, pp. 480–484, Dec. 2023, doi: 10.1037/mac0000147.

Authorized licensed use limited to: Princeton University. Downloaded on November 16,2026 at 17:05:54 UTC from IEEE Xplore. Restrictions apply.