BEYOND PERSONALIZATION: EMBRACING DEMOCRATIC LEARNING WITHIN ARTIFICIALLY INTELLIGENT SYSTEMS

Natalia Kucirkova

The Open University
University of Stavanger

Sandra Leaton Gray

Institute of Education
University College London

ABSTRACT. This essay explains how, from the theoretical perspective of Basil Bernstein's three "conditions for democracy," the current pedagogy of artificially intelligent personalized learning seems inadequate. Building on Bernstein's comprehensive work and more recent research concerned with personalized education, Natalia Kucirkova and Sandra Leaton Gray suggest three principles for advancing personalized education and artificial intelligence (AI). They argue that if AI is to reach its full potential in terms of promoting children's identity as democratic citizens, its pedagogy must go beyond monitoring the technological progression of personalized provision of knowledge. It needs to pay more careful attention to the democratic impact of data-driven systems. Kucirkova and Leaton Gray propose a framework to distinguish the value of personalized learning in relation to pluralization and to guide educational researchers and practitioners in its application to socially just classrooms.

KEY WORDS. personalization; artificial intelligence (AI); learning; teaching; digital technology

A central concern since the advent of universal primary education in the West in the nineteenth century has been to see education in the context of social relations and to maximize the benefits of group-based learning. In 1984, Benjamin Bloom asked, "Can researchers and teachers devise teaching-learning conditions that will enable the majority of students under group instruction to attain levels of achievement that can at present be reached only under good tutoring conditions?"[1] With his mastery learning model, Bloom urged researchers and instructors to seek "more practical and realistic conditions than the one-to-one tutoring, which is too costly for most societies to bear on a large scale."[2] One recent potential mechanism for this model over the last decade has been the availability of personal mobile technologies, such as smartphones and tablets, in schools worldwide. This availability has contributed to a rapid evolution of large-scale personalized learning in education, driven by big data and online learning.[3] In the space of a few years, data-based personalized learning has evolved from analytics providing

---

1. Benjamin S. Bloom, "The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring," *Educational Researcher* 13, no. 6 (1984): 5.

2. Ibid.

3. Neil Selwyn, *Is Technology Good for Education?* (London: John Wiley & Sons, 2016); Juliane Jarke and Andreas Breiter, "Editorial: The Datafication of Education," *Learning, Media and Technology* 44, no. 1 (2019): 1–6; and Jinyu Yang and Bo Zhang, "Review: Artificial Intelligence in Intelligent Tutoring

information on datafied student behavior[4] to the field of learning analytics and learner-focused systems, many of which are a direct response to political and economic concerns.[5] These systems can strategically collect, analyze, and archive students' data on a massive scale, and notionally adapt learning paths to maximize the rate of individual progress without the intervention or even presence of individual teachers (other than to create learning objects initially and to monitor pupil progress through the system remotely). In terms of design, these systems represent a form of artificial intelligence for supporting individualized learning, as well as a form of democratizing education, potentially providing the "practical and realistic" solution that Bloom sought.

However, while there may have been a democratization of the *provision* of educational content, this may not necessarily apply to educational processes and outcomes. A democratic classroom is typically understood as a place where individuals act with a sensitivity to the needs of other community members, which involves managing the tension between individual needs and desires, and the requirements of the group. However, the current personalized education models lack the social agency agenda initially envisaged by proponents of democratic personalized learning models in that (1) they are individual-centric, and (2) they follow cognitive and neurobiological models of learning, which, similar to efforts in personalized medicine, aim to "tailor decisions about which treatment or which dose is most appropriate" for each individual.[6] Note here the implicit comparison of an instructional intervention with a medical treatment or remedy; with artificially intelligent systems, the tailoring becomes even more precisely adjusted to an individual. Yet, for holistic and sustainable learning outcomes, the process of instruction needs to provide students with content that is most optimal for the individual student *within*, not at the expense of, collective or group-based learning. This point is also a fundamental concern of social justice, in which all

Robots: A Systematic Review and Design Guidelines," *Applied Sciences* 9, no. 10 (2019), https://doi.org/10.3390/app9102078.

4. Jamie Manolev, Anna Sullivan, and Roger Slee, "The Datafication of Discipline: ClassDojo, Surveillance and a Performative Classroom Culture," *Learning, Media and Technology* 44, no. 1 (2018): 36–51.

5. Rebecca Ferguson, "Learning Analytics: Drivers, Developments and Challenges," *International Journal of Technology Enhanced Learning* 4, no. 5/6 (2012): 304–317.

6. Kent E. Hutchison, "Substance Use Disorders: Realizing the Promise of Pharmacogenomics and Personalized Medicine," *Annual Review of Clinical Psychology* 6 (2010): 578.

NATALIA KUCIRKOVA is Professor of Early Childhood Research at the University of Stavanger and Professor of Reading and Child Development at The Open University, UK; email natalia.kucirkova@uis.no. Her research is concerned with innovative approaches to support children's reading, both through reading on-screen and reading personalized books.

SANDRA LEATON GRAY is Associate Professor of Education at University College London, Institute of Education; email s.leaton-gray@ucl.ac.uk. Her research interests include the sociology of technology and its impact on children and young people, including the role of "big data" and artificial intelligence.

learners have an equal right to high-quality educational provision. In this essay, we draw upon the social theory of Basil Bernstein[7] and his three conditions for democracy to highlight three equality principles that need to be applied to the adoption and implementation of artificial intelligence systems in personalized education — if they are to stand a chance of encouraging human flourishing in the medium- to long-term.

We begin by defining some key terms, addressing the current popular conceptualization of personalized education, and making a case for developing better-theorized approaches to artificial intelligence as it relates to personalized learning. Mindful of the importance of advancing educational theories to inform policy and practice on the pressing social problems of our time, we bind together Bernstein's understanding of democratic education with the current developments in personalized education and offer some guiding questions in the form of a three-layered framework.

Definitions of Key Terms

Personalized learning (PL) is a confused and confusing concept in education. Put simply, the adjective "personalized" implies that learning is adjusted to an individual, but it does not specify who makes the adjustment, to which extent the adjustment is controlled by the receiver, when the adjustment happens, or what its outcome is. Having systematically analyzed twenty-five years of research on digital personalized learning, instruction and education, Rani van Schoors et al. concluded that personalized education is a poorly defined concept and recommended differentiating and nuancing broader terms (e.g., instead of technology-enhanced web-based PL).[8] PL is generally followed with adjectives that specify certain aspects, such as for example *digital* PL, which implies that the adjustment of learning content to individual students has been made by a piece of technology. Technology is in itself a broad term and even the example of "digital PL" may refer to various types of software programs, including adaptive learning software or artificially intelligent software programs. This paper focuses on the latter, that is *artificially intelligent personalized learning*.

Artificially intelligent PL exists within a contested terrain of technology-mediated education. Personal mobile technologies, such as iPads and tablets, have become widely available among all sections of the population, including young children.[9] These tools are designed for individual use and thus

---

7. Basil Bernstein, *Pedagogy, Symbolic Control and Identity: Theory, Research, Critique,* revised ed. (London: Rowman and Littlefield, 2000).

8. Rani Van Schoors, Jan Elen, Annelies Raes, and Fien Depaepe, "An Overview of 25 Years of Research on Digital Personalised Learning in Primary and Secondary Education: A Systematic Review of Conceptual and Methodological Trends," *British Journal of Educational Technology* 52, no. 5 (2021): 1798–1822.

9. For documentation of this point in the UK context, see Ofcom, *Children and Parents: Media Use and Attitudes Report*, November 2015, https://www.ofcom.org.uk/research-and-data/media-literacy-

to facilitate personalized engagement, the potential of which has been explored from early on by software designers but less so by educationalists.[10] The 2010s saw the global rise in one-to-one tablet programs in schools, which were introduced to classrooms with the assumption that they would facilitate personalized learning. These programs were financed by national governments or technology providers: for example in Turkey (The FATIH Project), in the United States (The LAUSD project in Los Angeles); in the United Kingdom (the iPad project in Scotland), in Australia (the iPads for learning trial), in Malta (the Tablet Pilot Project), and in New Zealand (the Tauranga's Te Akau ki Papamoa Primary School). Personalized *education* (with or without personal mobile technologies) involves personalized learning and teaching. Personalized *teaching* is a type of differentiated instruction that not only determines the learning path for an individual student, but also adapts the learning content to individual students' needs, preferences, and abilities. Personalized *learning*, on the other hand, relates to the why, how, what, when, who, and where of learning, adjusted to an individual child/student.[11] Such learning might be supported by intelligent tutoring systems, explorative learning environments, or learning network organization. Johan Paludan makes a helpful distinction between personalized learning *content*, where knowledge is tailored to the individual in terms of areas of interest and ability range, and personalized learning *pathway*, in which a suitable learning program is curated from different set areas of content.[12] In this essay, we focus on the *content* that is being personalized for individual learners as well as the ways in which the provision of this content is enacted in the educational systems. In particular, we discuss personalized *data-based* education, which is personalized learning and teaching informed by data, such as students' individual assessment and performance scores, rather than teachers' own perceptions. Data-based personalized education is increasingly developed within the context of Artificial Intelligence (AI).

---

research/childrens/children-parents-nov-15; and Ofcom, *Children and Parents: Media Use and Attitudes Report*, November 2016, https://www.ofcom.org.uk/research-and-data/media-literacy-research/childrens/children-parents-nov16.

10. Hannah Green, Keri Facer, Tim Rudd, Patrick Dillon, and Peter Humphreys, "Futurelab: Personalisation and Digital Technologies," *TeLearn*, 2005, https://telearn.archives-ouvertes.fr/hal-00190337/.

11. Dmitry Izmestiev, "Personalized Learning: A New ICT-Enabled Education Approach" (Policy Brief, UNESCO Institute for Information Technologies in Education, 2012), https://iite.unesco.org/pics/publications/en/files/3214716.pdf; and Wayne Holmes, Stamatina Anastopoulou, Heike Schaumburg, and Manolis Mavrikis, *Technology-Enhanced Personalised Learning: Untangling the Evidence* (Stuttgart: Robert Bosch Stiftung GmbH, 2018), http://www.studie-personalisiertes-lernen.de/en/.

12. Johan Peter Paludan, "Personalised Learning 2025," in *Schooling for Tomorrow: Personalising Education*, Centre for Educational Research and Innovation (OECD Publishing, 2006), 83–100.

AI is an umbrella term, dating originally from the 1950s,[13] for a number of interconnected technologies including predictive analysis;[14] deep learning, machine learning,[15] neural networks, and expert systems[16] — otherwise known as expert tutoring, social robotics, or cloud robotics.[17] While these all rely on a similar looping function in terms of mathematical algorithms, rooted in probabilistic analysis of the likelihood of similarity or difference in response, the exact nature of the looping and associated self-learning or self-correction is subtly different in each case. The term AI is therefore better suited to describe goal-related behaviors rather than the precise technical means of achieving a goal[18] — a definitional nuance that has been covered in depth by Rose Luckin et al. in *Intelligence Unleashed*.[19]

AI is frequently talked about in terms of its potential to address educational inequalities through enhancing teachers' ability to detect individual differences, offer personalized feedback, and provide relevant instruction.[20] However, the design and application of AI systems are not free from cultural biases.[21] Indeed, AI design contains a strong political dimension and the desire to control, which is of interest to governments and commercial entities. In an economy where personal data are the "new gold" or "new oil," this potential is particularly attractive given that "anyone who nowadays wishes to control people needs to control the flows of information and the modes of communication."[22] In the educational context,

13. See A. M. Turing, "Computer Machinery and Intelligence," *Mind* 59, no. 236 (1950): 433–460, https://academic.oup.com/mind/article/LIX/236/433/986238?login=false; and John McCarthy et al., "A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence" (1955), http://jmc.stanford.edu/articles/dartmouth/dartmouth.pdf.

14. Irving John Good, "Speculations Concerning the First Ultraintelligent Machine," *Advances in Computers* 6 (1966): 31–88, https://doi.org/10.1016/S0065-2458(08)60418-0.

15. Arthur L. Samuel, "Some Studies in Machine Learning Using the Game of Checkers," *IBM Journal of Research and Development* 3, no. 3 (1959): 211–229, https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5392560.

16. Edward A. Feigenbaum and Richard W. Watson, "An Initial Problem Statement for a Machine Induction Research Project," Artificial Intelligence Project Memo No. 30, Computer Science Department, Stanford University, Stanford, CA (1965).

17. Ben Kehoe et al., "A Survey of Research on Cloud Robotics and Automation," *IEEE Transactions on Automated Science and Engineering* 12, no. 2 (2015): 398–409, https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7006734.

18. Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*, 3rd ed. (Harlow, England: Pearson, 2016).

19. Rose Luckin, Wayne Holmes, Mark Griffiths, and Laurie B. Forcier, *Intelligence Unleashed: An Argument for AI in Education* (London: Pearson, 2016).

20. Ibid.

21. Phaedra Mohammed and Eleanor Watson, "Towards Inclusive Education in the Age of Artificial Intelligence: Perspectives, Challenges and Opportunities," in *Artificial Intelligence and Inclusive Education*, ed. Jeremy Knox, Yuchen Wang, and Michael Gallagher (London: Springer, 2019).

22. Gert Biesta, "Responsive or Responsible? Democratic Education for the Global Networked Society," *Policy Futures for Education* 11, no. 6 (2013): 734.

Christothea Herodotou et al. have shown how predictive learning analytics systems can support teachers' monitoring of students' performance and improve student outcomes.[23] Charles Fadel, Wayne Holmes, and Maya Bialik have listed the benefits of several AI applications in curriculum delivery, including intelligent and dialogue-based tutoring systems, exploratory learning systems, and automatic writing evaluation software.[24] In this article, we expand on this literature by focusing specifically on AI use in data-driven personalized learning, and discuss the assumptions behind the design of these systems from a set of theorized perspectives. We interrogate the instructional implementation of these technologies and, drawing on Bernstein's theory, position AI-driven personalized pedagogy as a democratic concern.

Bernstein's Pedagogic Rights

There are various criteria for interpreting a system as democratic, but democracy as a set of values needs to sustain the values of inclusiveness,[25] civic equality, civic participation, freedom of expression,[26] and, from our educational perspective, educational equality. To help us reflect on and analyze current practices related to democratic education, we draw on Bernstein's seminal work *Pedagogy, Symbolic Control, and Identity: Theory, Research, Critique*, in which he lays out a framework of what he calls "conditions for democracy." These conditions provide a mechanism for understanding the issue of mutuality in education (who gives and who receives), as well as how and when we should contest any failures to promote mutuality — for example, when there is not a good reason given other than it is too difficult or expensive to operationalize. Bernstein consequently suggests three *pedagogic rights* based on this mutuality. He admits that the conditions for effective democracy are not derived from "higher-order principles" and that his starting point was a "naïve condition for democracy" that he translated into pedagogic democratic rights of enhancement, the right of inclusion, and the right of participation.[27] All three rights operate on individual, social, and political levels.

In our previous work, we discussed how these three rights could enhance the understandings of time in education, particularly in relation to disadvantaged social groups in England.[28] In this essay, we draw on Bernstein's concern with

23.   Christothea Herodotou, Martin Hlosta, Avinash Boroowa, Bart Rienties, Zdenek Zdrahal, and Chrysoula Mangafa, "Empowering Online Teachers through Predictive Learning Analytics," *British Journal of Educational Technology* 50, no. 6 (2019): 3064–3079.

24.   Charles Fadel, Wayne Holmes, and Maya Bialik, *Artificial Intelligence in Education: Promises and Implications for Teaching and Learning* (Boston, MA: The Center for Curriculum Redesign, 2019).

25.   Samuel P. Huntington, *The Third Wave: Democratization in the Late Twentieth Century* (Norman: University of Oklahoma Press, 1991).

26.   Robert A. Dahl, *On Democracy* (New Haven, CT: Yale University Press, 1998).

27.   Bernstein, *Pedagogy, Symbolic Control and Identity*, xx, xxv.

28.   Sandra Leaton Gray, "The Social Construction of Time in Contemporary Education: Implications for Technology, Equality and Bernstein's 'Conditions for Democracy'," *British Journal of Sociology of Education* 38, no. 1 (2017): 60–71.

democratic rights in relation to the model of AI embedded in personalized education. In particular, we argue that the three pedagogic rights are threatened by the systematic bias and unequal distribution of knowledge and power in AI personalized education.

Bernstein's Three Conditions for Democracy

Bernstein's three conditions for democracy are grounded in the concept of mutuality, as it is manifested within the educational processes of enhancement, inclusion, and participation in knowledge production.

Enhancement refers to the idea of seeing past and possible futures for pupils; Bernstein sees it as a path to developing new horizons and a degree of confidence. As he puts it, enhancement is "the means of critical understanding and to seeing new possibilities."[29] Monica McLean, Andrea Abbas and Paul Ashwin have argued in relation to university education that within a contemporary education system, enhancement can present a means of acquiring what might otherwise be known as sacred (as opposed to profane) knowledge,[30] allowing for a transformational process in which the learner experiences a more open mind.[31] Applying this to personalized learning, we can appreciate the importance of all children having equal access to a similar degree of "open-mindedness," transcending their immediate environment, regardless of whether their parents or school can afford to pay for it. Without such an enhanced perspective, acquired through the means of education, true democracy is not possible. This condition means that if a personalized learning system is to describe itself as democratic, it must take into account the scope for broadening horizons universally beyond a commercially profitable group of learners.

"The pedagogic right of social inclusion is," following Bernstein, "an individual's right to be included socially, intellectually, culturally, and personally [including] the right [to be] autonomous," and refers to the idea of social, cultural, intellectual, and personal inclusion operating individually as well as in the context of groups.[32] Beryl Exley and Linda-Dianne Willis usefully draw on the term *communitas* to frame this right, in the sense of describing a kind of cohort effect through the means of experiencing liminal states or transition periods together.[33] They use the term "adaptive expertise" to refer to what allows the achievement of a state of *communitas*. Inclusion and *communitas* offer conceptual tools for understanding

---

29. Bernstein, *Pedagogy, Symbolic Control and Identity*, xx.

30. Here, we use "sacred" in the Durkheimian sense of transcending the everyday. See Émile Durkheim, *Elementary Forms of Religious Life* (Oxford: Oxford University Press, 2008).

31. Monica McLean, Andrea Abbas, and Paul Ashwin, "A Bernsteinian View of Learning and Teaching Undergraduate Sociology-based Social Science," *Enhancing Learning in the Social Sciences* 5, no. 2 (2013): 32–44.

32. Bernstein, *Pedagogy, Symbolic Control and Identity*, xx.

33. Beryl Exley and Linda-Dianne Willis, "Children's Pedagogic Rights in the Web 2.0 Era: A Case Study of a Child's Open Access Interactive Travel Blog," *Global Studies of Childhood* 6, no. 4 (2016): 400–413.

personalized education systems through recognition of the importance of access to shared experiences common to a wider group. A democratic personalized education system therefore must recognize the need for commonalities within the provision of learning, as well as trying to address nuanced differences in order to make things easier and more effective for individual learners.

Finally, participation refers to the idea of the right to participate in civic practice, through procedures whereby order is constructed, maintained, and changed. Bernstein states that in addition to "the right to be included, socially, intellectually, culturally and personally," mentioned previously, there is also "the right to be separate, autonomous."[34] This is not the same as subsuming an individual within an existing group or system, as Daniel Frandji and Philippe Vitale make clear, as it has to allow for individual perspectives to thrive and also for existing structures and systems to be challenged.[35] With respect to personalized learning systems, here we see that a degree of user engagement and critique is essential if a system is to meet democratic standards, and not exclude "inconvenient members" of the learner population (perhaps those who are hard to reach, or those with only limited resources, for example). Participation can be achieved through student feedback, among other methods, and it is here that learner agency is most important.

To what extent are these three rights respected in the context of the most recent, AI-driven personalized learning? Our aim in the next section is not to give a comprehensive explanation of how AI-driven personalized education systems could be redesigned or applied to current practice in schools, but rather to begin a theoretical discussion for better understanding what these three components of democracy imply for AI personalized education.

Bernstein's Three Conditions for Democracy and AI Personalized Learning

AI has become one of the transforming forces of public education, according to several educational reports, including the Pearson's Open Ideas series[36] and the Open University Innovation Reports,[37] which were among the first mainstream policy-oriented publications calling for its imminent adoption. A common understanding of AI is that it is a "feature, function or characteristic of computer systems or machines that try to simulate human-thinking behaviour or human

---

34. Bernstein, *Pedagogy, Symbolic Control and Identity*, xx.

35. Daniel Frandji and Philippe Vitale, "The Enigma of Bernstein's 'Pedagogic Rights'," in *Pedagogic Rights and Democratic Education: Bernsteinian Explorations of Curriculum, Pedagogy, and Assessment*, ed. Philippe Vitale and Beryl Exley (London: Routledge, 2016), 13–32.

36. See, for example, Luckin et al., *Intelligence Unleashed*.

37. See, for example, Mike Sharples et al., *Innovating Pedagogy 2015: Open University Innovation Report 4* (Milton Keynes, UK: The Open University, 2015), https://oro.open.ac.uk/45319/; and Agnes Kukulska-Hulme et al., *Innovating Pedagogy 2021: Open University Innovation Report 9* (Milton Keynes, UK: The Open University, 2021), https://oro.open.ac.uk/74691/.

intelligence,"[38] but while many futuristic reports focus on systems that can emulate human thinking, the current technologies available to us can classify and recognize patterns, as described above, but not truly "think."[39] Luckin et al., therefore, discuss AI in terms of new teaching capabilities,[40] along the lines of the Stuart Russell and Peter Norvig's conceptual model of goal-related behavior.[41] They make the case for capitalizing on AI's particular strengths in relation to collecting real-time assessment scores, and adapting teaching accordingly. Such a conceptualization could enhance learning and better align with the vision advanced by Bernstein's "conditions for democracy."[42] Nevertheless, even if we promote artificial intelligence technologies under the auspices of adaptive teaching, their current design raises some significant democracy issues.

First, today's AI-driven personalized technologies come with ethical challenges linked to the professional responsibilities of educators.[43] Given the significant political backing in Anglo-American countries for technology-mediated personalized learning,[44] these systems are often imposed on schools from outside as a result of a political mandate rather than a theoretical or educational one.[45] This approach is at odds with Bernstein's inclusion right and leaves it unclear who is ultimately accountable for student achievement should the systems fail.[46] The model lacks dialogue with local users (such as teachers and the families of young learners) and without such local mediation it may not be sufficiently relevant or sustainable over the long term. As the local community is not sufficiently involved in commissioning, designing, implementing, and evaluating these educational models, it means that the community is effectively excluded from civic practice in relation to the

---

38. Utku Kose, "On the Intersection of Artificial Intelligence and Distance Education," in *Artificial Intelligence Applications in Distance Education*, ed. Utku Kose and Durmus Koc (London: IGI Global, 2015), 2.

39. Michael Ryan, *The Digital Mind: An Exploration of Artificial Intelligence* (Scotts Valley, CA: CreateSpace Independent Publishing Platform, 2014), 3.

40. Luckin et al., *Intelligence Unleashed*.

41. Russell and Norvig, *Artificial Intelligence*.

42. Bernstein, *Pedagogy, Symbolic Control and Identity*, xx.

43. Ben Williamson, "Digital Education Governance: Data Visualization, Predictive Analytics, and 'Real-Time' Policy Instruments," *Journal of Education Policy* 31, no. 2 (2016): 123–141.

44. See John F. Pane, Elizabeth D. Steiner, Matthew D. Baird, and Laura S. Hamilton, *Continued Progress: Promising Evidence on Personalized Learning* (Santa Monica, CA: RAND Corporation, 2015), https://www.rand.org/pubs/research_reports/RR1365.html; and John F. Pane, Elizabeth D. Steiner, Matthew D. Baird, Laura S. Hamilton, and Joseph D. Pane, *Informing Progress: Insights on Personalized Learning Implementation and Effects* (Santa Monica, CA: RAND Corporation, 2017), https://www.rand.org/pubs/research_reports/RR2042.html.

45. David Hartley, *Education and the Culture of Consumption: Personalisation and the Social Order* (London: Routledge, 2012).

46. Greg Thompson, "Computer Adaptive Testing, Big Data and Algorithmic Approaches to Education," *British Journal of Sociology of Education* 38, no. 6 (2017): 827–840.

teaching of their children. The persuasive power of technologies in the purchasing decisions made by public procurement services is not new,[47] but it has been exacerbated with personalized learning systems advertised as tailored to individual schools or students.

Second, these systems often have their effectiveness tested through a trial-and-error approach that is more characteristic of business ventures and not always suitable in the complex environment of schools.[48] With the dual focus on digitization and datafication in public schools, the consequences of such commercial approaches are visible in a number of software programs used on a daily basis by public schools, including attendance logs, which, despite the promise of their providers, turned out to produce "small, compromised data-sets that lacked the trustworthiness or granularity to underpin any kind of rigorous large-school modelling or prediction."[49]

There are clearly strong financial interests driving the dissemination of educational technologies, given that they are produced and delivered by commercial companies; these financial interests are in tension with Bernstein's notion of participation. Economic interests and the discourse of market competition and performance metrics take over the debate, giving rise to the popularity of autonomous schools (such as charter schools in United States or academies in the UK) that integrate community learning into a set of neoliberal and neoconservative political commitments.[50]

Third, Bernstein's right of enhancement is not in alignment with the current design of many AI applications of personalized education because their design lacks the social aspect of knowledge acquisition. As one of us has argued previously, current technology-driven personalized learning platforms of this kind do not personalize but rather standardize children's learning according to a particular Western, commercialized model of education.[51] They do this through a commodification of knowledge that follows a standard model of an "ideal child."[52] Bernstein's enhancement right also clashes with the shift to knowledge conceptualized as private property, which underpins some personalized education models,

47. Andrea Stefano Patrucco, Helen Walker, Davide Luzzini, and Stefano Ronchi, "Which Shape Fits Best? Designing the Organizational Form of Local Government Procurement," *Journal of Purchasing and Supply Management* 25, no. 3 (2019): https://doi.org/10.1016/j.pursup.2018.06.003.

48. Selwyn, *Is Technology Good for Education?*

49. Neil Selwyn, Luci Pangrazio, and Bronwyn Cumbo, "Attending to Data: Exploring the Use of Attendance Data within the Datafied School," *Research in Education* 109, no. 1 (2021): 87.

50. Valerie Visanich, *Education, Individualization and Neoliberalism: Youth in Southern Europe* (London: Bloomsbury Publishing, 2020).

51. Natalia Kucirkova, *The Future of the Self: Understanding Personalization in Childhood and Beyond* (London: Emerald Publishing Limited, 2021).

52. Michele A. Willson, "Raising the Ideal Child? Algorithms, Quantification and Prediction," *Media, Culture & Society* 41, no. 5 (2019): 620–636.

for example those studied by Verónica López, Romina Madrid, and Vicente Sisto in Chile.[53] This is where the pedagogy of AI-driven personalized education overtly deviates from Bernstein's principle of socio-personal and intellectual enhancement of knowledge.

Our brief exposé of the three inadequacies in the dominant model of AI in personalized learning sketches how the current educational landscape tends to accept the premise that education can proceed along a one-sided linear route of increasing an individual's child knowledge bank. In opposition to this tendency, the essence of Bernstein's conditions for democracy is the collective and social base of knowledge. He cautions against educational systems that jump on the bandwagon of "trainability," which "arises out of a particular social order, through relations which the identity enters into with other identities of reciprocal recognition, support, mutual legitimization and finally through a negotiated collective purpose."[54] Despite its opaque algorithms, AI is designed to train the child, not the collective. It is individually focused and it concretizes and makes visible the knowledge the child holds, by providing specific recommendations for an individual that are personalized according to the individual's past searches, past keywords, learning level, and knowledge base. At its core, then, this is not a democratic design principle; it advances the knowledge of an individual according to design principles established by a commercial group of designers and developers.

Furthermore, AI-driven personalized learning is not a democratic pedagogical intervention because it removes teachers' input rather than capitalizing on their expertise. While presented with the motivation to facilitate teachers' work, the systems are actually designed to replace and supplement rather than complement teachers' work.[55] As we showed in our previous work concerned with AI-enhanced library systems, the software takes over the teacher's support of student choice and makes the choice on behalf of the student. The removal of human control and agency from the learning process is where we locate the lack of democratic design principles.

Our concern is that even though the AI-driven personalized learning systems may have advanced some forms of information-sharing and instruction, these systems, in their current form, can be said to have failed their users in terms of promoting their deeper democratic rights.

---

53. Verónica López, Romina Madrid, and Vicente Sisto, "Red Light in Chile: Parents Participating as Consumers of Education under Global Neoliberal Policies," in *Globalization: Education and Management Agendas*, ed. Hector Cuadra-Montiel (Rijeka, Croatia: Intech, 2012), 28–54.

54. Basil Bernstein, *Class, Codes, and Control: Towards a Theory of Educational Transmission*, vol. 3 (London: Psychology Press, 2003), 59.

55. Sandra H. Leaton Gray and Natalia Kucirkova, "A United and Thriving Europe? A Sociology of the European Schools' and 'If Personalised Education and Artificial Intelligence Are a Democratic Problem, Could Pluralisation Be the Democratic Solution?" (paper presented at the annual conference of the British Educational Research Association, Northumbria University, 2018).

Where Next with Democratic AI Personalized Education?

The enhancement right, the right of inclusion, and the right of participation can serve as tools for critical reflection about the extent to which the educational systems in Western countries have at their core the somewhat difficult and complex "notion of egalitarianism."[56] In some ways, the advent of accessible and affordable Internet-connected devices (such as smartphones and tablets) has visibly expanded the opportunities for democratic engagement of previously marginalized groups.[57] A further consequence, however, has been to open up new educational agendas for technology developers and providers. While access to information might address important digital divides across the world, the simplistic idea that technology brings democracy to the world is not unproblematic and needs to be considered in relation to global identity and global citizenship,[58] as well as the relationship of technology with social, political, and economic power structures.

Furthermore, from a democratic perspective on education, personalized education developed and driven by a technology provider is always going to be inadequate because of its vested interests in continuing to provide the product to the target market. Algorithms that operate on a limited pool of participants represent a self-selecting elite, despite appearing on the surface to be a democratic platform. This issue connects to the history of the educational use of the term "personalization." Personalized education started as part of learner-centered initiatives that honored children's own talents, needs, and preferences, but that focus has been somewhat hijacked by the technocratic discourse of data-based personalized education.[59] AI-enhanced education requires data and the current data collection practices in schools can be criticized for being part of an asymmetric data economy that disadvantages marginalized and disadvantaged students and that is part of a system of surveillance capitalism in which data are being used to target specific individuals based on outdated and biased criteria.[60]

We need to consider the use of such personalized learning systems in the context of the wider educational model they promote in today's diverse society. If it is a primarily Western model, this might represent little more than the colonialization of education as it favors a preselected, narrowly defined model of

56. Laura B. Perry, "Education for Democracy: Some Basic Definitions, Concepts, and Clarifications," in *International Handbook on Globalisation, Education and Policy Research*, ed. Joseph Zajda et al. (Dordrecht, Netherlands: Springer, 2005), 686.

57. See Farid Shirazi, Ojelanki Ngwenyama, and Olga Morawczynski, "ICT Expansion and the Digital Divide in Democratic Freedoms: An Analysis of the Impact of ICT Expansion, Education, and ICT Filtering on Democracy," *Telematics and Informatics* 27, no. 1 (2010): 21–31.

58. Robert O. Keohane, "Nominal Democracy? Prospects for Democratic Global Governance," *International Journal of Constitutional Law* 13, no. 2 (2015): 343–353.

59. Deborah Lupton and Ben Williamson, "The Datafied Child: The Dataveillance of Children and Implications for Their Rights," *New Media & Society* 19, no. 5 (2017): 780–794.

60. Luci Pangrazio and Neil Selwyn, "Towards a School-Based 'Critical Data Education'," *Pedagogy, Culture & Society* 29, no. 3 (2021): 431–448.

learning. In such a situation, the scope for confidence in the democratic model on offer is going to be limited to a group of individuals, whose data are being used to model others' engagement. The social justice agenda of democratic classrooms needs to be at the forefront of the balance between the personal responsibility of citizens and the government's duty to care for those who cannot provide for themselves if personalized education is to succeed in the long term.[61]

If we accept that the current models in use for personalized learning frequently demonstrate inherent flaws in terms of the conditions for democracy and associated pedagogic rights, then it follows that we need to develop principles for more equitable future practice. In the next section, we attempt to draw on Bernstein's theoretical work to identify three principles that would promote a more democratic personalized learning.

Three Principles for Democratic AI Personalized Learning

To leverage the benefits of AI's precise and on-scale personalization, we suggest three principles — the principles of political, economic, and social equality — as a basis for moving forward in the direction of democratic classrooms. These three principles feed into the social justice agenda of democratic classrooms in that they cater to *all* learners and the diverse communities they represent and shape.

The first principle, political equality, underscores that personalized learning systems need to follow a more inclusive approach toward innovative outputs, in which children are positioned as makers and active citizens, and educators as those who determine content and its assessment. This is a very different model from the idea that a school should buy a learning package to unleash on children, for example. This principle requires a more willing approach to risk taking, in which the journey taken by a personalized learning system over time might be quite different from that envisaged by its original inventors or developers (or indeed purchasers).

The second principle, economic equality, implies that AI personalized education needs to be implemented together with participatory education systems that enable the growth of *all* children, not only those who have access to or possess particular resources and knowledge, or who have superior access to what might be classified as "sacred" knowledge by Bernstein (otherwise classified by him as "esoteric," or specialist, knowledge). This might include both subject-based knowledge (curriculum content) as well as skills knowledge (how to sit examinations successfully), to take two relatively simple examples.

With the third principle, social equality, we hark back to the notion of *communitas*, as referred to earlier in this article. The design of personalized learning technologies needs to be more community-oriented, to ensure that personalization does not happen at the expense of community participation. There needs to be a

---

61. Charles Leadbeater, *Personalisation through Participation: A New Script for Public Services* (London: Demos, 2004).

sense of the collective endeavor, and the collective experience, in order to ensure that social ties help achieve a fully participatory society.

By following these principles, personalized learning systems that draw on artificial intelligence mechanisms can achieve the degree of mutuality that Bernstein argues is necessary if democratic rights are to be ensured. This is not a theoretical utopia; indeed, we propose that all three principles can be achieved through a combination of personalization with *pluralization* in systems that combine artificial and human intelligence. Personalized pluralization — that is, personalization enriched with pluralization, rather than personalization on its own — could, we argue, give rise to an enhanced, more inclusive, and participatory *democratic* education. In the next section we explain this notion of personalized pluralization in more detail.

Personalized Pluralization in Education

Bernstein's work on pedagogic rights is echoed by that of David Hartley, who describes the tension between democracy and capitalism and cautions that the current purposes of personalized education are mostly economic and political.[62] A rich approach to personalization should be about collaboration as much as about personal development; or, as Bernstein might frame it, it should be about full engagement in civic practice (here, in the context of participatory learning). In this respect, Bernstein's argument makes it apparent that personalized education needs to be combined with pluralization, in which the collaborative and communal aspects of learning are made visible.

Pluralization represents an essential accompaniment to personalization; it is about human differences, diversity, and collectivism.[63] Similarly to personalization, pluralization is a multidisciplinary term, used in different disciplines for different purposes. For example, in social and cultural studies pluralization is used to discuss differences not only between different social groups but also within them;[64] in economics and policy studies, it refers to the politics of difference or market diversification.[65] We consider personalization and pluralization to be distinct but intertwined principles that can support more effective pedagogies, and our empirical work demonstrates the educational outcomes of applying such pedagogies to early and primary school classrooms.[66]

62. Hartley, *Education and the Culture of Consumption*.

63. Aga Khan, speech delivered at the graduation ceremony of the University of Alberta, June 8, 2009, http://www.akdn.org/speech/his-highness-aga-khan/graduation-ceremony-university-alberta.

64. Pierpaolo Donati, "We Need a Relational Reason for Different Cultures to Meet and Build a Common World," in *Retrieving Origins and the Claim of Multiculturalism*, ed. Antonio Lopez and Javier Prades (Cambridge: Eerdmans, 2014), 31–44.

65. James J. Rice and Michael J. Prince, *Changing Politics of Canadian Social Policy* (Toronto, Canada: University of Toronto Press, 2013).

66. Natalia Kucirkova and Karen Littleton, "Developing Personalised Education for Personal Mobile Technologies with the Pluralisation Agenda," *Oxford Review of Education* 43, no. 3 (2017): 276–288.

The design of AI-driven personalized pluralization systems should not be about competition but about achievement for all. This is where AI could offer a useful enhancement of face-to-face personalized education by providing, for example, elaborated feedback that is resource-intensive, as it involves additional teacher time. In the case of literacy classrooms, for instance, AI could usefully expand teachers' capacity to provide more precise and diverse book recommendations,[67] scaling up individual guidance over time,[68] or opportunities for artistic creation through artificially intelligent assistive technologies.[69]

These conclusions are not only theoretical propositions: for example, Subhagata Chattopadhyay et al. have considered AI-enhanced solutions for assessing students' learning outcomes along the lines of personalized pluralization.[70] They developed a generic model of an AI-based learner interface, which consists of three sub-models: a pedagogy model that incorporates teachers' expertise, assessment, and feedback, as well as parental involvement in the assessment process; a domain model that incorporates subject matter, facts, figures, and procedures; and a learner model that stores previous learning facts and can be used for peer-based learning.[71] The three models process data through algorithms that feed the learning content to individual students, adapted to their needs and capabilities. Results feed into an open learner model that makes the learning explicit to all involved in the system, that is, to the students as well as to the teachers. This structure offers sustainable learning benefits in terms of pluralization. It ensures that the condition of enhancement corresponds to the principles of political, economic, and social equality, where all learners are offered expert subject-based and skills-based learning opportunities. The pedagogy model can effectively bring together teachers' and parental expertise following a democratic condition of inclusion and its accompanying principle of social equality. Lastly, the learner domain in Chattopadhyay et al.'s model aligns with Bernstein's political equality and his idea that learners have a stake in society, with confidence in the political basis of such a system. There is a balance between human and artificial intelligence in that they feed into

---

67. Natalia Kucirkova and Teresa Cremin, "Personalised Reading for Pleasure with Digital Libraries: Towards a Pedagogy of Practice and Design," *Cambridge Journal of Education* 48, no. 5 (2018): 571–589.

68. Lindsay C. Page and Hunter Gehlbach, "How an Artificially Intelligent Virtual Assistant Helps Students Navigate the Road to College," *AERA Open* 3, no. 4 (2017), https://doi.org/10.1177/23328584177492.

69. Valerie Leuty, Jennifer Boger, Laurel Young, Jesse Hoey, and Alex Mihailidis, "Engaging Older Adults with Dementia in Creative Occupations Using Artificially Intelligent Assistive Technology," *Assistive Technology* 25, no. 2 (2013): 72–79, https://www.tandfonline.com/doi/full/10.1080/10400435.2012.715113.

70. Subhagata Chattopadhyay, Savitha Shankar, Ramya B. Gangadhar, and Karthik Kasinathan, "Applications of Artificial Intelligence in Assessment for Learning in Schools," in *Handbook of Research on Digital Content, Mobile Learning, and Technology Integration Models in Teacher Education*, ed. Jared Keengwe (Hershey, PA: IGI Global, 2018), 185–206.

71. Ibid.

and "augment" each other at different points of the learner journey.[72] The most recent developments in generative AI with specialized bots trained on curated and reliable data could be inspired by this approach. Kok-Lim Alvin Yau et al. present a survey of expert views on the partnership possibilities between human and computer intelligence, which they term augmented intelligence, and which they put forward as the future of AI in education.[73] To illustrate, we could imagine a scenario in the context of literacy education where a teacher recommends a book for the child to read by drawing on the teacher's own knowledge about the child's reading habits. This knowledge includes the teacher's repeated observations of children in the classroom, as well as information from the children's parents, peers, and the children themselves. An AI-powered reading database can tailor a reading recommendation by drawing on information about millions of relevant book titles, grouped around genre, reading level, or topics and information supplied by the child, the teacher, and the child's use of the database over time. The teacher's and the database's reading recommendation can, together, augment the relevance of their recommendations, particularly if the teacher actively interacts with the reading database used by the child.

Based on the lessons learned from previous work and the argument advanced in this paper, we posit that the current form of AI-driven personalized learning is inadequate, as its design focuses on personalization at the expense of pluralization. As Kucirkova argued earlier, many such systems follow the logic of commercial, defense, or simply capitalist strategies, where more data about an individual user can be used to produce more targeted offers or actions by the provider. The implicit assumption in these models is that increased personalization results in better outcomes. However, these outcomes may be better for the provider in terms of more data for more robust modeling via artificial intelligence, but not necessarily for the subject of personalization. Bernstein (and others) might even regard this data exploitation as a form of unrewarded labor with little regard for any democratic outcomes. This is because in education, content that the learner finds difficult or uninteresting creates a cognitive challenge or cognitive conflict that, according to constructivist learning theories, is the impetus for creating knowledge and transforming thinking.[74] Within a commercial model, this information from and about the learner has to be traded for the right to access the learning system, even though this access may have an overall negative effect on the pedagogic rights of the learner when it is not fully underpinned by civic engagement in a symbiotic sense, as we have discussed earlier in this essay.

---

72. Kok-Lim Alvin Yau, Heejeong Jasmine Lee, Yung-Wey Chong, Mee Hong Ling, Aqeel Raza Syed, Celimuge Wu, and Hock Guan Goh, "Augmented Intelligence: Surveys of Literature and Expert Opinion to Understand Relations Between Human Intelligence and Artificial Intelligence," *IEEE Access* 9 (2021): 136744–136761, https://ieeexplore.ieee.org/document/9548047.

73. Ibid.

74. See, for example, Jean Piaget, *Piaget's Theory* (Berlin, Germany: Springer, 1976); and Peter C. Brown, Henry L. Roediger III, and Mark A. McDaniel, *Make It Stick: The Science of Successful Learning* (Cambridge, MA: Harvard University Press, 2014).
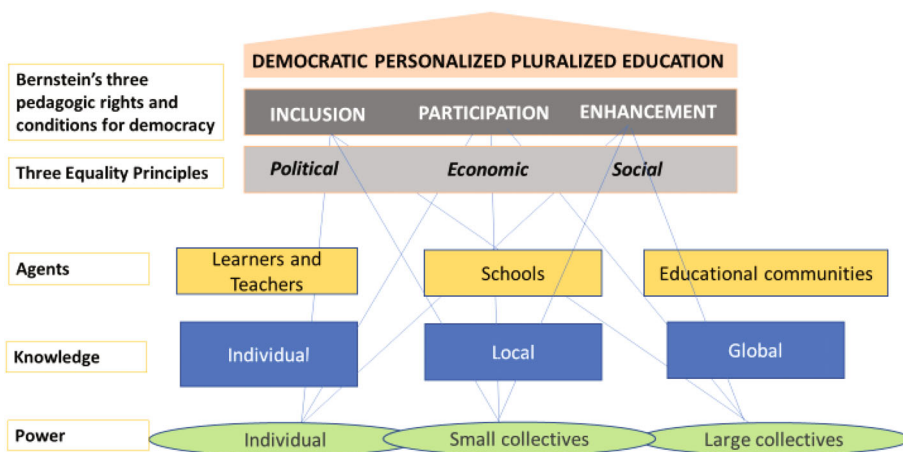
Figure 1. A visual representation of the PPAE Framework

We are not the first ones to point out that current AI systems are education-ally inadequate: Carlo Perrotta and Ben Williamson, for example, describe how the design of algorithms used in AI is based on predetermined, sociopolitically biased grouping criteria and attributes.[75] We add to this wider discussion by argu-ing that the pedagogy of using these systems within personalized education is undemocratic and is the result of undertheorized technological innovations. To draw together these themes, we incorporate our theoretical reflections with Bern-stein's three rights and the three equality principles into a framework of future personalized pluralization in AI education (PPAE). This framework is intended to guide future research, practice, and policy on democratic personalized plural-ization by drawing on the latest AI technologies and interrelating them with an understanding of socially just agents, knowledge, and power interests.

A Framework of Personalized Pluralization in AI Education

The PPAE framework has three components that dynamically and symbiot-ically influence each other and that are centered on the social justice agenda of democratic classrooms: (1) political equality, which is connected to Bernstein's inclusion right; (2) economic equality, which is connected to Bernstein's participa-tion right; and (3) social equality, which is connected to Bernstein's enhancement right. Figure 1 represents these considerations on three levels.

The three components give rise to some questions that educators, educational researchers, and educational professionals will need to reflect on as we discuss the shape of increasingly AI-driven education systems. We divided these questions into three interest structures that rely on certain types of *agents*, who produce a certain type of *knowledge* that is embedded in certain types of *power* relationships.

75. Carlo Perrotta and Ben Williamson, "The Social Life of Learner Analytics: Cluster Analysis and the 'Performance' of Algorithmic Education," *Learning, Media and Technology* 43, no. 1 (2018): 3–16, https://doi.org/10.1080/17439884.2016.1182927.

TABLE 1. The PPAE Framework with guiding questions for the field

Bernstein's Three Pedagogic Rights and Conditions for Democracy		
Inclusion	*Participation*	*Enhancement*
Three Equality Principles		
Political	*Economic*	*Social*
Guiding Questions Concerning Agents, Knowledge, and Power		
To what extent are teachers and learners involved in decision-making about AIT?	To what extent do individual schools have autonomy in AIT's application?	To what extent is community knowledge a component of AIT's provision?
To what extent is individual knowledge included in political AIT-related decisions?	To what extent does AIT draw on the local knowledge of families, schools, and community learning groups?	To what extent does AIT incorporate global knowledge that diversifies students' knowledge?
To what extent is the individual power of learners and teachers in AIT deployment perceived as politically important?	To what extent can small communities participate in the AIT economy?	To what extent does social knowledge generated through AIT enhance global educational communities?

The questions are phrased as open questions and the application of AI-driven technology is abbreviated to AIT. Table 1 captures the guiding questions.

The PPAE framework makes it clear that when it comes to AI-enhanced personalized learning, as opposed to AI-driven personalized learning, the question is not whether to include artificially intelligent software that personalize learning, but rather how to balance their contribution with human intelligence and pluralization. The search for a pluralization *and* personalization, as well as human *and* artificial intelligence is an ongoing, dynamic process that requires pluralistic approaches toward pluralism (pun intended). In the Nordic pragmatist tradition, which we side with, pluralism is considered as a "beneficial catalyst for doubting, justifying and revising one's ethical opinions," and we approach the social change necessary for democratic uses of AI from this pragmatic perspective.[76] We propose that while pluralism cannot resolve interest conflicts between varied groups of local and global developers and users of AI systems, it can foster more egalitarian power relationships in their development.

FUTURE DIRECTIONS AND OPPORTUNITIES

The field of personalized learning needs to emerge from its infancy to capitalize on the technological capabilities of AI within a democratic process. Far from

---

76. Henrik Rydenfelt, "Pragmatism, Education and the Problem of Pluralism," in *Rethinking Ethical-Political Education*, ed. Torill Strand (Cham, Switzerland: Springer, 2020), 199.

being a threat, artificial intelligence has the potential for supporting powerful forms of learning, in the context of instruction as well as assessment. However, we argue that this potential will be realized if, and only if, sufficient attention is given to the three pedagogic rights and conditions for democracy laid out by Bernstein: enhancement, inclusion, and participation. We have considered how these three conditions relate to three types of equality in socially just classrooms and connected these conditions to the research on the potential of AI in enhancing current models. With the public launch of generative AI in 2023, many predict that AI-enhanced personalization can revolutionize children's education and our lives more broadly, but we caution against jumping onto the AI bandwagon without the essential theorizing that is necessary for bridging the gaps between the rhetoric and the reality of personalization. Personalization is a complex nexus of practices, products, and processes that need to be disentangled in the data-based education context before the AI frontier becomes its largest component. To this end, we have proposed the combination of personalization with pluralization and mapped it onto three principles for future practice: political, economic, and social equality. We suggested some basic guiding questions to illustrate how a new framework based on these principles could advance democratic personalized pluralization in AI-enhanced learning.

Practical Implications

Setareh Maghsudi et al. identify AI as being a valuable resource for personalized education, which they conceive of as particularly relevant for online education, such as that experienced during the abnormal educational circumstances of the pandemic.[77] However, this potential is not being realized more generally due to significant practical challenges in the areas of content production, evaluation, and lifelong, diverse, and fair learning.[78] Debates about AI are thriving in posthumanist circles but are missing in many educational theories. The PPAE framework offers a line of thinking that can be used not only to better understand practical challenges, but also to indicate gaps in the interdisciplinary understanding of personalized education.

We propose that the PPAE framework can prompt reflection on complex issues regarding the transparency of AI-driven personalized education systems, encourage discussions about the democratic nature of learning models embedded in such systems, and steer a more democratically oriented analysis of their learning value for diverse stakeholders (e.g., designers, educators, and researchers). As a theoretical tool, the framework cannot be reduced to a checklist for verifying best practice, but our guiding questions can be usefully considered by designers, practitioners, and researchers who are willing to engage with the complexity

77. Setareh Maghsudi, Andrew Lan, Jie Xu, and Mihaela van der Schaar, "Personalized Education in the AI Era: What to Expect Next?," *Cornell University Depository*, January 19, 2021, https://arxiv.org/abs/2101.10074.

78. Ibid.

of optimizing human and artificial intelligence for individualizing children's learning.

Conclusion

Meta-analytical evidence shows that personalized education, which uses AI to adapt the content to the level of individual learners, is of greater learning value than simple technology-supported personalized learning.[79] However, if personalized education augmented by AI is to work in the long term and holistically, the real question becomes when to apply *and when to restrict* personalization, and when to combine it with pluralization. The current AI models lack sympathy, empathy, and common sense, which are necessary for establishing trust.[80] While self-aware and conscious AI robots cannot be considered a real competitor to teachers' guidance in classrooms,[81] the importance of human intelligence in optimally implementing personalization and pluralization cannot be denied in the age of AI. Inge Molenaar[82] specified six degrees of automation in personalized learning, ranging from teacher's full control to AI's full control (full automation). Students' own choices could be conceptualized in a similar way. Although many current AI designs remove choice-making through automatic adaptations, AI could, instead, both personalize (adapt to the child) and pluralize (expand the child's choices) the learning environment. The child's agency and AI's automation in the process are both represented in the PPAE framework, which we have described as a collaborative, dynamic process. In other words, we conceptualize the child's agency as both shaping and being shaped by the AI automation process, yielding an inclusive participatory process that enhances both human and artificial intelligence. That is why we propose changing the language from AI-driven learning to AI-enhanced learning.

Sophisticated personalized learning systems underpinned by artificial intelligence need to strike an optimal balance between the roles played by humans and AI in the learning process. They need to do more than deliver a canon of curriculum knowledge while assessing whether it has been suitably absorbed by the learner. They need to be flexible and responsive at a human level, respecting the differences between individuals, and this requires extensive engagement at the design

79.   Louis Major, Gill A. Francis, and Maria Tsapali, "The Effectiveness of Technology-Supported Personalised Learning in Low- and Middle-Income Countries: A Meta-Analysis," *British Journal of Educational Technology* 52, no. 5 (2021): 1935–1964.

80.   Sana Khanam, Safdar Tanweer, and Syed Khalid, "Artificial Intelligence Surpassing Human Intelligence: Factual or Hoax," *The Computer Journal* 64, no. 12 (2021): 1832–1839.

81.   Aljoscha C. Neubauer, "The Future of Intelligence Research in the Coming Age of Artificial Intelligence — With a Special Consideration of the Philosophical Movements of Trans- and Posthumanism," *Intelligence* 87 (2021): https://doi.org/10.1016/j.intell.2021.101563.

82.   Inge Molenaar, "Personalisation of Learning: Towards Hybrid Human-AI Learning Technologies," in *OECD Digital Education Outlook 2021: Pushing the Frontiers with Artificial Intelligence, Blockchain, and Robots*, ed. Andreas Schleicher (Paris: OECD Publishing, 2021), 57, https://read.oecd-ilibrary.org/education/oecd-digital-education-outlook-2021_589b283f-en#page1.

stage with teachers and students. Yet AI can also add value to learning, particularly for groups with limited access to teachers, mentors, and educational resources. We argue that if innovative AI education systems respect the principles embedded in the PPAE framework, then learning stands a better chance of maximizing civic participation and human flourishing.