Personalized Learning and the Digital Privatization of Curriculum and Teaching

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Executive Summary

Personalized learning programs are proliferating in schools across the United States, fueled by philanthropic dollars, tech industry lobbying, marketing by third-party vendors anxious to enter the K-12 education market, and a policy environment that provides little guidance and few constraints. This brief examines the promise and limitations of personalized learning by reviewing its history, identifying its key assumptions, assessing the roles and possible impacts of the digital technologies it deploys, and reviewing relevant research evidence. Familiarity with these factors will maximize policymakers' ability to craft appropriate guidelines for personalized learning initiatives and will help educators critically evaluate personalized learning products being marketed to them.

Our analysis reveals questionable educational assumptions embedded in influential programs, self-interested advocacy by the technology industry, serious threats to student privacy, and a lack of research support.

Despite many red flags, pressure to adopt personalized learning programs keeps mounting. States continue to adopt policies that promote implementation of digital instructional materials[1] but that do little to provide for oversight or accountability. Even the RAND Corporation, a distinguished research organization, published a 2018 paper offering schools strategies for how to implement personalized learning despite admittedly weak evidence to support its efficacy.[2]

Linking personalized learning with proprietary software and digital platforms puts important educational decisions (such as whether a child has attained a specific competency or grade level) in private hands, and it can compromise the privacy of children and their teachers. It can also distort pedagogy in ways that stifle student learning and stunt their ability to

grow as people and as participants in a democratic system. Because the influential programs reviewed in this report privilege data over all other instructional considerations, they reflect a restricted, hyper-rational approach to curriculum and pedagogy that limits students' agency, narrows what they can learn in school, and limits schools' ability to respond effectively to a diverse student body.

Given the manifest lack of oversight and accountability, it is recommended that schools and policymakers pause in their efforts to promote and implement personalized learning programs until rigorous review, oversight, and enforcement mechanisms are established. It is also recommended that states establish an independent government entity responsible for implementing and enforcing the following recommendations relevant to personal learning programs, including recommendations for safeguarding the use of student and teacher data:

- Require that program curriculum materials be externally reviewed and approved by independent third-party education experts.
- Require that pedagogical approaches be externally reviewed and approved by independent third-party education experts to ensure that the approaches are appropriate for intended student populations.
- Require that both the validity of assessment instruments and the instructional and programmatic usefulness of data generated be independently certified by independent third-party education experts.
- Require that the assumptions and programming of all algorithms associated with personalized learning materials be reviewed and approved by independent third-party education experts *before* any processes employing the algorithms are implemented.
- Develop—and require that all entities that collect student, teacher, and other data through personalized learning materials and related software platforms be subject to—a standard, legally binding, transparent privacy and data security agreement that:
    - Requires the entity collecting data to disclose its financial interests and business relationships as well as any potential commercial implications of data collection;
    - Vests the ownership of any and all data collected on a student with the student or the adult(s) legally responsible for the student;
    - Prohibits the entity collecting data from collecting any data not directly relevant to an agreed-upon specified educational purpose and from using any data collected for any purpose other than the agreed-upon specified educational purpose;
    - Makes the entity collecting data legally responsible for protecting the security of data if data are shared with a third party;
    - Requires that the entity referring students to a third party be legally responsible for ensuring the security of any data the third party may collect from the students referred;

- Requires the entity collecting data to provide a legally enforceable data agreement that clearly explains what kinds of data it proposes to collect from children under 13, how it proposes to store the data and for how long, who will be allowed access, and what educational purpose all data will serve;
- Requires a standard, explicit, and easy to understand explanation of what kind of data use is incorporated in such activities as "improving" websites, apps, or services, or in "personalizing and improving" users' experience with the platform.

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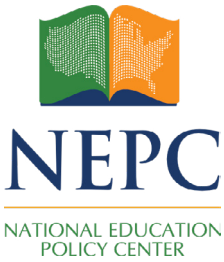

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Personalized learning is a hot topic, garnering policymaker interest, media attention, and widespread school implementation. Much of this is driven by focused philanthropic funding (e.g. the Bill and Melinda Gates Foundation and the Chan Zuckerberg Initiative), the advocacy of large digital platforms (e.g., Facebook and Google) and tech industry trade associations, and investors anxious to cash in on the school market.

Pedagogical thinking embedded in contemporary personalized learning programs and practices stresses attention to individual student needs and interests—although such thinking has been around for a long time. In fact, current attempts to implement personalized learning reflect educational goals popular in the early twentieth century, including making learning more efficient in terms of students' time and effort and more relevant to their interests. Now, one hundred years later, proponents of high-tech digital products argue that those products can transform traditional classrooms into responsive learning environments that help children realize their personal learning goals.

Without doubt, many well-intentioned educators are attracted to and enthusiastic about the child-oriented promises held out by various approaches to personalized learning. Unfortunately, our analysis suggests that these educators' good intentions and hard work are likely to be overwhelmed by the corporate march to dominate the personalized learning landscape. Corporations have for years sought ways to transform education from a cost center to a profit center. Personalized learning, particularly digital personalized learning with its prepackaged curricula, assessments, and continual data collection, is currently the obvious area of corporate growth and control. The disappointing experience of educators who in the past few decades were attracted to the promise of charter schools is telling: well-funded and powerful for-profit corporate interests now dominate charter school reform. The probability is high that well-funded and powerful for-profit interests will overtake "personalized learning" as well.

In terms of pedagogy, the digital products that corporations market as an integral part of personalized learning can undermine the ability of educators to provide students with engaging and educative school experiences. Such products subtly subvert teachers' ability to control their classroom pedagogy, moving pedagogical control to vendors and programmers—thus, in effect, privatizing consequential educational decision-making. Digital products also tend to require massive amounts of continuously collected data, the existence of which threatens to compromise teacher and student privacy.

To understand the threats inherent in the current push for personalized learning, it is helpful to understand the movement's historical background, identify its key assumptions, assess the role and possible impacts of current digital technologies, and review the research evidence related to the efficacy of personalized learning. Taking these factors into account can help inform policymaking and enhance the ability of educators to critically evaluate the personalized learning products marketed to them.

Personalized Learning: Historical Context

Early efforts to individualize instruction foreshadow contemporary personalized learning initiatives. Then, as now, educators strove to provide children with immediate feedback and interesting, personally relevant educational materials. They also tried to delegate the tedious tasks of drilling, testing, and grading in order to provide teachers more time for work with children on more meaningful pursuits.[3] Individualized instruction was intended to promote these goals, often by allowing students to progress independently through rationalized materials and assessments.[4]

In the 1920s, individualized instruction meant workbooks and paper-and-pencil tests. The "Winnetka Plan," for example, included: self-paced, self-instructional, self-corrective workbooks; diagnostic placement tests to determine which goals and tasks students should tackle; self-tests allowing students to determine if they were ready for testing by the teacher; and a simple recordkeeping system to track individual student progress.[5]

Also at this time, principles of "scientific management," or Taylorism, were imported into schools.[6] Scientific management sought to remake the school on the factory model by measuring and controlling the behavior of teachers and students. Implicit in this approach, which peaked in the 1950s and 1960s, was the idea of knowledge as a deliverable unit, like a product or commodity. This is the context in which "teaching machines" were introduced to schools.

The first real teaching machine was patented in 1928 and described by its inventor, Sidney L. Pressey, as "a simple apparatus which gives tests and scores—and teaches."[7] Interestingly, Pressey's first commercial education venture involved tests that he eventually claimed his machines would save teachers from having to administer and score. He called for an "industrial revolution" in education in which "educational science and the ingenuity of educational technology [would] combine to modernize the grossly inefficient and clumsy procedures of conventional education." Imagining the educational future, he predicted that schools would

eventually contain many labor-saving devices that would free students and their teachers from "educational drudgery and incompetence."[8]

In the 1950s and 1960s, cold war military and economic competition with the Soviet Union and the attendant fear of losing the "race" for technological leadership made decision-makers more willing to open their wallets for public education reform than they had been during the Great Depression.[9] At this time, behavioral psychologist B.F. Skinner promoted a teaching machine based on his theory of reinforcement. Skinner's machine presented logically organized information in extremely small steps. After each step students were required to provide answers to questions about the information they had just read before they could proceed to the next step. Skinner argued that by following this process students would experience repeated success that would positively reinforce their behavior and motivate them to continue learning. Skinner called his approach "programmed instruction."

Skinner and Pressey came to disagree strongly about the pedagogical strategies embedded in their respective machines. Skinner argued that Pressey's machine tested rather than taught (because it required students to answer multiple choice questions about things they had learned without the machine). Pressey considered Skinner's positive reinforcement approach too rigid and slow.

The two innovators did, however, each consistently claim that their respective approaches offered three advantages over standard school practices: Students would receive immediate feedback about their answers, work at their own pace, and benefit from more personal attention from their teachers.[10] Both Pressey and Skinner also assumed that a student's ability to provide the required response to a question demonstrated competency/mastery—and therefore "learning."[11]

Key Assumptions Underlying Personalized Learning

Contemporary personalized learning programs, as well as the digital platforms designed to implement them, often make the same claims as Pressey and Skinner and share their assumptions about competency/mastery and learning. "Personalized learning" itself, however, still has no generally agreed-upon explicit definition.[12] In the absence of a common definition, personalized learning advocates tend to point to broad goals and assert that their pedagogical approaches will meet the needs, strengths and interests of each learner. [13]

Common sense suggests that the term "personalized learning" implies a humane school and classroom environment and open, flexible teaching strategies. Such an environment allows the kind of experience that educator Alfie Kohn defines as "personal" learning—the result of a caring teacher working with each child "to create projects of intellectual discovery that reflect his or her unique needs and interests."[14] When New Hampshire redesigned its high schools in 2007 to create "learning communities," for example, its Department of Education's guiding principles emphasized this perspective on personalization to explain its focus on building relationships between students and adults.[15] Others emphasize such ideas as "meeting each student at their own level," challenging students with high expectations, in-

creasing students' agency over their learning, or addressing the needs of the "whole child."[16] Goals such as these, in combination with the real shortcomings of their schools, likely provide the motivation for many child-oriented educators and policymakers to consider revamping schools in favor of some personalized learning model.

The Bill and Melinda Gates Foundation has been the prime mover in the push for widespread adoption of personalized learning. In 2014, it provided funding for a group of organizations (Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, the Learning Accelerator, the Michael & Susan Dell Foundation, and Silicon Schools) to develop a contemporary "working definition" of personalized learning that could serve as a guide for implementing personalized learning in schools.[17] The resulting working definition identifies the following goals:

> Personalized learning seeks to accelerate student learning by tailoring the instructional environment—what, when, how and where students learn—to address the individual needs, skills and interests of each student. Students can take ownership of their own learning, while also developing deep, personal connections with each other, their teachers and other adults.[18]

Schools pursuing these goals are to implement four practices: providing students with regularly updated records of their individual strengths, needs, motivations, and goals; continually assessing students' progress toward their goals and giving them credit when they "demonstrate mastery"; holding students to clear, high expectations as each follows a customized path that responds and adapts to their individual learning progress, motivations and goals; and providing flexible learning environments that are driven by student needs (see Appendix A for full text of the working definition, including the questions provided to guide schools and districts as they develop and implement personalized learning).[19]

The Gates Foundation's working definition of personalized learning offers a tech-friendly vision of an individualized, data-heavy, mastery-based educational system. Because the Foundation funds and collaborates with multiple organizations that participate in framing personalized learning initiatives, its word carries particular weight. Not surprisingly, then, the Gates approach is arguably now the most widely used and influential base for personalized learning initiatives in the United States. However, research does not support the core recommended practices following from this rationale.[20]

Although on their face the assumptions appear child-centered, deeper analysis of them suggests that they are anything but.

Rather than building on what is known about teaching and learning, the Gates definition communicates a common-sense logic to educators and policymakers that emphasizes a need for continual data collection to enable competency-based learning. This common-sense logic, however, embeds a number of unstated assumptions about children, learning, assessment, and technology evident in the core recommended practices and guiding questions that decision-makers are encouraged to adopt. (Again, see Appendix A for the full text of the working definition). Although on their face the assumptions appear child-centered, deeper analysis of them suggests that they are anything but.

Assumptions about Children

The working definition assumes that children can and should each develop and articulate their own motivations and personal goals. This assumption is reflected in questions that imply that personalized learning ought to "support each student in understanding and articulating his/her interests and aspirations," "ensure that each student has a learning plan that takes into account his/her strengths, needs, motivations and goals," and "ask students to reflect on their progress and adjust their goals as necessary."[21] Having individual goals is important to children, the working definition assumes, because it will motivate them to follow their personal learning path. A further assumption is that as children make their way along their personal paths, they will require some, but not much, guidance. The thinking here is that when children have articulated their particular strengths, needs, motivations, and goals, and then been provided a personal learning path based on their individual characteristics, they will be eager and able to "take ownership" of their education. That is, they will automatically and independently follow the steps provided in the structured learning experiences and effectively incorporate feedback provided, ensuring their continual progress along the path. These assumptions are reflected in questions that focus users of the document on how they might "enable students to manage their own learning path" and "provide timely, actionable information and feedback to each student," their teachers, and their families.[22]

Finally, the working definition assumes that while children are individuals who may sometimes work in the same space and interact with one another, they will, for the most part, pursue their individual paths toward their individual goals. Although a few questions refer to helping students develop personal connections with others and to grouping them in order to "enable the varied learning experiences we hope to offer" or to "respond and adapt to [students'] changing needs," other questions imply the priority of each student following his or her "customized path" and "[maximizing] the time each student spends pursuing his/her goals."[23] In short, this model relies heavily on the assumption that children's primary interests and efforts are, and should be, focused primarily on themselves rather than on classroom or other communal interests and goals.

Assumptions about Learning and Knowledge

In relation to what it means to learn and to know, the working definition's central assumption is evident in its core practice of competency-based progression, in which "each student's progress toward clearly-defined goals is continuously assessed," and each student "advances and earns credit as soon as he/she demonstrates mastery. "[24] "Learning" is thus the acquisition, over time, of particular skills and information in a rational linear fashion (i.e., "competency-based progression"). At each point in their progression through the standards set for them, students build on previous abilities and information in order to continually attain more skills and more information—such acquisition serving as the implied definition of "knowledge."

To fully understand the assumptions in play here, it is important to understand the relation-

ships among standards, mastery, and competence. "Standards" are goals, or what students are expected to know and be able to do at specific stages of their education. "Mastery" refers to students' demonstration that they have acquired some information or attained some skill set. And "competence," finally, is a quality or state that arises from mastery of some set of standards, of having the capacity to function or develop in a particular way.[25] The assumption here is that when students successfully master standards building on others that came before, they demonstrate competency to perform a particular job or to undertake higher education. For example, a student who mastered multiple standards involved in writing essays, such as identifying grammatical errors, generating thesis statements, and structuring evidence, might be deemed competent in writing. Inevitably, however, this central assumption narrows pedagogical practices and curriculum because they must be limited to elements that can be both logically structured and measured (making them, not coincidentally, technology-friendly).

Assumptions about Assessment and Technology

Assessment, the Gates Foundation definition assumes, must be based on high expectations. In addition, it assumes that regular feedback, testing and data reporting are necessary to ensure children's continual progress, in part because of the assumption that repeated feedback from assessments will motivate children to keep moving along their personal learning paths. Whether they progress quickly or slowly through various assessments is thought to make no difference to their attainment of mastery status. These assumptions emerge in the definitions of "personal learning paths" and "competency based progression." Although each student's path is individualized, "all students are held to clear, high expectations": Students' individual "progress toward clearly defined goals is continually assessed" and students receive credit for having met goals as soon as they demonstrate mastery.[26] The assumptions are also evident in questions that focus on providing information and feedback to students, on capturing students' "current level of mastery" of various standards, and on highlighting gaps in each student's performance in order to define his or her individual needs. Ongoing assessment provides the information that ensures continual progress.

Although the Gates working definition of personalized learning mentions technology explicitly only once, in the context of providing children with "varied learning opportunities," it provides a congenial framework for advocating the increased use of digital technology in schools. For example, its call for "flexible learning environments" may involve redesigning classrooms away from desks in rows toward clustered seating, but it also easily translates into "anytime, anywhere learning" conducted via digital platforms.[27] More significantly, the need to collect, organize and report volumes of quantitative assessment data that is at the heart of "competency-based progression," "learner profiles," and "personal learning paths" clearly promotes the use of digital platforms. Indeed, the centrality of data collection in the Gates vision rests on assumptions about the inherent value of digital technology and its cost effectiveness, as well as the inherent value of gathering ever more quantitative data.

In other words, the Gates working definition of personalized learning promotes a regime of continuous assessment, recordkeeping, and feedback that relies on an ever-increasing

amount of quantitative data. And thus it establishes, without ever saying so explicitly, a default requirement to use digital technologies. Against this backdrop it is interesting to note that the guidance provided by Excel*in*Ed and Education Elements explicitly warns personalized learning advocates to avoid using words and phrases that might trigger parents' known concerns about implementing digital/online learning. Instead, the guidance advises: "Technology should be presented as a tool that can help enable personalized learning, especially at scale, but it cannot and will not ever replace teachers."[28]

Issues Raised by Tech-Centric Personalized Learning

The language in the Gates Foundation working definition and often heard from personalized learning advocates generally sounds progressive, child-centered, and inclusive of students with varying needs and interests. However, the vision embodied in the definition—of children as individuals on separate, parallel, predefined paths toward their individual goals—assumes that learning is best understood as a series of self-contained individual behaviors rather than a collaborative process engaged in by members of a learning community.[29] In general, the logic underlying the contemporary personalized learning movement has much more in common with the twentieth-century ideas related to programmed instruction than it does with the progressive approaches to education that their language evokes.

To understand the contradiction between the child-centered language of the working definition and the nature of the education implied in its logic, it is helpful to consider the different pedagogical implications of the terms "individual" and "person." Merriam-Webster defines "individual" as "a single human being as contrasted with a social group or institution" and "person" as "the personality of a human being: self."[30]

Although the two words are often used interchangeably, the subtle differences between them have pedagogical implications. Whereas "individuals" are valued only for being separate and unique, "persons" are different from one another but are recognized and valued because of their shared humanity and their shared motivation to create a meaningful life.[31] This distinction is apparent in the difference between, on the one hand, Skinner's "programmed instruction" that allows individuals to progress at their own pace, and on the other hand, by (among others) James Macdonald's person-oriented curriculum, Lorrie Shepard and her colleagues' emphasis on sociocultural approaches to teaching and assessment, and Alfie Kohn's progressive, child-centric approach to education.[32]

The latter approaches regard each child as a person whose development and growth derives from his or her unique interactions with the curriculum. In other words, they view children as subjects, with developing identities, each of whom engages with the curriculum and creates meaning from it in ways that no teacher or curriculum writer should presume to be able to predict or control. Because they understand children's learning to be much more than acquiring knowledge, they stress that any effort to measure learning in pre-specified, ordered, degrees actually undermines children's learning because it prevents them from creating meaning from their school experiences and stunts their development as persons.[33]

Shepard and her colleagues, for example, emphasize that students' cognitive development is entwined with the development of their social identities, including such aspects as their sense of self-efficacy and belonging and their ability to self-regulate. For this reason, Shepard et al. eschew standardized testing and standardized curricula in favor of formative assessments in the form of questions, tasks, and activities designed to help teachers better understand how their students are thinking and thereby determine how to best help them continue to create meaning from the curriculum.[34]

In contrast, Skinner's model treats children as isolated individuals whose learning is defined and controlled by a highly rationalized program of instruction.[35] To make the work pleasant and engaging and to move them through the instructional program, Skinner's approach provides students who provide the correct responses with regular external rewards, such as praise. Such positive reinforcement is used to prompt children to behave in ways that the programmer has defined for them as correct.[36] Whether or not what is learned means anything to students who move through this process is rarely if ever considered. Thus, although the behaviorist approach embedded in competency-based progression is characterized as "personalized," it is seen by many as profoundly impersonal.

Narrow Understanding of Children's Agency

As has been noted, implementing learner profiles, competency-based progression, personal learning paths, and flexible learning environments ostensibly allows students to take ownership of their learning, allowing them to accelerate their progress and to develop deep relationships with each other and their teachers. However, a deeper look at the definition suggests stunted student agency, no clear path to student-teacher relationships, and a goal of accelerated learning that may very well do more harm than good.

Specifically, the questions offered to guide implementation of what is described as "student-centered instructional models" actually suggest a top-down instructional model in which someone else (an undefined "we" in the working definition) determines important goals and decisions for students, while leaving them (and often their teachers as well) to make cosmetic choices such as when or where to do a given assignment or whether a grammar exercise will ask them about movies or dogs.[37] Children may find such choices inviting but they do not offer or provide them real agency, either in their intellectual development or in their lives more generally. These choices are neither "student-centered" nor "personalized" in any meaningful way.

Some specific examples demonstrate how the unknown "we" embodied in the Gates Foundation approach removes children's agency and effectively treats them as objects to be manipulated. With respect to competency-based progression, the working definition suggests that educators ask, "In what ways and how frequently might we assess each student's level of mastery within the dimensions that we believe are essential for his/her success?" With respect to learner profiles, it offers, "How might we capture each student's current level of mastery within each of the dimensions that we believe are essential for his/her success (e.g. academic standards, skills)? In what ways might we highlight a student's gaps to draw at-

tention to their individual needs?" The "needs," "gaps," and "standards" are all defined, not by or with the students, but by someone else. It is important to ask who that someone else might be. In practice it may be a commercial enterprise or trade organization rather than a teacher.[38] As noted earlier, the Gates working definition, while not explicitly referring to vendors, is built on assumptions congenial to the digital technology that third parties produce and sell to schools.

The purposeful-sounding goal of "accelerating" children's learning via competency-based progression implies that faster learning is possible and unquestionably desirable. This assumes that there is a defined set of knowledge to be transferred to students, and that when students have received that knowledge, their learning is complete. Alternative views understand children's learning as dynamic and their knowledge as deep, personal understanding developed in dialogue with their teachers and the curriculum.[39]

Even if learning could be accelerated, there are good reasons not to do it.[40] Children's development requires time. While rote learning of facts or the repetitive elements of basic skills may in some instances be sped up, such acceleration may prevent children from developing a contextual understanding of what they are learning. In other words, while children may quickly "master" the facts and skills defined in the standards set for them, it is quite possible that they will not have any real use for this type of mastery in real world situations. What they learn may be of little or no use to them—except perhaps to pass tests.[41] While contextualized learning encourages students to engage with the curriculum in a way that encourages their social agency, decontextualized learning is little more than performance, with no intrinsic value. Its value is simply a promise of possible future success ("college and career readiness") in the form of work and consumption.[42] The promise that what is being learned will be valuable in some distant tomorrow is not likely to be compelling to many students who already disengage from their education. And organizing content for which students see no use into "individual learning paths" is highly unlikely to make it more compelling to them.

Narrow Understanding of Learning

The assumption that acquiring a collection of small bits of discrete information and numerous discrete skills is the essence of learning necessarily tends to leave out of the educational picture anything that cannot be reduced to a quantifiably measurable standard. In contrast, most educators understand their role to include such complex goals as helping children learn to imagine alternative approaches and find creative solutions to problems, interpret information based on sound reasoning, develop their personal identity, use their knowledge in ways that are meaningful to them, and develop the interpersonal and social skills necessary to participate in and contribute to democratic civic life.[43]

In addition, human learning is often not sequential. Therefore, narrowing children's education to the acquisition of one skill, fragment of information, or concept after the other in a logical progression not only constrains their experiences, it undermines their ability to integrate what they have learned in real world situations (i.e., transfer of learning) and can

inhibit the achievement of broader educational goals.[44] Children can learn much more in school than predefined skills. They can learn to be part of a learning community in which academic knowledge, technical competence, social skills and personal identity are also developed in the context of genuine engagement with other people.[45] For example, children who learn about plant growth by cooperatively designing and cultivating a class garden and then eating the resulting fruits and vegetables have a vastly different learning experience than children who acquire information about photosynthesis from predetermined curricular materials—even if they learn those facts from an amusing, gamified educational application.

It is thus problematic to tacitly define important learning as acquiring facts and skills, and teaching as transmitting those facts and skills, assessing the transmission, and then transmitting still more—or going even further down this path by defining teaching as simply coaching students in the use of a computer program that takes over transmission of facts and assesses how well students remember them.

Narrow Understanding of Culture

The assumptions about children and learning inherent in the Gates Foundation's vision of personalized learning, and also therefore in platforms designed to implement its vision, are those of a largely young, largely white, and largely male technology industry culture.[46] As Skinner pointed out in a 1958 paper on "teaching machines," the programmer, not the machine, teaches the child.[47] This is not to say that young white men cannot be well-intended. Some may see only their own profit, some may see a lucrative education technology venture as a "win-win" for themselves and others, and some, no doubt, may identify with children and put children's interests foremost. Even with the best of intentions, however, they cannot help but have biases that they transmit to children via their programming. Foremost among them is "technological hubris"—an assumption that technology can and should "disrupt" and thereby revolutionize other domains in order to reproduce them in its image.[48]

Additionally, any other cultural biases that they may hold as white men may find their way into digital curricula, assessments, and machine learning algorithms, just as cultural bias can find its way into textbooks. That is, real human beings are creating these curricula, assessments, and algorithms, and their products reflect their values, assumptions, social positions, and interests. However, the products present themselves as transmitting "truth" or "fact," seemingly independent of any perspective on the part of their creators. As such, they do not allow students to recognize or question the content of the materials, or to interact with the party claiming to present truth.[49] Students' role is simply to "master" what is presented to them. Although textbooks and other analog curriculum materials suffer from this same problem, they lend themselves to public review in a way that digital curricula, assessments, and algorithms currently do not.

The dangers of relying on opaque algorithms to make consequential decisions about people's lives in such domains as employment, career advancement, health, credit, and education, have been explored by, for example, Cathy O'Neil, and Frank Pasquale.[50] Safiya Noble has shown how seemingly objective Google search algorithms perpetuate harmful stereotypes

about women and minorities.[51] These authors note that although algorithms are commonly thought of as purely mathematical and objective, in practice they are not. They reflect the myriad choices made by their developers and are thus value-laden and vulnerable to significant and difficult-to-correct error.[52]

The assumptions, perspectives, ideologies, and related social positions (in other words, the inescapable bias) of the creators of digital personalized learning software are concealed and thus impervious to review and critique. Significantly, the more sophisticated software becomes (i.e., the extent that it is adaptive and/or based in machine learning), the more profound and far-reaching the implications of the concealed bias become. All of these problems are compounded by a general lack of transparency with regard to the underlying assumptions and algorithms used.

Moreover, there is no clearly defined right for the public to review this information. RAND Corporation researchers have noted, for example, that algorithm designers make many design choices that may turn out to have far-reaching consequences. For this reason, they called both for diversity in the ranks of algorithm developers, to help alleviate the problem, and for regulation of algorithmic systems, because developer diversity alone cannot resolve the issue.[53] It follows that in order to minimize the possibility that digital platforms have built-in biases, their programming should be reviewed by a diverse group of third-party experts with a variety of perspectives.

The Role of Venture Capital

Hundreds of companies now offer platforms and software to address various aspects of schooling, and hundreds of investors are eager to partner with them.[54] Conferences such as those held by Reimagine Education and SXSW EDU encourage matchmaking between investors and startups.[55] The actual value of the industry is hard to pinpoint because not all investments are publicly reported, but there are enough data to provide rough estimates of the size of the market. The most recent report released by the Software and information Industry Association (SIIA) in 2014 valued the K-12 market for education software and digital content/resources at $8.38 billion.[56] Audrey Watters, an independent journalist who compiles records of investments reported in public sources such as *Education Week*, *EdSurge*, and *TechCrunch*, reports investments in products for the K-12 education technology sector that totaled over $4.5 billion in 2015-2018.[57] Her lists include nearly 600 products that supported by over 1500 investors since 2015.[58] Because Watters collects information from public sources and cannot possibly know every investment, her calculations are a rough and conservative estimate. Even so, they reach billions, providing a general indication of the immense scope of venture capital firms' investments. Watters finds that in 2017 and 2018, venture capitalists made an average of 16 investments in education technology each month. The median investment was $5.1 million, and the average size was $22.4 million, putting the average monthly investment at over $330 million.[59] Finally, the investment bank Berkery Noyes counted a total of 247 mergers and acquisitions in the K-12 education technology sector in 2015-2017. It reported the majority of these deals resulting from companies moving to strategically integrate their products or gain competitive advantage.[60] In short, there is a lot

of money to be made from widespread school adoption of personalized learning products.

The vast amounts of money invested in promoting digital education technologies by the Gates Foundation, Facebook and the Chan Zuckerberg Initiative, Google, and others has led to the creation of a tech-friendly narrative about their potential and their efficacy. To help justify the rapid and widespread adoption of digital technologies, advocacy organizations such as KnowledgeWorks and iNACOL retail a simplistic story about failing schools in need of a comprehensive digital upgrade. This "failing schools" argument is questionable, but it is pervasive, and has been repeatedly offered to justify privatizing reforms such as charter schools and school vouchers, as well as other school reforms. [61]

Countless companies offer platforms and software to address various aspects of schooling.[62] Many of those that have raised significant investment money (e.g., VIPKID, BYJU's) focus on the Chinese, Indian, or other international markets, and many products are geared for corporate (e.g., Absorb), individual (e.g., Coursera), or higher education (e.g., Degreed) uses.[63] Given the value of the K-12 market, however, some products whose primary market is elsewhere also offer a "for schools" version. For example, there is a "for schools" version of Duolingo, a language-teaching application.[64] Personalized learning products for North American K-12 schools are a subset of the many education technology products currently sold.

We can narrow the many offerings to three broad types of product marketed to the K-12 school market for personalizing learning. Such products can then be mapped onto the strategies the Gates Foundation identifies as central to the construct:

1. Those that focus on curriculum and instruction ("personal learning paths"), such as Nearpod (https://nearpod.com/), Houghton Mifflin Harcourt's Go Math! (www.hmhco.com/programs/go-math), Rosetta Stone's Lexia (www.lexialearning.com), Edgenuity's Hybridge and Courseware (www.edgenuity.com), and Odysseyware (www.odysseyware.com/).

2. Those that manage students and their learning ("learner profiles"), such as Canvas (https://www.canvaslms.com/), Schoology (www.schoology.com), Google Classroom (https://classroom.google.com/h), and Microsoft Teams (www.microsoft.com/en-us/education/products/teams).

3. Those that focus on assessments ("competency-based progression"), such as Pearson's Schoolnet (https://www.pearsonassessments.com/largescaleassessment/products-services/schoolnet.html#) and the Northwest Evaluation Association's (NWEA) Measures of Academic Progress (MAP) assessments (www.nwea.org/map-growth/).

These are, of course, overlapping categories, such that any company may provide a product that addresses multiple categories. Products such as Summit Public Schools' "Personalized Learning Platform," Pearson's "System for Learning and Assessment," and Houghton Mifflin Harcourt's "Personal Math Trainer Powered by Knewton" all make claims related to all three categories.[65]

Such products can often satisfy any one or more of the Gates Foundation goals: maintaining

and using learner profiles; providing support for students to create and follow their personal learning paths; implementing competency-based progression by assessing students' progress toward goals; allowing students to move at their own pace to receive credit for mastering goals; and supporting the creation of flexible learning environments. Because of the way the Gates Foundation definition describes the goals of personalized learning, any digital product offering some form of choice to children and collecting and recording data on their activities may satisfy one or more elements of a personalized learning approach.

Importantly, however, while a product may satisfy the requirements outlined in the Gates Foundation's working definition, it may still be educationally problematic in a variety of important ways. There may be problems related to the many assumptions described earlier about children and learning that underlie the concept of personalized learning itself. Problems may also be related to the collection, retention, and dissemination of data by digital platforms.

To illustrate characteristic problems and issues, we explored three digital personalized learning tools currently widely marketed and used in North American K-12 schools: Nearpod (a curriculum and instruction product), Canvas (a learning management product) and Pearson Schoolnet (an assessment product). These illustrate the types of products that have received heavy investment, have been aggressively promoted and praised, and are being widely adopted by North American schools. They also share marketing language and images that promise to personalize learning by providing teachers with extensive data "in real time." Teachers are told that these products will make learning for their students more engaging and effective because they deliver material in a medium (a digital platform) that children expect and enjoy and that provides them with agency over their own learning. Appendix B contains detailed analysis of these products; the implications of our analysis are discussed below.

Threats Posed by Tech-Centric Personalized Learning

The implementation of personalized learning via digital platforms raises several significant concerns as it outsources decisions about pedagogy and curriculum to unknown programmers. In doing so, it allows opaque algorithms to generate consequential educational decisions and hands over key school and teacher functions to third-party technology vendors. These features create a situation in which: the reality of the digital educational process belies advocates' pervasive rhetoric; the technology disables or sidelines professional teachers; students and teachers lose privacy as data is collected and sold; and, public education effectively becomes privatized education as control moves away from local education professionals to assorted business interests.

The Contradiction Between Rhetoric and Reality

Within the personal learning rationale, the bedrock promotional assertion that children are individuals who should each be appropriately challenged in school and be able to learn about

things that interest them has much to commend it. Indeed, it has guided the work of many thoughtful educators for over a hundred years. However, the reality of forcing all children to learn via technology-mediated relationships with their teachers and to learn in compliance with the requirements imposed by a platform's programming contradicts the rhetoric of personalizing education as responding to children's unique needs and interests. In other words, forcing all children to learn the same way via digital means, with constant focus on assessment data and "mastery" as the definition of learning, can reasonably be seen as the opposite of personalizing. The reality is that the only choices actually given to children—such as the order in which they tackle certain topics, how long they choose to work on this or that lesson on a given day, when they choose to take an assessment, or where they do their work—are trivial. They serve not to meet children's individual needs and interests, but rather to help camouflage and promote a uniform, tech-centric approach to education.

Disabling of Professional Teachers

Another concern, independent of core concerns about competency-based progression as a pedagogical approach, comes from another disconnect between rhetoric and reality. While automated grading and record-keeping are promoted as ways to decrease drudgery and increase teacher time with students, tech-centric systems actually do less to improve teachers' interactions with students than they do to impede or marginalize the teacher's role. For example, teachers may be unable to see how their students earned the designation of mastery of a goal because in some applications, the software, not the teacher, determines the questions asked and the grades assigned. This is true, for example, in corporate-sponsored financial education courses produced by Everfi, which are offered free to schools across the U.S. and which include a statewide middle school program developed with and funded by officials in Colorado (Colorado Kids MoneyWi$er™).[66] In this system and others like it, teachers are told whether an individual child has passed or failed an assessment—but they receive no information on how the evaluation was done. And when students take an Everfi quiz, the software reports to teachers the percentage of answers each student answered correctly for each unit, but not which questions the students answered correctly or incorrectly.

And in the case of Summit Learning's "Personalized Learning Plan," students can take assessments until they provide the correct answer. What students do not have to demonstrate is that they have interacted with the program in any meaningful way, and students have reported looking up answers on their computers while taking assessments.[67] The weekly 10 minutes the program allocates for a teacher to talk with individual students about their learning is not enough for teachers to determine what a student does or does not understand, much less to respond in any meaningful way.

In situations like these, teachers are forced to assume that students know "enough" of whatever the product's developers have determined is required. This makes it impossible for teachers to use the machine-generated assessments to inform teaching decisions. Of course, in adaptive learning situations in which the product's algorithm makes the teaching decisions, the teacher is removed from this equation entirely. In other blended-learning scenarios, such as those Nearpod and Pearson provide, teachers can modify vendor-provided

lessons, including the assessment questions. This is certainly preferable to teachers having no control, but it means that teachers must spend a significant amount of time amending someone else's lessons and assessment questions instead of creating their own lessons or interacting with children directly. Despite such concerns, the ease with which prefabricated assessments can be administered and graded increases the likelihood that teachers will increasingly turn to them.

In general, the common sense logic evident in advocacy rhetoric promoting these products and systems ("Less drudgery!" "More one-on-one time with students!") has a surface validity that encourages educators to increasingly rely on them to the exclusion of other options that may be more costly, time-consuming, or cumbersome. This is not necessarily good news for students.

Loss of Student and Teacher Privacy

Digital platforms that provide curriculum and assessment collect extensive information about students as they learn. The typical platforms examined in this brief—popular platforms that have been heavily promoted and adopted throughout North American schools—raise serious concerns about the amounts of data collected from unwitting children and teachers. These concerns include how such information can be adequately protected and what providers do with the information collected.

Recently, students attending Brooklyn's Secondary School for Journalism eloquently challenged Mark Zuckerberg about the collection of their data: "Summit collects too much of our personal information, and discloses this to 19 other corporations. What gives you this right, and why weren't we asked about this before you and Summit invaded our privacy in this way?"[68] And yet, in the face of such intrusion, Elana Zeide, a UCLA privacy expert, told *NYmag* that Summit's privacy agreements are "about as strong as anyone could hope for." This is troubling, given that Summit collects student and parent names and email addresses; student ID numbers, attendance, suspension and expulsion records, disabilities, gender, race, ethnicity and socioeconomic status, date of birth, teacher observations of behavior, grade promotion or retention, test scores, IB and AP test information, college admissions, survey responses, homework assignments, and information about extracurricular activities. Summit also plans to track students' college attendance and career paths after they graduate from high school—for purposes it neither reveals nor, in some cases, has yet identified.[69]

Our own exploration of platform privacy policies found vague disclosures of the uses for vast amounts of information collected from children and teachers. Instructure uses the information collected from Canvas, for example, to improve websites, apps, and services, and to "personalize and improve" users' experience with the platform."[70] Like Summit, Canvas connects children to third-party sites (such as YouTube) that collect data for advertising purposes, and it denies responsibility for any use a third party might make of children's or teachers' data. Companies may share aggregated and de-identified data without notice to users, despite evidence that such de-identified data is easily re-identified.[71] Pearson's Schoolnet is designed to collect and hold data on every assessment children take in their

classes and for district and state testing purposes, with no published privacy policy for parents to evaluate. How data collected by these digital platforms may be used in the future is unknown.

We do have some hint, however, of the extent of the possibilities. Companies using predictive analytics are already collecting and combining data from assorted sources (including insurance claims, digital health records, housing records, and personal information about a person's friends, family and roommates) for use in algorithms that produce "risk scores" to identify individuals at risk of opioid addiction or overdose.[72] These scores are sold to doctors, insurers and hospitals to be used in their decision-making.

It is important to note that big data algorithms do not have to connect the nature of the input data and the type of inference drawn. Children's choices of school projects, or their progress toward mastery of particular skills, or how many times a day they access their school dashboard, are all food for these algorithms, the specific details of which are trade secrets protected from review. The quantified, seemingly neutral and objective inferences that emerge at the end of the data-crunching process are also beyond review. These inferences may be used most directly in educational settings, where they make a longitudinal case about students as they progress through their schooling, to be used to sort and sift them over time.[73] They may also, as we see in the case of risk scores, be sold and used to make cases about them in very different settings—all of which are to the financial benefit of people other than themselves.

That the information is collected at all, even if companies do not use it for ill, makes it available for theft.

Although technology companies are subject to the Family Educational Rights and Privacy Act (FERPA), Children's Online Privacy Protection Act (COPPA), and the (voluntary) Student Privacy Pledge in their use of children's data, they are rarely, if ever, held to account. The Federal Trade Commission never responded to a December 2015 complaint in which the Electronic Frontier Foundation accused Google of violating the Student Privacy Pledge by mining students' browsing data and other information and using it for the company's purposes.[74] Additionally, a November 2018 audit found not only a two-year backlog in the Department of Education's Privacy Office's processing of FERPA complaints, but also that the Privacy Office is unable to resolve many of the complaints because of "significant control weaknesses" and unresolved policy questions about FERPA.[75]

That the information is collected at all, even if companies do not use it for ill, makes it available for theft. EdTech Strategies, a cybersecurity consulting firm, has documented 442 cybersecurity incidents in U.S. public schools since January 2016.[76] And in September 2018, the Federal Bureau of Investigation (FBI) published a public service announcement warning that the "widespread collection of sensitive information by EdTech could present unique exploitation opportunities for criminals," and that education technology connected to the internet could facilitate criminals' access to data collected from children by their devices.[77] Although the FBI's warning contained a few modest recommendations for districts and families, it made no recommendations related to education technology companies and increased data security, nor did the FBI suggest that schools reduce their use of digital education technologies.

Privatizing Education Via Digital Application

As noted above, digital personalized learning platforms do not appear to work as advertised to serve individual students well or to provide teachers with more time to develop close relationships with students. Instead, among their other accomplishments is a stealthy transfer of education from public sources to private interests. The more educational tasks these programs assume, the more that consequential educational decision-making is transferred from transparent public sources to self-interested private corporations, the unknown developers who work for them, and the opaque algorithms that these developers write. Because the algorithms that drive personalized learning products are legally protected as trade secrets, they are not available for public scrutiny—unlike school board meetings or textbooks. Nor are the processes that yield their outputs open for examination and discussion in parent-teacher meetings—unlike decisions made by teachers. As digital platforms reduce the information available to the public, parents, and students, however, they increase the information available to the corporations who provide them for a wide variety of corporate—not public—interests.

Weak Research Base

In the narrative advanced by personalized learning advocates and the tech industry, U.S. schools are failing, and only substantial widespread change can improve their performance. Therefore, since personalized learning aspires to create significant change, it should be implemented in schools.[78] Advocates argue that digital platforms are not only the logical modern means of providing personalized learning, but also that real personalization requires them to supplant the outdated "factory method" of education. Only such platforms, advocates say, can allow students to set their own pace as they master the "21st century skills" necessary for college and career success after graduation.[79]

But in fact, the "factory method" comparison is a straw man.[80] Many schools not identified as personalized learning schools have approaches that not only allow students to discuss their learning progress and goals with their teachers, but also enable teachers to use high-quality curricula, tailor instruction to student needs, and regularly document students' strengths, weaknesses, and goals.[81] However disingenuous it may be, the technology narrative has been effectively deployed to help frame how the general public, policymakers, parents, and educators view personalized learning and the digital technology that supports it.[82] It does so despite the lack of evidence to support the claims that personalized learning and/or digital technologies are superior to current school practices.[83]

A number of reports have claimed to provide evidence of personalized learning's efficacy, but actual research support is weak.[84] Importantly, studies that examine personalized learning find that the pedagogical techniques used in settings not called "personalized" or "competency-based" overlap with those used in "personalized" settings.[85] Despite claims that personalized learning enhances "21st century skills," such as creativity, collaboration, and communication, such skills are difficult to define and measure; moreover, they do not substantially differ from skills emphasized in other educational settings.[86] Research does

not convincingly support broad claims that personalized learning improves student competencies any more than other types of pedagogical approaches.[87]

Michael Barbour's analysis of blended learning provides a thoughtful summary of the state of current research knowledge: although blended learning may have potential in certain circumstances, in general the current research base does not provide any guidance for the field; also, it is teachers, not technology, that likely play a fundamental role in students' success in blended settings.[88] In other words, when blended learning situations are successful, it is likely because of teachers and not technology.

The RAND Corporation has specifically tried to examine the effectiveness of Gates-defined personal learning practices (learner profiles, personal learning paths, competency-based progression, and flexible learning environments) by assessing performance in Gates-funded schools that use Gates strategies to varying degrees.[89] Although advocates regularly cite reports of this research project as support for personalized learning, its results may be best interpreted as consistent with Barbour's conclusions about the role of teachers. While there were some effects on academic achievement—students in the participating schools showed greater growth in math and reading scores on the Northwest Evaluation Association's (NWEA) Measures of Academic Progress (MAP) assessment than the national average, and more than 50% of the students from these schools showed greater growth than "virtual students" created to serve as comparison standards—the researchers could not confidently point to personalized learning as the cause of any differences.[90]

In fact, it is not surprising that the schools studied showed student growth above national norms, given that the Gates Foundation had identified them as having strong leadership and vision and so had provided special support to them during the time of the RAND study. Moreover, the implementation of personalized learning strategies varied widely among the schools. The most common practices implemented were practices also used in "traditional" education settings, especially providing time for individual tutoring, advising, and extra help.[91] Although the researchers explored the data for suggestions of which practices might be associated with stronger test scores, too few schools could be included in the analysis for researchers to confidently draw conclusions about the impact of the various elements of personalized learning.[92] There is not, then, even in the report most often cited by personalized learning advocates, research evidence that supports the widespread adoption of personalized learning programs.

Conclusion and Recommendations

The questionable assumptions embedded in the most influential personalized learning products, the self-interested advocacy of the technology industry and threats to student privacy, along with the lack of research support, should give pause to policymakers and district- and school-level decision-makers who are considering implementing personalized learning.

Despite many red flags, pressure to adopt personalized learning continues to mount. The RAND Corporation, for example, published a 2018 paper offering schools strategies for how

to implement personalized learning despite the weak evidence for its efficacy.[93] And states are increasingly adopting policies that support the use of digital instructional materials.[94]

Our analysis suggests that, rhetoric notwithstanding, the personalized learning agenda is now for the most part dominated by a restricted, data-centric, hyper-rational approach to curriculum and pedagogy that limits students' agency, narrows what they can learn in school, and limits the ability of schools to respond effectively to a diverse array of students. Further, for-profit entities are promoting a multitude of personalized learning offerings that tend to privatize consequential educational decision-making, compromise children and teachers' privacy, and distort pedagogy in ways that stifle students' learning and their ability to grow as people and as participants in a democratic system.

It is therefore recommended that schools and policymakers pause in their efforts to promote and implement personalized learning until rigorous review, oversight, and enforcement mechanisms are established. With regard to data gathered and or stored by digital means, it is recommended that states establish an independent governmental entity that has the responsibility for implementing and enforcing the following recommendations:

- Require that program curriculum materials be externally reviewed and approved by independent third-party education experts.
- Require that pedagogical approaches be externally reviewed and approved by independent third-party education experts to ensure that the approaches are appropriate for intended student populations.
- Require that both the validity of assessment instruments and the instructional and programmatic usefulness of data generated be independently certified by independent third-party education experts.
- Require that the assumptions and programming of all algorithms associated with personalized learning materials be reviewed and approved by independent third-party education experts *before* any processes employing the algorithms are implemented.
- Develop—and require that all entities that collect student, teacher, and other data through personalized learning materials and related software platforms be subject to—a standard, legally binding, transparent privacy and data security agreement that:
    - Requires the entity collecting data to disclose its financial interests and business relationships as well as any potential commercial implications of data collection;
    - Vests the ownership of any and all data collected on a student with the student or the adult(s) legally responsible for the student;
    - Prohibits the entity collecting data from collecting any data not directly relevant to an agreed-upon specified educational purpose and from using any data collected for any purpose other than the agreed-upon specified educational purpose;
    - Makes the entity collecting data legally responsible for protecting the security of

data if data are shared with a third party;

- Requires that the entity referring students to a third party be legally responsible for ensuring the security of any data the third party may collect from the students referred;
- Requires the entity collecting data to provide a legally enforceable data agreement that clearly explains what kinds of data it proposes to collect from children under 13, how it proposes to store the data and for how long, who will be allowed access, and what educational purpose all data will serve;
- Requires a standard, explicit, and easy to understand explanation of what kind of data use is incorporated in such activities as "improving" websites, apps, or services, or in "personalizing and improving" users' experience with the platform.

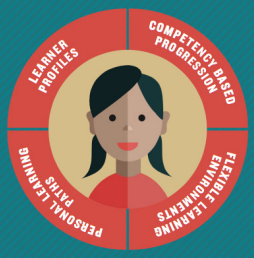
Appendix A: Gates Foundation's "Working Definition" of Personalized Learning

A WORKING DEFINITION OF PERSONALIZED LEARNING

Personalized learning seeks to accelerate student learning by tailoring the instructional environment—what, when, how and where students learn —to address the individual needs, skills and interests of each student. Students can take ownership of their own learning, while also developing deep, personal connections with each other, their teachers and other adults.

GETTING STARTED

This is a working definition of personalized learning that is intended as a tool to help educators design student-centered instructional models. These attributes and tactics were developed from the practices of a number of leading schools. They are grouped together to offer a comprehensive view of the possible. No one school fully employs each of these today. Start where you want and progress from there.



LEARNER PROFILES

Each student has an up-to-date record of his/her individual strengths, needs, motivations and goals.

STRENGTHS & NEEDS	How might we capture each student's current level of mastery within each of the dimensions that we believe are essential for his/her success (e.g. academic standards, skills)? In what ways might we highlight a student's gaps to draw attention to their individual needs?
MOTIVATIONS	How might we support each student in understanding and articulating his/her interests and aspirations?
GOALS	How might we support each student in setting personalized goals within each dimension that we believe is essential for his/her success? In what ways and how frequently might we ask students to reflect on their progress and adjust their goals accordingly?
INFORMATION & FEEDBACK	In what ways and how frequently might we provide timely, actionable information and feedback to each student? How might we also provide that information to their teachers and families?

PERSONAL LEARNING PATHS

All students are held to clear, high expectations, but each student follows a customized path that responds and adapts based on his/her individual learning progress, motivations and goals.

PERSONALIZED LEARNING PLANS	How might we ensure that each student has a learning plan that takes into account his/her strengths, needs, motivations and goals? How might a student's plan respond and adapt to his/her changing needs?
VARIED LEARNING EXPERIENCES (MODALITIES)	What types of experiences (e.g. complex tasks, experiential learning) might our students need to achieve their goals? What are the ideal modalities (e.g. small group instruction, one-on-one tutoring, online learning) to deliver these experiences?
STUDENT OWNERSHIP	In what ways might we enable students to develop and manage their own learning path?

COMPETENCY BASED PROGRESSION

Each student's progress toward clearly-defined goals is continually assessed. A student advances and earns credit as soon as he/she demonstrates mastery.

ONGOING ASSESSMENT	In what ways and how frequently might we assess each student's level of mastery within the dimensions that we believe are essential for his/her success?
INDIVIDUAL ADVANCEMENT	How might we enable an individual student to pursue new learning experiences as soon as he/she has mastered the prerequisite content? How might students attain course credit based on mastery?

FLEXIBLE LEARNING ENVIRONMENTS

Student needs drive the design of the learning environment. All operational elements—staffing plans, space utilization and time allocation—respond and adapt to support students in achieving their goals.

OPERATIONAL ALIGNMENT	How might we deliver all of the learning experiences that our students need, with the resources we have available? How might we build flexibility into our design to enable us to respond and adapt to changing student needs?
STAFFING & ROLES	In what ways might we structure teacher and other educator roles to support our instructional vision? How might we build flexibility into these roles to enable our staff to respond and adapt to changing student needs?
SPACE UTILIZATION	How might we design our physical space to support our instructional vision? Might we use spaces beyond our walls, and if so, how?
TIME ALLOCATION	In what ways might we maximize the time each student spends pursuing his/her goals? How might our student and staff schedules respond and adapt to changing student needs?
GROUPING & CONNECTIONS	How might we group students to enable the varied learning experiences we hope to offer? How might the way we group students respond and adapt to their changing needs? In what ways might we facilitate personal connections between students, and between students and adults?

Developed by The Bill & Melinda Gates Foundation, Afton Partners, The Eli & Edythe Broad Foundation, CEE Trust, The Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, The Michael & Susan Dell Foundation, Silicon Schools, and educators across the United States. Funding provided by the Bill & Melinda Gates Foundation.

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GROUPING & CONNECTIONS	How might we group students to enable the varied learning experiences we hope to offer? How might the way we group students respond and adapt to their changing needs? In what ways might we facilitate personal connections between students, and between students and adults?

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Appendix B: Analysis of a Sample of Personalized Learning Products

The sample products we examine below—one each in the areas of curriculum and instruction, learning management, and assessment—are popular, heavily funded, and promoted in North American schools. For each product we offer first a summary analysis and then a more detailed interrogation of how it meets the goals outlined in the Gates Foundation definition of personalized learning.

Curriculum and Instruction—Nearpod[95]

Produced by: Nearpod

Summary

Nearpod raised $30.7 million in venture capital funding between 2013 and 2017.[96] It provides web-based multimedia presentations for children in a variety of school subject areas. It offers a wide variety of content (including many lessons in primary academic subjects), provides tools for teachers to upload, augment, and share their own content. Teachers can obtain free accounts and some free content, but the free offerings are minimal compared with content and features available to teachers if they or their district buy a membership.[97]

Nearpod is popular with teachers. It received a five-star review from teachers at Common Sense Media, and was included in Common Sense Media's list of "Essential Back-to-School Tools for Teachers" in the "Presentation and Video" category.[98] Reviews at Common Sense Media suggest that teachers appreciate personalizing features that encourage participation by shy students, who might be less likely to raise their hand in a more traditional type of lesson.[99] Teachers can upload a slide show they created in PowerPoint and then embellish it with instructions for students to pair for conversation, "draw," or answer questions or quizzes. With an upgraded, paid membership, teachers can also add content from the internet or from Nearpod's "virtual class trips" (which are, basically, Google Earth views of various locations). Students follow and participate in lessons on their own devices. Nearpod provides teachers with a view of all students' responses as they are entered, and with a report following the lesson so that they have a record of student activity during class. Although self-pacing is typically lauded by personalized learning advocates, several teachers expressed unease with it in their reviews. They thought it created too much chaos in the classroom and preferred to control the pace of the lessons.[100]

If teachers like and want the increased use of personal devices in class that use of Nearpod necessarily entails, these features may add some desirable functionality when they create their own lessons through the platform. Nearpod's pre-prepared lessons, however, may be sponsored (and so include marketing); quizzes may provide invalid measurements of learning; and, the activities incorporated into lessons may not be valuable, interesting, or engaging. Our review of several pre-prepared lessons found them to be of doubtful quality.[101]

To the extent that teachers adopt its pre-prepared lessons, Nearpod limits what they do and what "learning" means. For example, a mind-numbing 8th grade lesson on "Friendships, Communication, and Problem Solving," available for purchase for $4.99, devotes a full 10 of 28 slides to quizzing students on the difference between acquaintances, casual friends, and close friends.[102] A representative slide contains the following:

> Penelope is an old friend from school. You talk to her daily and see her once a month. Mason is a friend from work. You don't know much about him. Austin is a neighbor. You wave at each other every time you leave for work. Who is a close friend?

(Answer options are Penelope, Mason, and Austin). The "reflection" slide at the end of the lesson asks students to report how they feel about friendship, communication, and problem solving: are they "a pro," "need more practice," or "confused"? Should children answer that they are "a pro," because the lesson did not include anything they did not already know, or should they answer "confused" because it did not offer them any useful information? Either way, it is likely that students will quietly satisfice in order to get through the lesson and move on. It is hard to divine what teachers are supposed to conclude from the assessment questions, and whether correct answers imply any development in students' thoughts about friendship. Presumably, teachers would not use this lesson at all or would substantially edit it—but if that is the case, they must waste a lot of time examining it, and other lessons like it, in order to find something worth using.

Although Nearpod does not meaningfully personalize instruction, it does collect, retain, and disseminate data about teacher and student use of the platform. Three privacy-related documents detail how Nearpod uses and shares information, and any teachers concerned about their own or their students' privacy must review all three.[103] The privacy policy is explicit but confusing:

> The Nearpod account owner is the owner of any data, including student Content, submitted through the Nearpod Materials. Nearpod retains a perpetual, irrevocable, worldwide, sublicensable and transferable right to use, publish, display, modify and copy anonymized Content. For the avoidance of doubt, such anonymized Content shall not include any personally identifiable information.[104]

In other words, the platform does not intentionally collect personally identifying information from children (teachers are the "members"), but it may use, publish, display, modify and copy content created by both children and their teachers.

Nearpod retains content (including anonymous student content) as long as teachers maintain their accounts, or as long as provided for in the contract with the district. It shares the email addresses of its members (teachers) with Facebook and participates in Facebook.com's Custom Audience program. This enables Nearpod to display personalized ads to teachers on Facebook; it also opens teachers to whatever other use Facebook may make of their email addresses.[105] It shares teachers' personal information with Appnexus, Google AdWords, Hotjar, LinkedIn and Twitter. Teachers concerned about their privacy must opt out of each

of these default disclosures individually, with no guarantee of success.[106]

That teachers may sign up for and use Nearpod with their classes outside of a district contract means that they may bypass any district oversight of student privacy that may exist and use the product on their own. Nearpod's partnership with the popular learning management system, Canvas, further facilitates teachers' use of this product.

Links to Gates Foundation Working Definition

1. **"Learner Profiles"**

Definition: *Each student has an up-to-date record of his/her individual strengths, needs, motivations and goals.*[107]

- Does the product provide students with the record of strengths, needs, motivations and goals? If so, how? If not, what record does it provide, and to whom?

It does not provide students with records. It provides the teacher with student responses to quizzes and other activities embedded in the lessons. Teachers can choose to share this information with the class or with administrators. If the district has a contract, the lessons and student content may automatically be shared with administrators. Teachers can also voluntarily share lessons and reports of student content with administrators, colleagues, parents, and students.

- How is the information provided used? And to what effect?

Seeing student content during the time of the lesson can help teachers assess student understanding/response, stimulate student activity, group work and class discussion, and assess the effectiveness of the lesson. The report of student content after the lesson can, again, help teachers assess student understanding/response and the effectiveness of the lesson. It can also help teachers decide how to differentiate instruction. The usefulness of the information depends on how teachers use the product (e.g., whether they create their own or use pre-prepared lessons; whether they let students pace themselves through the digital slideshow or use it as the frame for a lesson they walk the class through; whether the information provided is useful, and to what extent; and whether they rely on it for subsequent differentiation of instruction). If the information is shared with administrators, it may be useful in teacher evaluation.

Note: Although the reports of student content that Nearpod provides can be valuable to teachers, it is not at all a "record of strengths, needs, motivations and goals."

- Is child and teacher privacy protected? How?

Theoretically, sharing of lessons and of student information is under the control of the teacher. Nearpod is a signatory to the Student Privacy Pledge.[108] Nearpod's privacy policy is explicit but confusing:

> *The Nearpod account owner is the owner of any data, including student Content, submitted through the Nearpod Materials. Nearpod retains a perpetual, irrevocable, worldwide, sublicensable and transferable right to use, publish, display, modify and*

> *copy anonymized Content. For the avoidance of doubt, such anonymized Content shall not include any personally identifiable information.*[109]

In other words, teachers are advised not to associate real student names with student content. Presumably, content they upload (in the form of lessons they create) is also subject to Nearpod's right to use, publish, display, modify, and copy. Teachers concerned about their own or their students' privacy must review three lengthy privacy-related documents, and opt out individually from each of the advertising networks with which the product cooperates, with no guarantee that opt-out will be successful.[110]

Nearpod retains content (including student content) as long as teachers maintain their account, or as long as provided for in the contract with the district.

2. **"Personalized learning paths"**

Definition: *All students are held to clear, high expectations, but each student follows a customized path that responds and adapts based on his/her individual learning progress, motivations and goals.*

- How does the product operationalize the idea of a "personalized learning path"?

Teachers may implement some semblance of a "personalized learning path" by allowing for students to work through a lesson at their own pace. This is personalized only in terms of how quickly and when they do it. Teachers may also assign subsets of students to work through different lessons, thereby differentiating instruction.[111] *Students draw pictures and answer questions (including "reflection" questions) as part of the slide show; it would be a stretch to call this activity a "personalized learning path."*[112]

- How does the product adapt the path to correspond to the student's individual progress, motivation, and goals? How does it know what those are?

It does not—teachers are responsible for knowing those and for figuring out how they might adapt the product accordingly.

- How does the product hold the child to clear, high expectations?

It does not. Teachers are responsible for setting all expectations.

- How does the product balance the tension between externally defined expectations and the child's motivation and goals?

Nearpod does not address expectations, motivations, or goals.

- Does the product increase children's motivation/"engagement"? How?

It is possible that children enjoy digitally presented lessons, although that may be an effect of novelty when the product is new (i.e., it can get tedious, too). Teacher comments noted that children unlikely to participate in a group setting are more likely to participate when they can privately communicate their responses to the teacher from their devices.[113]

- How much of the "personalization" relies on the teacher?

Personalization is completely dependent on how teachers use the product.

3. **"Competency-based progression"**

Definition: *Each student's progress toward clearly defined goals is continually assessed. A student advances and earns credit as soon as he/she demonstrates mastery.*[114]

- How does the product assess student progress?

Nearpod does not assess student progress. It provides data on children's performance on quizzes, and shows other student input during the class, but does not analyze them.

- How is "mastery" defined?

Mastery is not defined.

- How responsible is the product itself for determining what "progress" means; alternatively, to what extent does it provide teachers with information for them to evaluate?

The product provides teachers with information to evaluate. In pre-prepared lessons, it provides quiz questions and determines right or wrong answers.

- Does the product keep students' data? What does it do with it?

Yes, it retains student content as unidentified as long as the teacher doesn't include real names. The company retains a "perpetual, irrevocable, worldwide, sublicensable and transferable right to use, publish, display, modify and copy anonymized Content."

4. **"Flexible learning environments"**

Definition: *Student needs drive the design of the learning environment. All operational elements—staffing plans, space utilization and time allocation—respond and adapt to support students in achieving their goals.*[115]

- How does the product contribute to flexibility of the staffing plans, space utilization, and time allocation that are part of the learning environment?

Students watch the presentation on their own devices. Theoretically (and perhaps this happens in higher grades, if the teacher has a paid membership that allows for students to progress individually through lessons) this means that a teacher can provide the child with a code and they can do it "anywhere, anytime."

- How does any increased flexibility in the learning environment enhance learning?

It is not clear that it does enhance learning, compared to doing the lesson in class, guided by the teacher.

- How does it contribute to students' progress toward their personal goals?

It is not clear that it does enhance students' progress toward their personal goals, as compared to doing the lesson in class, guided by the teacher.

5. **What are the unintended consequences of using the product?**

- To what extent does using the product increase the surveillance of children and teachers?

Teacher and student content may be surveilled by school/district administration. Nearpod

retains a right to hold and use the content for its own purposes. It claims not to use content for advertising purposes, but it does share data with ad networks for advertising purposes, and it uses information collected for product development.

- Does the product unintentionally contribute to a narrowing of learning?

This depends on how much teachers create and control the lessons and the data collected, and what they do with both the lessons and the data. Ideally, teachers constantly revise their lessons, tying them to student interests, current events, and other happenings in the classroom. That kind of revision is inhibited especially when they used pre-prepared lessons they download from Nearpod. Nearpod's prepared lessons also contain quizzes, students' answers to which teachers may be misled to consider as valid measurement of learning.

- Does the product socialize children to device use?

Yes.

Learning Management—Canvas[116]

Produced by: Instructure

Summary

Instructure, the company that produces Canvas, raised $89.1 million from investors between 2010 and 2015.[117] According to the Software and Information Industry Association, which awarded Canvas its 2018 CODiE Award for "Best K-12 Course or Learning Management Solution," Canvas is the fastest growing learning management solution (LMS) in K-12.[118] Its number 10 rank in the Lea(R)n Platform's Ed Tech Top 40 is consistent with that claim: According to Lea(R)n's analysis, 37% of users in schools across the country access Canvas from school computers, the most for a paid product (Google Classroom, which requires no monetary outlay, is the most accessed LMS, with 64% of users in the study accessing it).[119] Canvas is popular largely because it is easy to adopt and to use, and it interfaces easily with other applications and systems.[120]

Canvas promotes personalized learning within the platform by allowing teachers: to organize content so that students can progress at an accelerated rate; to include formative assessments; to implement collaboration between and among students; and to include "mastery paths" that allow teachers to differentiate assignments based on results of initial individual assessments.[121] Because children can always access Canvas from their own devices, the platform does allow flexibility in where and when learning can occur. "What if" grades allow children to predict their grades on assignments, which may (or may not) increase children's motivation and engagement. However, it is worth noting that without the platform, children could also receive differentiated assignments from their teachers, collaborate with their classmates, take formative assessments, do their homework at different times and places, and predict their grades.

Canvas's ability to interact with other applications and systems and its partnerships with other companies facilitate teachers' use of additional education technology products, such as Nearpod, PlayPosit (an interactive video application) or Badgr (which awards children digital badges of mastery that can be exported as evidence of what they "know" or can do) after working through modules.[122] Although we have not reviewed all the products that Canvas promotes, our review of Nearpod suggests that their value as teaching tools cannot be assumed.

Canvas makes several aspects of teaching much easier for teachers. It can automatically grade and record certain assessments, and it allows teachers to organize many aspects of their work in one easily accessed location. The more that teachers use the system for various tasks (communicating with students and parents; using digital assessments; and entering lessons into the system), the more they come to rely on it. And, not surprisingly, Canvas encourages teachers to use technology still more, serving as a hub providing access to its many partnerships.

The privacy policy of Instructure (Canvas's parent company) raises several red flags. Among these, it is particularly troubling that Instructure takes no responsibility for the many third-party providers with whom it works. Its privacy policy notes that third-party partners may, for example, place Flash cookies on users' devices and thereby track browsing activity and display personalized advertising. Rather than accept responsibility for such activities of third-party partners, Instructure assigns users the practically impossible task of researching their privacy policies.

Other red flags concern how much and what kind of data Instructure collects, how long it is stored, and how widely it is shared. And, the company policy does not make explicit how the company handles children's data compared to adult data. As a signatory to the Student Privacy Pledge, the company does promise not to target advertisements to students based on their online behavior.[123] However, according to the privacy policy, whenever users visit the website, use apps, or access their Canvas accounts, Instructure collects and stores a variety of information that may link to personally identifying information: Collected data includes browser type, operating system, Internet Protocol (IP) address, domain name, date and time, searches run and search results. In addition, when Canvas sends emails to users, web beacons record whether users open or act on those emails.

Instructure claims to use personal information to improve its website, apps, and services, and to "personalize and improve" users' experience with the platform."[124] But, the privacy policy notes that the company "may also share de-identified and/or aggregated data with others for their own uses." In other words, for its own purposes as well as for those of its partners, Instructure gathers, retains and shares significant amounts of information about children and adults using its products. Ample evidence demonstrates, however, that de-identified information is easily re-identified.[125] And even without any explicit re-identification, such detailed information is valuable to companies hoping to increase profits by analyzing how, when and where children (and perhaps their parents) use platforms.[126]

Links to Gates Foundation Working Definition

1. **"Learner Profiles"**

Definition: *Each student has an up-to-date record of his/her individual strengths, needs, motivations and goals.*[127]

- Does the product provide students with the record of strengths, needs, motivations and goals? If so, how? If not, what record does it provide, and to whom?

No. The product provides a framework in which teachers can manage students' assignments, homework, and grades. It does provide a running record of students' accomplishments (i.e., the assignments they have completed and the grades and feedback they received) and a record of what they have been assigned to do.

- How is the information provided used? And to what effect?

Using the Canvas system, teachers assign work to students, students upload their work to the platform, and teachers review and grade it. Canvas interacts with many other products that provide such features as assessments, "smart" pens, videos, videoconferencing, badges, and more.[128] *Teachers or schools can choose to use these products via the Canvas interface.*

- Is child and teacher privacy protected? How?

Canvas accounts are password-protected, and Instructure is a signatory to the Student Privacy Pledge.[129] *However, its privacy policy does not explicitly address child users.*[130] *Close reading of the privacy policy reveals that whenever users visit the website, use apps, or access their Canvas accounts, Instructure collects a variety of information that it stores and may link to personally identifying information. The collected data includes browser type, operating system, Internet Protocol (IP) address, domain name, date and time, searches run and search results. When Canvas sends emails to users, web beacons record whether they open or act on those emails. Third-party partners may place Flash cookies on users' devices and thereby track browsing activity and display personalized advertising. Instructure takes no responsibility for tracking and advertising by these third-party partners (it advises users to research third-party privacy policies). Among the ways Instructure claims to use personal information are to improve its website, apps, and services, and to "personalize and improve" users' experience with the platform."*[131]

The privacy policy also notes that if Instructure shares information about users in connection with "any merger, financing, acquisition, bankruptcy, dissolution, transaction or proceeding involving sale, transfer, divestiture or disclosure of all or a portion of our business or assets to another company"—which it may do—it will post a notice that users may find on its website.[132] *And finally, it "may also share de-identified and/or aggregated data with others for their own uses." In other words, Instructure gathers, retains, uses, and shares significant amounts of information about how and when users use the its products, both for its own use and the use of its partners.*

2. **"Personalized learning paths"**

Definition: *All students are held to clear, high expectations, but each student follows a customized path that responds and adapts based on his/her individual learning progress,*

motivations and goals.

- How does the product operationalize the idea of a "personalized learning path"?

Aspects of a "personalized learning path" are options for teachers to use in Canvas: Teachers can organize content such that students can progress at an accelerated rate; they can add formative assessments; they can facilitate group collaboration between students; and they can assign "mastery paths" that include differentiated assignments.[133]

- How does the product adapt the path to correspond to the student's individual progress, motivation, and goals? How does it know what those are?

The product itself is not adaptive, but teachers can use information collected by the product (i.e., student assignments, performance on assessments) to differentiate assignments. To use the "Mastery Path" feature, teachers program grade ranges for an initial assignment that would lead to students being assigned different "mastery paths." Once students are assigned to a given path, they receive the assignments their teacher associated with that particular path, in the order that the teacher specifies. Each assignment in the path opens for the student when they complete the prior assignment to the teacher's satisfaction.

- How does the product hold the child to clear, high expectations?

The product itself does not hold expectations for the child. It provides a digital context in which teachers may communicate their expectations to children.

- How does the product balance the tension between externally defined expectations and the child's motivation and goals?

The product itself does not; it provides a digital framework in which teachers communicate expectations (via, for example, assignments, syllabi, and messages).

- Does the product increase children's motivation/"engagement"? How?

Children's motivations and goals are not reported within the product. It does, however, have a feature called "What-if Grades," allowing students to enter their expected grades on assignments and in a course and later compare them to actual grades.[134] *How exactly students use this feature to increase their motivation is unclear and likely varies based on how it is implemented.*

- How much of the "personalization" relies on the teacher?

Personalization is fully dependent on how the teacher uses the array of features and partnerships associated with the platform.

3. "**Competency-based progression**"

Definition: *Each student's progress toward clearly defined goals is continually assessed. A student advances and earns credit as soon as he/she demonstrates mastery.*[135]

- How does the product assess student progress?

Canvas can automatically grade some work; other work requires teachers to manually grade.

Teachers conduct actual assessment of student progress. Canvas provides them a platform through which they can see students' collection of work and grades.

- How is "mastery" defined?

Mastery is defined by the teacher.

- How responsible is the product itself for determining what "progress" means; alternatively, to what extent does it provide teachers with information for them to evaluate?

It provides teachers with information to evaluate.

- Does the product keep students' data? What does it do with it?

Yes, the product holds the information, using it as indicated above.

4. **"Flexible learning environments"**

Definition: *Student needs drive the design of the learning environment. All operational elements—staffing plans, space utilization and time allocation—respond and adapt to support students in achieving their goals.*[136]

- How does the product contribute to flexibility of the staffing plans, space utilization, and time allocation that are part of the learning environment?

Teachers and students can access Canvas from their own devices, anywhere. Teachers and students can take work home (as they always have), but through Canvas they have access to everything that is posted on the platform when they leave the school building. Students can move around the classroom with their devices to work in groups, something that they have traditionally been able to do without devices.

- How does any increased flexibility in the learning environment enhance learning?

It does not; what is enhanced is the ability of students to work from their devices.

- How does it contribute to students' progress toward their personal goals?

It does not; students can do their work "anywhere, anytime," but (a) they always could, and (b) progressing in their work is not the same as progressing "toward their personal goals."

5. **What are the unintended consequences of using the product?**

- To what extent does using the product increase the surveillance of children and teachers?

To the extent that records are available to administrators and others to see, surveillance is increased. The retention of the details of student work over years also increases the level of possible "back surveillance": at any point a teacher, administrator, or others with access can review retained student assignments or teacher comments.

Canvas automatically collects and stores a wide variety of use information about users, that it may link with personally identifiable information and that its parent company may use for a variety of purposes.

One of Canvas' selling points is its partnerships with many third-party providers.[137] Instructure does not take responsibility for the privacy of data shared with third parties; instead, its privacy policy puts the onus on users to explore and understand the privacy policies of third parties. For example, the policy notes,

> *Third party partners who provide certain features on our websites, such as videos, may place Flash cookies on your device. They may use Flash cookies to track your Web browsing activity and to display personalized advertising… We do not control the privacy practices of the third parties who place or track Flash cookies and this privacy policy does not cover their practices. You should visit the privacy policies of companies who place Flash cookies to understand their practices.[138]*

Canvas's parent company, Instructure, is a signatory to the Student Privacy Pledge.[139]

- Does the product unintentionally contribute to a narrowing of learning?

Canvas makes many aspects of teaching and classroom management easier for teachers and students. By doing so, however, it may funnel teachers toward the choices that make their lives easier (such as giving exams that can be automatically graded by the platform, or doing virtual, rather than live, labs) or toward using products like Nearpod available through Canvas, thereby increasing use of devices and the narrowing of learning that comes with it. Similarly, it may funnel students toward choices that are easier for them (and that make use of a business partner's digital product, such as preparing a digital presentation on a research project instead of producing a physical project), narrowing their scope of experience.

- Does the product socialize children to device use?

Yes. Canvas's interoperability is designed to encourage more use of the platform by allowing teachers and children to conduct ever more aspects of their work within it. The more that children use their devices in school, the more they come to expect technology as an integral part of their educational experience. When teachers promote the use of the platform and associated products, children are likely to assume that using them is benign.

Assessment—Pearson Schoolnet[140]

Produced by: Pearson Education

Summary

Pearson Education, Inc. is the largest testing vendor in the United States. More than half of the total tests administered in the United States are now digital, Pearson CEO John Fallon told *Education Week* in March 2018, and Pearson's market share in digital testing is greater than 35 percent.[141] The company is well-positioned, given its history as an assessment provider, to take advantage of the way in which continual assessment is integral to most conceptualizations of personalized learning. Although Pearson still offers non-digital products, it maintains that ultimately, "Technology makes personalized learning possible," and so its personalizing products are delivered either completely or partially digitally.[142] Assessment, not surprisingly, is at the core of all offerings. The plethora of products marketed by Pearson

exceeds the scope of our discussion, so we will focus on Schoolnet, an assessment product used in 190 districts and four U.S. states (according to Pearson, by more than 6.2 million students).[143]

Schoolnet is geared toward district adoption, to encourage and help districts use assessment data as the basis of their educational mission. It promises flexible assessments to "drive personalized learning" by combining assessment, reporting, and instructional management tools within the same platform.[144] Although Schoolnet provides extensive data and data organization, its personalization does not yet extend to automating decisions about student learning (i.e., via adaptive software). Instead, it provides a framework for collecting, storing, and analyzing student data, including providing a space for students to upload an individual learning plan and additional work that allows them to demonstrate mastery and helps their teachers differentiate their instruction.[145] Schoolnet can be used for district and state assessments and also for classroom-level assessments created by teachers.

Schoolnet is especially efficient when it is used in conjunction with TestNav, Pearson's digital testing platform, because the combination of products allows for the system to immediately grade tests and upload grades to student profiles. Although teachers can manually upload grades for open-ended questions they generate themselves, the comparative ease with which closed-ended questions can be copied from a resource bank to a test, and grades for them assigned and uploaded, may encourage teachers to prefer closed- to open-ended questions.

Marketing materials for Schoolnet focus on the important role to be played by data in facilitating personalized learning: By providing students access to data on such things as test results, attendance, discipline, their individual learning plan, and additional work, the platform theoretically facilitates their motivation and ability to set goals and "own" their education.[146] In other words, Schoolnet's ostensible value is two-fold: it enables teachers to use data to personalize teaching to students' different needs, and it enables students to set their own goals, determine their progress toward those goals, and motivate themselves along the way.

The value of having more and more data is assumed: marketing materials emphasize the significance of having all different kinds of data easily accessible in one location.[147] However, several questions arise about the assumed value of data. In particular, it is unclear how teachers, students, and administrators are to assess the validity of the available data, how teachers should use it to personalize their teaching, and whether students are willing and able to use the data to facilitate their learning.

Links to Gates Foundation Working Definition

1. **"Learner Profiles"**

Definition: *Each student has an up-to-date record of his/her individual strengths, needs, motivations and goals*.[148]

- Does the product provide students with the record of strengths, needs, motivations and

goals? If so, how? If not, what record does it provide, and to whom?

The product provides students with a "student workspace" to which they can upload work that supplements testing. Each student has a profile linked to the school's student information system (SIS). This connection to the SIS allows the profile to show teachers and administrators the following kinds of data about each student in a single dashboard: student overview, standardized tests, growth reports, enrollment and academic record, programs, learning plan and teacher notes, disciplinary incidents, benchmark tests, classroom tests, and interventions. Of these items, districts can choose to allow students to view their academic record, individualized learning plan, classroom test results, standardized test results, and benchmark assessment results for the current school year.[149]

- How is the information provided used? And to what effect?

The student workspace is intended to allow students the opportunity to upload work that demonstrates performance and mastery in ways other than testing. Teachers can also use that space to assign work or comment on work that students have posted. Generally, the student profile is the basic data element that teachers can use to evaluate overall student performance. Flexibility in report format means that student data can be compiled into many different kinds of reports for teachers and administrators to use in a variety of ways including lesson planning, student and teacher evaluations, and school and district decision-making.

Note: Although the student profiles and reports that Schoolnet provides can be valuable to teachers, they are primarily records and reports of test results. In that sense it does provide a record of "strengths," to the extent that successful test results can be interpreted as such. It is not, however, a record of "needs, motivations and goals."

- Is child and teacher privacy protected? How?

Pearson is not a signatory to the Student Privacy Pledge.[150] *We could find no public information about a privacy policy for Schoolnet.*[151] *It negotiates terms and conditions with each state and district separately, and the only way to know which policies are in place for a given district is to get the information from the district.*[152] *A notice "About Schoolnet" posted by Denver Public Schools (DPS) is an example of such an agreement.*[153]

The privacy portion of the DPS notice describes Schoolnet's data collection and use. The policy is of limited use because few details and explanations are provided: It notes that Schoolnet collects information about user visits to its website via cookies and that it aggregates this information and uses it anonymously. It does not explain what kinds of information it collects (Instructure's more detailed policy, in contrast, specifies that it collects such information as device identifiers, how often users visit the site, the pages they visit, and which sites they visited prior to an Instructure site). In the notice, Schoolnet claims to provide only necessary information to companies it hires to provide some of its services and prohibits those companies from using that information for purposes other than for which they are contracted. However, it notes that Schoolnet also links to other sites, and denies responsibility for any practices or content associated with those sites, including their privacy practices. It claims that "Schoolnet strictly protects the security of your personal information and honors your choices for its intended use. We carefully protect your data from loss, misuse, unauthorized access or disclosure, alteration, or destruction." It is unclear how Schoolnet knows and honors users' choices for the use of their data.

2. **"Personalized learning paths"**

Definition: *All students are held to clear, high expectations, but each student follows a customized path that responds and adapts based on his/her individual learning progress, motivations and goals.*

- How does the product operationalize the idea of a "personalized learning path"?

Each student's profile contains a place for teachers to designate a learning plan, although the content of a learning plan is not specified. If the district chooses, students may view their learning plans in their dashboards.

- How does the product adapt the path to correspond to the student's individual progress, motivation, and goals? How does it know what those are?

It does not. Teachers are responsible for knowing how students are doing and adapting paths accordingly.

- How does the product hold the child to clear, high expectations?

It does not. Teachers, schools, and districts are responsible for setting all expectations. Schoolnet is adopted at the district level, and is intended to be used at the teacher, school, and district levels.

- How does the product balance the tension between externally defined expectations and the child's motivation and goals?

Schoolnet does not address children's motivations or goals. It provides assessment data and analyses of those data, for teachers and administrators to use in determining whether students are mastering standards and what instructional modifications might help them do so.

- Does the product increase children's motivation/"engagement"? How?

Ostensibly, by viewing information in their student profile, students "can take control to learn more about the areas in which they need assistance."[154] How this is accomplished is unspecified.

- How much of the "personalization" relies on the teacher?

Personalization is completely dependent on how teachers use the product.

3. "**Competency-based progression**"

Definition: *Each student's progress toward clearly defined goals is continually assessed. A student advances and earns credit as soon as he/she demonstrates mastery.[155]*

- How does the product assess student progress?

Teachers and administrators can access reports of analyses of student performance on assessments. Schoolnet features a wide variety of analyses that teachers and administrators can conduct on students' performance. Although the product allows for teachers to upload tests that contain open-ended questions for class-level testing, students' responses to open-ended questions do not lend themselves to the variety of analyses that the product

offers.

- How is "mastery" defined?

Mastery is defined based on standards used by each district (i.e., usually state standards).

- How responsible is the product itself for determining what "progress" means; alternatively, to what extent does it provide teachers with information for them to evaluate?

The product provides teachers with information to evaluate.

- Does the product keep students' data? What does it do with it?

Yes, it retains student data. It is not clear how long data is retained, or how it is disposed of.

4. "**Flexible learning environments**"

Definition: *Student needs drive the design of the learning environment. All operational elements—staffing plans, space utilization and time allocation—respond and adapt to support students in achieving their goals.*[156]

- How does the product contribute to flexibility of the staffing plans, space utilization, and time allocation that are part of the learning environment?

The product does not contribute to these types of flexibility.

- How does any increased flexibility in the learning environment enhance learning?

n/a

- How does it contribute to students' progress toward their personal goals?

Ostensibly, students can use data about themselves to which they are given access (i.e., a subset of the data collected from them) to measure their progress toward their goals. Depending on what the district allows, students may see their academic record, individualized learning plan, classroom test results, standardized test results, and benchmark assessment results for the current school year.[157]

5. **What are the unintended consequences of using the product?**

- To what extent to using the product increase the surveillance of children and teachers?

Student profiles are fully accessible to teachers and administrators and are retained year after year. The product conducts analyses on the information in the profiles for use in evaluating student and teacher performance.

- Does the product unintentionally contribute to a narrowing of learning?

The product is designed to help districts, schools, and teachers design instruction based on data collected about students' performance on assessments (i.e., which ostensibly measure their mastery of standards). "Learning" is defined as mastery in this system.

- Does the product socialize children to device use?

The product provides for digital administration and scoring of tests. To the extent that districts, schools, and teachers use this feature, it does socialize children to device use. Schoolnet uses Pearson's online test delivery platform, TestNav, to deliver benchmark testing. In districts in states that administer Partnership for Assessment of Readiness for College and Careers (PARCC) high-stakes tests, which are also delivered via TestNav, students are able to get used to the testing environment as well as to test content if they do their benchmark testing online. This feature encourages districts in the few remaining "PARCC states" to use Schoolnet's online testing feature.

Appendix C: Promoting Digital Personalized Learning

The tech industry vision of personalized digital learning stands to benefit the bottom line of major corporations, education technology entrepreneurs, and investors.[158] It is unlikely to benefit schools or students, however, as the movement toward digitalization removes from schools and educators significant decisions about how learning is defined and how that definition shapes curriculum and assessment. The discussion below explores the influence of three major advocates: the Bill and Melinda Gates Foundation, the Chan Zuckerberg Initiative/Facebook, and Google.

Bill and Melinda Gates Foundation

As detailed above, the Gates Foundation funds efforts to define what educators and policymakers understand personalized learning to be. It also funds many of the organizations that promote personalized learning, the research used to support it, and many of the efforts to implement it. Sometimes Gates Foundation funding is transparent. Sometimes it is less obvious, as in the case of Project Unicorn, an effort to promote "data interoperability" (the process of sharing information between data systems[159]). Nine of Project Unicorn's 16-member steering committee received funding from the foundation.[160]

The Gates Foundation awarded its first grants "to support personalized learning environments where all students achieve" in the early 2000s. Early on it awarded $6,336,481 (2003) to Communities in Schools in Georgia, "to establish small, personalized, high achievement secondary schools known as Performance Learning Centers."[161] More recently it has awarded $5,000,000 (2016) to the University of Kentucky Research Foundation "to support system-wide shifts, working with both state and local levels, around the implementation of the Common Core, and the adoption of personalized and deeper learning strategies"; $850,000 (2017) to the North American Council for Online Learning, "to educate school leaders and policymakers on how personalized, competency-based education models can help all students, especially under-served students, to be college and career-ready;" and $376,000 (2017) to MindWires Consulting

> to increase knowledge in the postsecondary and higher education community around research-validated innovations in personalized learning (high quality digital courseware) to increase broad awareness of these innovations as well as to encourage greater usage of more appropriate terminology to describe these efforts.[162]

Additional grants promote coding education, blended learning, adaptive learning, and standards-based learning (i.e. the Common Core curriculum). Since 2007, the Gates Foundation has given over $35 million to Summit Public Schools, a charter school chain that has developed a digital personalized learning program that was marketed across the United States. This funding supported a range of activities, from general conference support to implementation of Summit's personalized learning program "in targeted geographies."[163]

In recent years and in some of its grant work, the Gates Foundation has collaborated with

the Chan Zuckerberg Initiative (CZI). CZI is poised in coming years to overtake the Gates Foundation spending to promote personalized learning.[164]

Chan Zuckerberg Initiative (CZI)/Facebook

Facebook supports personalized learning both directly and indirectly, via Mark Zuckerberg's fortune.[165] For example, Facebook contributed employees to develop Summit Public Schools Personalized Learning Platform. In addition, the Chan Zuckerberg initiative (CZI) continues to provide support for Summit Learning, although neither Summit nor CZI publishes the dollar amount of that support.[166] Summit currently claims to provide its program to over 380 schools involving more than 72,000 students and 3,800 educators throughout the United States.[167] In October 2018, Summit Learning announced a new nonprofit organization to operate the company beginning in the 2019-2020 school year. Board members include both Priscilla Chan and Peggy Alford, CZI's Chief Financial Officer and its Head of Operations.

Less directly, Mark Zuckerberg has also distributed money via several linked organizations subject to limited reporting requirements: the Chan Zuckerberg Initiative (CZI), Zuckerberg Education Ventures, Startup:Education, and a donor-advised fund at the Silicon Valley Community Foundation for which Startup:Education is a supporting organization.[168] The Chan Zuckerberg Initiative (CZI) is the mechanism by which the others are organized,[169] quite likely because as a Limited Liability Company (LLC), CZI can make charitable donations, for-profit investments, and political contributions; it can also engage in lobbying activities.[170] Although it is impossible to independently verify the claim, CZI claims it has not made any political contributions. It has, however, invested in for-profit companies, both directly and indirectly through donations to the New Schools Venture Fund.[171] Beneficiaries of these investments include: BYJU's (an Indian platform which provides digital learning content); Panorama Education (which provides surveys and data analytics for schools, particularly to implement social and emotional learning programs); MasteryConnect (which provides a competency-based learning platform); and Ellevation (which provides software providing data management for English language learners).[172]

According to *Chalkbeat*, CZI makes many of its donations through the donor-advised fund at the Silicon Valley Community Foundation, to which Chan and Zuckerberg have given stock worth some $1.75 billion. In September 2018, CZI told *Chalkbeat* that it had made $308 million in education grants since January 2016. It provided details of 19 grants, accounting for about one-third of the total $308 million. Among these grants were $10 million to LEAP Innovations and $4 million to Chicago Public Schools to support personalized learning instructional models; $7 million to Turnaround for Children to bring "new knowledge to the field about how to effectively implement and integrate tools to help achieve personalization of learning for all students"; and $6 million to New Profit to "build capacity and evidence" in personalized learning.[173] Other grants that provide indirect support for and promotion of personalized learning initiatives were $8 million to EducationSuperHighway to increase the internet connectivity of classrooms across the U.S., $775,000 to Lindsay Unified School District to advance the district's performance-based system, and $700,000 to *EdSurge* for a research project to "explore how school communities across the country are changing to

meet the needs of all learners."[174] It provided $400,000 to the Council of Chief State School Officers (CCSSO) for personalized-learning-related initiatives and $3 million to Chiefs for Change for a "transforming schools and systems workgroup."[175] Chiefs for Change is an advocacy group representing a smaller group of state education officials than CCSSO. In addition to supporting such education reforms as Common Core State Standards, using test scores to evaluate teachers, and expanding charter schools, it has advocated for states to expand digital learning in public schools.[176]

CZI's funding of personalized learning initiatives is guided by the view that personalized learning includes "social-emotional and interpersonal skills, mental and physical health, and a child's confident progress toward a sense of purpose."[177] CZI's interest in companies such as Panorama Education that measure children's mindsets, attitudes, and feelings is consistent with this understanding of the scope of personalized learning technology. The LLC's orientation toward personalized learning, which provides justification for the collection and analysis of intimate information about children, echoes Mr. Zuckerberg's approach to Facebook. The Facebook platform gathers information that allows it to effectively target advertising to children based on, among other things, its assessments of their feelings of insecurity and worthlessness.[178]

Overall, because of the tax laws governing limited liability corporations and donor-advised funds, there is little transparency regarding how Mark Zuckerberg is using his money to influence education.[179] Unlike major foundations, including the Gates Foundation, the Chan Zuckerberg Initiative typically does not list its grants publically. This lack of transparency is particularly problematic given Zuckerberg's stated intention to transfer 99 percent of his Facebook stock to the organization, and that as an LLC, CZI can move money in and out, such that the lines between "for-profit" and "non-profit" are completely obscured. It is also problematic because under the auspices of the LLC, he can easily use tax-free dollars to provide himself with investment opportunities. This, of course, raises questions about the extent to which Mark Zuckerberg is attempting to use the Chan Zuckerberg initiative to shape education policy in ways that further enrich him.

Google

Although its approach differs from Facebook and CZI, Google's role is equally opaque. As the dominant provider of technology to schools, Google has placed itself in a position to promote both itself and personalized learning to children as well as education decision-makers; to collect terabytes of data from children as they do their schoolwork; and to socialize children in behaviors that benefit the corporation.[180] Like Facebook, Google contributes to organizations that promote personalized learning, such as Digital Promise and CK-12.[181] In its own promotions, Google tends to avoid referring to "personalized learning" as such, but rather promotes buzzwords currently associated with personalized learning, such as innovation, efficiency, and student "ownership" of their learning.[182]

Google's strategy has been to get its easy-to-use free and inexpensive products into as many classrooms as possible, to be the go-to provider of hardware and software for every need a

class may have.[183] This strategy of providing free digital product to schools in order to accustom children to branded digital environments recalls Apple's donations of Apple II computers to schools in the 1980s and Microsoft's donations of software in the 1990s and early 2000s.[184] As the platform of choice, Google is positioned to sell additional services to schools and districts already using its basic services, and to funnel students and school personnel to its additional, general-use products, such as YouTube and search.[185]

Over half the mobile devices shipped to schools are Google Chromebooks, making them the devices most used in schools to provide student internet access.[186] Additionally, schools can and do use Google's free platforms without purchasing Chromebooks: A Google spokesperson told the *New York Times* in May 2017 that more than 30 million of the approximately 49 million elementary and secondary school children in the U.S. use a Google educational app in school, and that approximately 15 million students use Google Classroom specifically.[187] Though Google requires that G-Suite be adopted at the school administrative level, Google Classroom may be adopted by individual teachers.[188]

When schools sign up for G-Suite for Education, their users gain access to a variety of Google products, including Gmail, Google Calendar, Google Docs (word processing software), Google Drive (file storing and sharing platform) Google Sheets (spreadsheet software), Google Slides (presentation software), and Google Forms (survey design software).[189] Chrome Sync synchronizes bookmarks, history, passwords, and other settings across children's devices where they are signed in to Google's browser, Chrome.[190]

Using Google Classroom, the classroom management platform component of G-Suite for Education, teachers can create, collect, and grade assignments; students can view and submit assignments and receive grades. Google Classroom ranks #4 in the Lea(R)n Platform's 2018 "Ed Tech Top 40," a study of the education technology applications most accessed in schools: 64 percent of all users studied accessed Google Classroom.[191] Other Google products that may be used with or without Google Classroom took the top three rankings in this analysis: Google Docs ranked #1, with 8 percent of users accessing it; Google Drive ranked #2, with 78 percent of users accessing it; and YouTube ranked #3, with 74 percent of users accessing it. Significantly, Google does not include YouTube as a "core" application in G-Suite for Education, so unlike other "core" applications, YouTube contains ads and collects information from users about both their school-related and private use of the app.[192]

Google collects massive amounts of data about children from both its core G-Suite for Education products (such as Google Classroom, Docs, and Drive) as they do their schoolwork and as their teachers organize their classes. Data includes: hardware models, operating system versions, unique device identifiers, mobile network information (including children's phone numbers), log information (including details about how children used the service, device event information, and Internet Protocol (IP) addresses, location information, unique application numbers (such as application version number), and cookies or similar technologies that collect and store information about the browser or device, such as their preferred language and other settings. While Google claims not to use this information to target students with advertising, it fails to specify how it does use the information.[193] Further, students are encouraged before they graduate from high school to maintain a history of their work by

transferring the contents of their school Google account to a personal Google account.[194] When they do, the transferred material becomes subject to Google's general privacy policy.[195]

Children's school-related use of Google's general-use products like YouTube and search intensifies the threat to their privacy already inherent in educational platforms. In a 2018 complaint submitted to the Federal Trade Commission (FTC), child privacy advocates noted that YouTube's privacy policy allows for collection of information including geolocation, mobile telephone numbers, and persistent identifiers such as unique device identifiers.[196] Such data allows YouTube (i.e., Google) to identify users over time and across different websites or online services. Because YouTube does not have a separate privacy policy for children, such data is collected from them as well as adults, as children access YouTube via G-Suite for Education. If YouTube knowingly collects this information from children under the age of 13 and uses it to target advertisements without giving notice or obtaining advanced, verifiable parental consent, it is violating the Children's Online Privacy Protection Act (COPPA)."[197] The FTC has not responded to the advocates' complaint.[198]

There is little public understanding of how Google, its partners, or its clients may use the information it collects, either now or in the future, to manipulate children and cultivate them as current and future consumers.[199] Google is, first and foremost, a multinational advertising agency whose business is based upon collecting data from users and selling it to advertisers for the purposes of conducting targeted marketing. In December 2018, the *Missouri Education Watchdog* reported that elementary and middle school students had been served ads for sex and prescription drugs while logged into their G-Suite accounts.[200]

Google is notorious for collecting data from children and then either apologizing about it when caught and/or being opaque about the uses to which the data are put.[201] In October, 2018, for example, the *Wall Street Journal* revealed that Google had known for six months, but had not revealed, that since 2015 its Google+ platform had exposed the names, email addresses, occupations, genders and ages of hundreds of thousands of users—including school users.[202]

Because Google's public statements make assurances of what it does not do rather than transparently reveal what it does do with the data it collects from children, there is much that the public does not know.[203] We do know, however, that its strategies of offering low-price hardware and free educational platforms to schools have put an enormous amount of data from millions of schoolchildren into the company's hands, and that its advertising business can only benefit from increased adoption of personalized learning approaches that call for extensive data collection from children. It is not, of course, the only company that stands to profit.

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Shepard, L.A. (in press). Assessment for classroom teaching and learning. In M.J. Feuer, A. Berman, & J.W. Pellegrino (Eds.), *The ANNALS of the American Academy of Political and Social Science*;

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Skinner, B.F. (1958, October 24). Teaching machines. *Science, 128* (3330), 969-977. Retrieved November 21, 2018, from https://www.jstor.org/stable/1755240?seq=1#page_scan_tab_contents

33 Kohn, A. (2001, September 26). Beware of the standards, not just the tests. *Education Week*. Retrieved March 18, 2019, from https://www.edweek.org/ew/articles/2001/09/26/04kohn.h21.html;

Macdonald, J.B. (1966). The person in the curriculum. In H.F. Robison (Ed.), *Precedents and promise in the curriculum field*. New York, NY: Teachers College Press. Reprinted in *Urban Review*, *8*(3), 191–201 (1975, September);

Shepard, L.A., Penuel, W.R., & Pelegrino, J.W. (2018). Using learning and motivation theories to coherently link formative assessment, grading practices, and large-scale assessment. *Educational Measurement, 37*(1), 21-34.

See also:

Saltman, K.J. (2018). *The swindle of innovative educational finance* (pp. 1-23). Minneapolis, MN: University of Minnesota Press.

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35 Skinner, B.F. (1958, October 24). Teaching machines. *Science, 128* (3330), 969-977. Retrieved November 21, 2018, from https://www.jstor.org/stable/1755240?seq=1#page_scan_tab_contents

36 Skinner, B.F. (1958, October 24). Teaching machines. *Science, 128* (3330), 969-977. Retrieved November 21, 2018, from https://www.jstor.org/stable/1755240?seq=1#page_scan_tab_contents

37 This is why Peter Greene notes that in many implementations, personalized learning is really "personalized pacing." See:

Greene, P. (2018, November 5). When is personalized learning not actually personalized learning? *Forbes*. Retrieved November 9, 2018, from https://www.forbes.com/sites/petergreene/2018/11/05/when-is-personalized-learning-not-actually-personalized-learning/#17fc07c331b7

A middle schooler we spoke to was tickled by being able to pick her favorite cartoon, movie, and TV shows in the app No Red Ink, so that they would later show up in the questions the program provided for her.

Jackson, D. (2018, March 14). Personal communication (in person) with Faith Boninger. (Name changed to protect the student's identity)

38 For examples, see:

Aurora Public Schools (n.d.). *Digital badge program: Endorsers* [webpage]. Retrieved November 29, 2018, from https://sites.google.com/aurorak12.org/badge-endorsers/endorsed-badges;

Jump$tart Coalition for Personal Financial Literacy (2017). *National standards in K-12 personal finance education, 4th edition* (2nd printing, 2017). Author. Retrieved November 29, 2018, from https://3yxm0a3wf-gvh5wbo7lvyyl13-wpengine.netdna-ssl.com/wp-content/uploads/2018/01/2017_NationalStandardsBook.pdf;

International Society for Technology in Education (ISTE) (2018). *ISTE standards for students*. Author. Retrieved November 29, 2018, from https://www.iste.org/standards/for-students

39 See, for example:

Macdonald, J.B. (1966). The person in the curriculum. In H.F. Robison (Ed.), *Precedents and promise in the curriculum field*. New York, NY: Teachers College Press. Reprinted in *Urban Review*, *8*(3), 191–201 (1975, September);

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40 See, for example:

Macdonald, J.B. (1966). The person in the curriculum. In H.F. Robison (Ed.), *Precedents and promise in the curriculum field*. New York, NY: Teachers College Press. Reprinted in *Urban Review*, *8*(3), 191–201 (1975, September).

41 For a review of the challenges inherent in teaching thinking and the transfer of learning, and the importance of classroom and school environments, see:

Molnar, A., Boninger, F., & Fogarty, J. (2011). *The educational cost of schoolhouse commercialism--The fourteenth annual report on schoolhouse commercializing trends: 2010-2011* (pp. 6-7). Boulder, CO: National Education Policy Center. Retrieved November 21, 2018, from http://nepc.colorado.edu/publication/school-house-commercialism-2011

Recent findings show that computer use can inhibit learning and memory:

Mueller, P.A. & Oppenheimer, D.M. (2014, May 22). The pen is mightier than the keyboard:

Advantages of longhand over laptop note taking. *Psychological Science*. Retrieved November 21, 2018, from https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/6/132/files/2010/11/Psychological-Science-2014-Mueller-0956797614524581-1u0h0yu.pdf

For discussion of building skills via play vs. working and testing, see:

Yogman, M., Garner, A., Hutchinson, J., Hirsh-Pasek, K., & Golinkoff, R.M. (AAP Committee on Psychosocial Aspects of Child and Family Health, AAP Council on Communications and Media) (2018, August). The power of play: A pediatric role in enhancing development in young children. *Pediatrics*, *142*(3). Retrieved December 11, 2018, from http://pediatrics.aappublications.org/content/pediatrics/142/3/e20182058.full.pdf

42 Saltman, K.J. (2018). *The swindle of innovative educational finance*. Minneapolis, MN: University of Minnesota Press.

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Laguardia, A. & Pearl, A. (2009). Necessary Educational Reform for the 2lst Century: The Future of Public Schools in our Democracy. *Urban Review, 41*(4), 352–368;

Macdonald, J.B. (1966). The person in the curriculum. In H.F. Robison (Ed.), *Precedents and promise in the curriculum field*. New York, NY: Teachers College Press. Reprinted in *Urban Review*, *8*(3), 191–201 (1975, September);

Shepard, L. A. (in press). Assessment for classroom teaching and learning. In M.J. Feuer, A. Berman, & J.W. Pellegrino (Eds.), *The ANNALS of the American Academy of Political and Social Science*

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45 Brown, A.L., Campione, J.C., Webber, L.S. & McGilly, K. (1992) Interactive learning environments: A new look at assessment and instruction. In B.R. Gifford & M.C. O'Connor (Eds,), *Changing assessments: Alternative views of aptitude, achievement and instruction*. Dordrecht, the Netherlands: Kluwer Academic Publishers;

Illeris, K. (2018). An overview of the history of learning theory. *European Journal of Education, 53*(1), 86-101. Retrieved December 3, 2018, from https://onlinelibrary.wiley.com/doi/full/10.1111/ejed.12265;

Shepard, L.A., Penuel, W.R., & Pelegrino, J.W. (2018). Using learning and motivation theories to coherently link formative assessment, grading practices, and large-scale assessment. *Educational Measurement, 37*(1), 21-34.

46 For discussion of the lack of diversity in the technology sector, see:

Cuba, D. (2015, July 8). The loud fight against Silicon Valley's quiet racism. *Motherboard*. Retrieved May 4, 2017, from https://motherboard.vice.com/en_us/article/the-loud-fight-against-silicon-valleys-quiet-racism;

Williams, L.C. (2017, May 2). Facebook's gender bias goes so deep it's in the code. *ThinkProgress*. Retrieved May 8, 2017, from https://thinkprogress.org/wsj-reports-facebook-gender-bias-966263e64646;

Wong, G. (2015, April 9). Silicon Valley's other diversity problem: Age bias in tech. *Model View Culture*. Retrieved May 4, 2017, from https://modelviewculture.com/pieces/silicon-valleys-other-diversity-problem-age-bias-in-tech

For discussion of the implications of the biases programmed into algorithms, see:

O'Neil, C. (2016). *Weapons of math destruction: How big data increases inequality and threatens democracy*. New York, NY: Crown;

Osoba, O.A. & Welser, W. (2017). *An intelligence in our image: The risks of bias and errors in artificial intelligence*. Santa Monica, CA: RAND Corporation. Retrieved June 20, 2017, from https://www.rand.org/pubs/research_reports/RR1744.html;

Pasquale, F. (2015). *The black box society: The secret algorithms that control money and information*. Cambridge, MA: Harvard University Press.

Pasquale's *Aeon* article offers an abridged version of his discussion:

Pasquale, F. (2015, August 18). Digital star chamber. *Aeon*. Retrieved May 1, 2017, from https://aeon.co/essays/judge-jury-and-executioner-the-unaccountable-algorithm

47 Skinner, B.F. (1958, October 24). Teaching machines. *Science, 128* (3330), 969-977. Retrieved November 21, 2018, from https://www.jstor.org/stable/1755240?seq=1#page_scan_tab_contents

48 David Lazer and his colleagues report on the "Google Flu" hype and mis-predictions; Audrey Watters explores the radical individualist, libertarian "Silicon Valley narrative" behind the drive for "personalization"; and Ben Williamson examines the transfer of the social media platform to education.

Lazer, D., Kennedy, R., King, G., & Vespignani, A. (2014, March 14). The parable of Google Flu: Traps in big

data analysis. *Science, 343*, 1203-1205. Retrieved June 23, 2017, from https://gking.harvard.edu/files/gking/files/0314policyforumff.pdf;

Watters, A. (2017, June 9). The histories of personalized learning. *Hack Education* [blog]. Retrieved June 23, 2017, from http://hackeducation.com/2017/06/09/personalization;

Williamson, B. (2016, October 24). Schooling the platform society. *dmlcentral*. Retrieved May 3, 2017, from https://dmlcentral.net/schooling-platform-society/

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Pasquale, F. (2015). *The black box society: The secret algorithms that control money and information* (p.141). Cambridge, MA: Harvard University Press.

Pasquale's *Aeon* article offers an abridged version of his discussion:

Pasquale, F. (2015, August 18). Digital star chamber. *Aeon*. Retrieved May 1, 2017, from https://aeon.co/essays/judge-jury-and-executioner-the-unaccountable-algorithm

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52 For an argument to increase developer diversity, see:

Osoba, O.A. & Welser, W. (2017). *An intelligence in our image: The risks of bias and errors in artificial intelligence*. Santa Monica, CA: RAND Corporation. Retrieved June 20, 2017, from https://www.rand.org/pubs/research_reports/RR1744.html

For examples of the dangers of relying on algorithms to make decisions that affect people's lives, see:

Liptak, A. (2017, May 1). Sent to prison by a software program's secret algorithms. *New York Times*. Retrieved May 1, 2017, from https://www.nytimes.com/2017/05/01/us/politics/sent-to-prison-by-a-software-programs-secret-algorithms.html?hp=undefined&action=click&pgtype=Homepage&clickSource=story-heading&module=first-column-region&region=top-news&WT.nav=top-news&_r=0;

Pope, D.G. (2017, March 18). How colleges can admit better students. *New York Times*. Retrieved March 20, 2017, from https://www.nytimes.com/2017/03/18/opinion/sunday/how-colleges-can-admit-better-students.html;

Ravindranath,M. (2019, February 3). How your health information is sold and turned into 'risk scores.' *Politico*. Retrieved February 4, 2019, from https://www.politico.com/story/2019/02/03/health-risk-scores-opioid-abuse-1139978;

Taylor, A. & Sadowski, J. (2015, May 27). How companies turn your Facebook activity into a credit score. *The Nation*. Retrieved May 1, 2017, from https://www.thenation.com/article/how-companies-turn-your-facebook-activity-credit-score/

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54 CB Insights (2017, June 21). *The ed tech market map: 90+ startups building the future of education*. Author. Retrieved May 30, 2018, from https://www.cbinsights.com/research/ed-tech-startup-market-map/;

Watters, A. (2018). Who's funding education technology? *Hack Education* [blog]. Retrieved November 18,

2018, from http://funding.hackeducation.com/investments.html

55 Reimagine Education's 2018 conference was held November 29-30 in San Francisco, CA. Find details at:

Reimagine Education (2018). Reimagine Education Conference and Awards [webpage]. Retrieved November 18, 2018, from https://www.reimagine-education.com/

SXSW.edu's 2018 conference was held March 3-7 in Austin, TX. Find details at:

SXSW, LLC (2018). SXSW EDU Schedule [webpage]. Retrieved November 18, 2018, from https://schedule.sxswedu.com/2018

56 Richards, J. & Stebbins, L. (2014). *2014 U.S. education technology market: PreK-12 (executive summary)*. Washington, DC: Software and Information Industry Association. Retrieved August 21, 2018, from https://www.siia.net/Portals/0/pdf/Education/SIIA2014Report_PreK12_FINAL%201%2031%202015_Exec%20Summ.pdf

57 Watters' compilations of education technology investments are located at the Hack Education Data site below. The "over $4.5 billion" estimate results from our adding up the investments she reported in 2015, 2016, 2017, and the first half of 2018 in categories of products used in K-12 settings (i.e, those used only in K-12, used in Pre-K and K-12, used in K-12 and post-secondary, and used in all settings).

Watters, A. (2018). Ed-tech companies that have raised venture capital (since 2015). *Hack Education Data*. Retrieved August 21, 2018, from https://hack-education-data.github.io/investments/

58 Watters, A. (2018). *Ed-tech companies that have raised venture capital (since 2015*). *Hack Education Data*. Retrieved August 21, 2018, from https://hack-education-data.github.io/investments/

59 We calculated these numbers from Watters' data, which she reported monthly.

For the landing page with links to monthly investment data, see:

Watters, A (2018). Who's funding education technology? *Hack Education* [blog]. Retrieved November 18, 2018, from http://funding.hackeducation.com/archives.html

60 Consistent with these findings, Audrey Watters reports a total of 180 acquisitions and 13 mergers since January 2017. Acquisitions and mergers are significant not only financially, but with respect to children's data. When companies are acquired or merge, the data those companies have collected from children changes hands.

Cavanagh, S. (2018, April 26). Value of education mergers and acquisitions soars, though number of K-12 deals dips. *Education Week*. Retrieved August 21, 2018, from https://marketbrief.edweek.org/marketplace-k-12/value-education-mergers-acquisitions-soars-though-number-k-12-deals-dips/;

Watters, A (2018). Who's funding education technology? *Hack Education* [blog]. Retrieved November 18, 2018, from http://funding.hackeducation.com/archives.html

61 See, for example:

Berliner, D.C., Glass, G.V & Associates (2014). *50 myths and lies that threaten America's public schools: The real crisis in education*. New York, NY: Teachers College Press;

Digital Global Promise (2016). *Making learning personal for all: The growing diversity in today's classroom*. Author. Retrieved December 11, 2018, from http://digitalpromise.org/wp-content/uploads/2016/09/lps-growing_diversity_FINAL-1.pdf;

Fox, C. & Jones, R. (2018). *Navigating the digital shift 2018: Broadening student learning opportunities* (p.6). Washington, DC: State Educational Technology Directors Association (SETDA). Retrieved November 14, 2018, from https://www.setda.org/master/wp-content/uploads/2018/05/Nav_ShiftIII_Accessible5.29.18-1.pdf;

Office of Educational Technology, U.S. Department of Education (2017, January 18). What is personalized learning? *Medium*. Retrieved November 6, 2018, from https://medium.com/personalizing-the-learning-experience-insights/what-is-personalized-learning-bc874799b6f

62 CB Insights (2017, June 21). *The ed tech market map: 90+ startups building the future of education*. Author. Retrieved May 30, 2018, from https://www.cbinsights.com/research/ed-tech-startup-market-map/;

Watters, A. (2018). Who's funding education technology? *Hack Education* [blog]. Retrieved May 30, 2018, from http://funding.hackeducation.com/investments.html

63 For overviews, see:

CB Insights (2017, June 21). The ed tech market map: 90+ startups building the future of education. Author. Retrieved May 30, 2018, from https://www.cbinsights.com/research/ed-tech-startup-market-map/;

Watters, A. (2018, November 1). The business of ed-tech: October 2018 funding data. *Hack Education* [blog]. Retrieved November 19, 2018, from http://funding.hackeducation.com/2018/11/01/october

64 Duolingo.com (n.d.). Bring the world's most popular language learning platform to your classroom [webpage]. Retrieved August 28, 2018, from https://schools.duolingo.com/

65 Knewton (2013, June 6). *Houghton Mifflin Harcourt and Knewton announce pioneering partnership to deliver adaptive learning solutions to K–12 students* [press release]. Author. Retrieved July 18, 2018, from https://www.3blmedia.com/News/CSR/Houghton-Mifflin-Harcourt-and-Knewton-Announce-Pioneering-Partnership-Deliver-Adaptive;

Pearson (2018). *System for learning & assessment* [webpage]. Retrieved July 18, 2018, from https://www.pearson.com/us/prek-12/assessment/transcend.html

Pearson (2018). *Online & blended learning solutions* [webpage]. Retrieved July 18, 2018, from https://www.pearson.com/us/prek-12/products-services-teaching/online-blended-learning-solutions.html;

Summit Learning (n.d.). *Summit Learning Platform* [webpage]. Retrieved July 18, 2018, from https://www.summitlearning.org/program/online-platform

66 Everfi provides courses in such areas as financial education, STEM and career readiness, and social and emotional learning. The courses are sponsored by business interests and are free to schools. The Mass Mutual Foundation sponsors a course in financial education for every middle school in the country. In Colorado, the Attorney General's office and Canvas Credit Union provide the "Colorado Kids MoneyWiser™" program to elementary schools across the state.

Canvas Credit Union (2018). *Financial education* [webpage]. Retrieved December 3, 2018, from https://canvas.org/community/financial-education;

Cipriani, S. (2018, August 27). Personal communication with Faith Boninger (telephone);

Colorado Attorney General's Office (2017, February 7). *AG Coffman* announces new financial literacy program for Colorado kids [press release]. Retrieved December 3, 2018, from https://coag.gov/press-room/press-releases/02-07-17;

Massachusetts Mutual Life Insurance Company (MassMutual) (2017, March 29). *MassMutual Foundation expands reach of financial ed program with free app*. Retrieved December 3, 2018, from https://www.massmutual.com/about-us/news-and-press-releases/press-releases/2017/03/27/17/47/massmutual-foundation-expands-reach-of-financial-ed-program-with-free-app

67 Tabor, N. (2018, October 11). Mark Zuckerberg is trying to transform education. This town fought back. *New York Magazine* (nymag.com). Retrieved October 30, 2018, from http://nymag.com/intelligencer/2018/10/the-connecticut-resistance-to-zucks-summit-learning-program.html

68 Akila Robinson and Kelly Hernandez's letter on behalf of students at the Secondary School of Journalism was reprinted in *EdSurge*:

Tate, E. (2018, November 15). 'Dear Mr. Zuckerberg': Students take Summit Learning protests directly to Facebook chief. *EdSurge*. Retrieved December 3, 2018, from https://www.edsurge.com/news/2018-11-15-dear-mr-Zuckerberg-students-take-summit-learning-protests-directly-to-facebook-chief

69 For Elana Zeide's comment, see:

Tabor, N. (2018, October 11). Mark Zuckerberg is trying to transform education. This town fought back. *New York Magazine* (nymag.com). Retrieved October 30, 2018, from http://nymag.com/intelligencer/2018/10/the-connecticut-resistance-to-zucks-summit-learning-program.html

Summit also plans to collect college admission test scores, college eligibility and acceptance, and employment information. For a list of the information that Summit collects, see:

Summit Learning (2018, March 19. *Summit Learning platform privacy policy*. Retrieved November 29, 2018, from https://help.summitlearning.org/hc/en-us/articles/360000806087-Summit-Learning-Platform-Privacy-Policy

70 Instructure, Inc. (2018, November 17). *Instructure privacy policy*. Author. Retrieved October 5, 2018, from https://www.instructure.com/policies/privacy/

71 Narayanan, A. & Shmatikov, V. (2008). Robust de-anonymization of large sparse datasets. *SP '08 Proceedings of the 2008 IEEE Symposium on Security and Privacy,* pp. 111-125. Retrieved December 20, 2015, from https://www.cs.utexas.edu/~shmat/shmat_oak08netflix.pdf

72 Ravindranath,M. (2019, February 3). How your health information is sold and turned into 'risk scores.' *Politico*. Retrieved February 4, 2019, from https://www.politico.com/story/2019/02/03/health-risk-scores-opioid-abuse-1139978

73 Saltman, K.J. (2018). *The swindle of innovative educational finance* (p. 70). Minneapolis, MN: University of Minnesota Press.

74 Electronic Frontier Foundation (2015, December 1). *Google deceptively tracks students' Internet browsing, EFF says in FTC complaint* [press release]. Retrieved December 10, 2018, from https://www.eff.org/press/releases/google-deceptively-tracks-students-internet-browsing-eff-says-complaint-federal-trade;

Gilulla, J. (2015, December 2). Google's student tracking isn't limited to Chrome Sync. *Electronic Frontier Foundation*. Retrieved December 10, 2018, from https://www.eff.org/deeplinks/2015/12/googles-student-tracking-isnt-limited-chrome-sync

75 U.S. Department of Education Office of Inspector General (2018, November 26). Office of the Chief Privacy Officer's Processing of Family Educational Rights and Privacy Act Complaints (ED-OIG/A09R0008). Retrieved November 29, 2018, from https://www2.ed.gov/about/offices/list/oig/auditreports/fy2019/a09r0008.pdf

76 EdTech Strategies, LLC (2018, November 21). The K-12 cyber incident map [webpage]. Retrieved April 17, 2019, from https://k12cybersecure.com/map/

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79 For examples, see:

Carter, D. (2016). Goodbye, linear factory model of schooling: Why learning is irregular. *Edsurge*. Retrieved July 23, 2018, from https://www.edsurge.com/news/2016-07-06-goodbye-linear-factory-model-of-schooling-why-learning-is-irregular;

Fox, C. & Jones, R. (2018). *Navigating the digital shift 2018: Broadening student learning opportunities* (p. 6). Washington, DC: State Educational Technology Directors Association (SETDA). Retrieved November 14, 2018, from https://www.setda.org/master/wp-content/uploads/2018/05/Nav_ShiftIII_Accessible5.29.18-1.pdf;

Hammonds, V. & Moyer, J. (2018, April 5). *From vision to reality: Personalized, competency-based learning for all kids*. Cincinnati, OH: KnowledgeWorks Foundation. Retrieved July 23, 2018, from https://knowledgeworks.org/resources/vision-reality-personalized-cbe/;

Rose, J. (2012, May 9). How to break free of our 19th-century factory-model education system. *Atlantic*. Retrieved October 31, 2018, from https://www.theatlantic.com/business/archive/2012/05/how-to-break-free-of-our-19th-century-factory-model-education-system/256881/

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Dorn, S. (2011, September 4). Being careless with education history. *Sherman Dorn: Work to understand how schools have been social institutions* [blog]. Retrieved July 23, 2018, from http://shermandorn.com/wordpress/?p=3780;

Watters, A. (2015, April 25). The invented history of 'the factory model of education.' *Hack Education* [blog]. Retrieved July 23, 2018, from https://hackeducation.com/2015/04/25/factory-model

81 RAND's study found no differences between NGCL schools and other schools nationally with respect to several practices.

Pane, J.F., Steiner, E.D., Baird, M.D., Hamilton, L.S, & Pane, J.D. (2017). *Informing progress: Insights on personalized learning implementation and effect*s (pp. 8-24). Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2042/RAND_RR2042.pdf

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from https://www.newclassrooms.org/wp-content/uploads/2019/02/Final-Impact-Results-i3-TtO.pdf

85 Haynes, E., Zeiser, K., Surr, W., Hauser, A., Clymer, L., Walston, J., Bitter, C., & Yang, R, (2016). *Looking under the hood of competency-based education: The relationship between competency-based education practices and students' learning skills, behaviors, and dispositions* (p.21). Washington, DC: American Institutes for Research. Retrieved March 25, 2018, from https://www.air.org/sites/default/files/downloads/report/CBE-Study%20Full%20Report.pdf;

Pane, J.F., Steiner, E.D., Baird, M.D., Hamilton, L.S, & Pane, J.D. (2017). *Informing progress: Insights on personalized learning implementation and effect*s (p. 3). Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2042/RAND_RR2042.pdf

86 For some ideas of what 21st century skills may be, see:

United States Department of Education, Office of Education Technology (2010). *Transforming American education: Learning powered by technology* (p. xi). Author. Retrieved March 24, 2018, from https://www.ed.gov/sites/default/files/netp2010.pdf;

Morrison, J.R., Ross, S.M., Risman, K.L., & Reilly, J.M. (2018, February). *Report for Baltimore County Public Schools: Students and Teachers Accessing Tomorrow – Year Four Mid-Year Evaluation Report (*pp. 33-35). Baltimore, MD: Johns Hopkins School of Education. Retrieved April 22, 2019, from https://www.bcps.org/academics/HowWeTeach/misc/BCPS-Y4-Midyear-STAT-Evaluation_FINAL.PDF;

RAND's study of personalized learning found that schools were unable to determine appropriate measures of the skills they considered "21st Century," such as critical thinking and collaboration.

Pane, J.F., Steiner, E.D., Baird, M.D., Hamilton, L.S, & Pane, J.D. (2017). *Informing progress: Insights on personalized learning implementation and effect*s (p. 11). Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2042/RAND_RR2042.pdf

87 Pane, J.F. (2018). *Strategies for implementing personalized learning while evidence and resources are underdeveloped (*p.4). Santa Monica, CA: RAND Corporation, 2018. Retrieved November 9, 2018, from https://www.rand.org/pubs/perspectives/PE314.html

Penuel, W.R., & Johnson, R. (2016). *Review of "Continued progress: Promising evidence on personalized learning."* Boulder, CO: National Education Policy Center. Retrieved September 4, 2018, from https://nepc.colorado.edu/thinktank/review-personalized-learning

88 Barbour, M. (2017, April). *Virtual schools in the U.S. 2017, Section II: Still no evidence, increased call for regulation: Research to guide virtual school policy* (p. 61). Boulder, CO: National Education Policy Center. Retrieved June 24, 2017, from http://nepc.colorado.edu/publication/virtual-schools-annual-2017

89 Pane, J.F., Steiner, E.D., Baird, M.D., & Hamilton, L.S. (2015). *Continued progress: Promising evidence on personalized learning*. Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/pubs/research_reports/RR1365.html;

Pane, J.F., Steiner, E.D., Baird, M.D., Hamilton, L.S., & Pane, J.D. (2017). *Informing progress: Insights on personalized learning implementation and effect*s. Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2042/RAND_RR2042.pdf

90 NWEA (formerly the Northwest Evaluation Association) is a testing company based in Oregon. Its MAP Growth tests use "adaptive" algorithms to begin with a question appropriate for a student's grade level and then choose subsequent questions throughout the test in response to student responses. For more information

on NWEA and MAP Growth, see:

NWEA (2018). *MAP Growth* [webpage]. Retrieved November 19, 2018, from https://www.nwea.org/map-growth/

RAND's research is reported in detail here:

Pane, J.F., Steiner, E.D., Baird, M.D., & Hamilton, L.S. (2015). *Continued progress: Promising evidence on personalized learning*. Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/pubs/research_reports/RR1365.html;

Pane, J.F., Steiner, E.D., Baird, M.D., Hamilton, L.S., & Pane, J.D. (2017). *Informing progress: Insights on personalized learning implementation and effect*s. Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/content/dam/rand/pubs/research_reports/RR2000/RR2042/RAND_RR2042.pdf

For a follow-up discussion, see:

Pane, J.F. (2018). *Strategies for implementing personalized learning while evidence and resources are underdeveloped (*p.4). Santa Monica, CA: RAND Corporation, 2018. Retrieved November 9, 2018, from https://www.rand.org/pubs/perspectives/PE314.html

For a review of RAND's 2015 report, see:

Penuel, W.R., & Johnson, R. (2016). *Review of "Continued progress: Promising evidence on personalized learning."* Boulder, CO: National Education Policy Center. Retrieved September 4, 2018, from https://nepc.colorado.edu/thinktank/review-personalized-learning

91 Pane, J.F., Steiner, E.D., Baird, M.D., & Hamilton, L.S. (2015). *Continued progress: Promising evidence on personalized learning* (pp. 18). Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/pubs/research_reports/RR1365.html

92 Pane, J.F., Steiner, E.D., Baird, M.D., & Hamilton, L.S. (2015). *Continued progress: Promising evidence on personalized learning* (p. 30). Santa Monica, CA: RAND Corporation. Retrieved June 27, 2018, from https://www.rand.org/pubs/research_reports/RR1365.html;

Penuel, W.R., & Johnson, R. (2016). *Review of "Continued progress: Promising evidence on personalized learning."* Boulder, CO: National Education Policy Center. Retrieved September 4, 2018, from https://nepc.colorado.edu/thinktank/review-personalized-learning

93 Pane, J.F. (2018). *Strategies for implementing personalized learning while evidence and resources are underdeveloped (*p.4). Santa Monica, CA: RAND Corporation, 2018. Retrieved November 9, 2018, from https://www.rand.org/pubs/perspectives/PE314.html

94 Fox, C. & Jones, R. (2018). *Navigating the digital shift 2018: Broadening student learning opportunities* (p.6). Washington, DC: State Educational Technology Directors Association (SETDA). Retrieved November 14, 2018, from https://www.setda.org/master/wp-content/uploads/2018/05/Nav_ShiftIII_Accessible5.29.18-1.pdf

95 Nearpod (n.d.). *Transforming teaching. Together.* [webpage] Retrieved February 11, 2019, from https://nearpod.com/

96 Crunchbase, Inc. (2018). *Nearpod*. Author. Retrieved September 26, 2018, from https://www.crunchbase.com/organization/nearpod#section-overview

97 2018 pricing is $120 per teacher per year for a "gold membership" that includes features such as the ability to assign homework, create "virtual field trips" and allow students to pace themselves through the slide show on an individual basis; $349 per teacher per year for a "platinum membership" that also includes access to thou-

sands of lessons that otherwise would have to be purchased individually; and unspecified district level pricing. District-level contracts include integration with learning management systems such as Canvas and Schoology, "exclusive" administrator features and data reports of the results of formative assessments included in the content. The more expensive the membership, the larger the number of students that can be included in the teacher's account.

Nearpod (n.d.). *Pricing*. Author. Retrieved September 26, 2018, from https://nearpod.com/pricing

98 Common Sense Media gave Nearpod four stars, but teacher reviewers gave it five stars.

Common Sense Media (2018). *Nearpod* [webpage]. Retrieved September 26, 2018, from https://www.commonsense.org/education/app/nearpod;

Common Sense (n.d.). *Essential back-to-school tools for teachers* [webpage]. Retrieved September 26, 2018, from https://www.commonsense.org/education/top-picks/essential-back-to-school-tools-for-teachers;

Crunchbase, Inc. (2018). *Nearpod*. Author. Retrieved September 26, 2018, from https://www.crunchbase.com/organization/nearpod

99 Common Sense (n.d.). *Teacher review for Nearpod.* [webpage]. Retrieved September 26, 2018, from https://www.commonsense.org/app/nearpod-teacher-review/3971526

100 Common Sense (n.d.). *Teacher review for Nearpod.* [webpage]. Retrieved September 26, 2018, from https://www.commonsense.org/app/nearpod-teacher-review/3971526

101 Classroom Complete Press (n.d.). *Friendships, communication, and problem-solving* (n.d.). Retrieved October 4, 2018, from https://nearpod.com/s/general/8th-grade/friendships-communication-and-problem-solving-L35432235;

Nearpod + Classroom Complete Press (n.d.). *Buying of goods and services*. Author. Retrieved October 5, 2018, from https://nearpod.com/s/general/8th-grade/buying-of-goods-and-services-L35436063 [subscription required];

Nearpod + OZY (n.d.). *That new jacket could be a fishing net in disguise.* Author. Retrieved October 5, 2018, from https://app.nearpod.com/command [subscription required];

Nearpod + Sway (n.d.). *Who was Harriet Tubman?: Historical events and figures*. Author. Retrieved October 5, 2018, from https://app.nearpod.com/library/preview/lesson-L32922707 [subscription required]

102 Classroom Complete Press (n.d.). *Friendships, communication, and problem-solving* (n.d.). Retrieved October 4, 2018, from https://nearpod.com/s/general/8th-grade/friendships-communication-and-problem-solving-L35432235;

Classroom Complete Press, the creator of this lesson offered by Nearpod, offers "LESSON PLANS FOR TEACHERS BY TEACHERS created to empower students to reach their full potential."

Classroom Complete Press (2018). *Classroom Complete Press* [webpage]. Retrieved October 4, 2018, from https://classroomcompletepress.com/

103 Nearpod privacy docs:

Nearpod (n.d.). *Privacy policy*. Author. Retrieved October 4, 2018, from https://nearpod.com/privacy-policy;

Nearpod (n.d.). *Privacy and security FAQ*. Author. Retrieved October 5, 2018, from https://nearpod.com/privacy-faq;

Nearpod (2016, November 12). *Terms and conditions*. Author. Retrieved October 5, 2018, from https://nearpod.com/terms-conditions/

104 Nearpod (n.d.). *Privacy policy*. Author. Retrieved October 4, 2018, from https://nearpod.com/privacy-policy

105 Molnar, A. & Boninger, F. (2018). *Why we're glad that the National Education Policy Center deleted its Facebook account*. Boulder, CO: National Education Policy Center. Retrieved October 5, 2018, from https://nepc.colorado.edu/publication/facebook-student-privacy

106 As an experiment, we tried opting out at appnexus.com. After reading the page and finding a link to follow to the Network Advertising Initiative (NAI) (http://optout.networkadvertising.org/?c=1#!%2F), we tried to opt out of all NAI associated advertising. None of the 74 requests were successful. A few days later we tried again, again with no success.

Find information about sharing of data with advertising networks at:

Nearpod (n.d.). *Privacy and security FAQ*. Author. Retrieved October 5, 2018, from https://nearpod.com/privacy-faq

107 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

108 The Student Privacy Pledge has recognized weaknesses. For explication, see:

Boninger, F. and Molnar, A. (2016). *Learning to be watched: Surveillance culture at school—The eighteenth annual report on schoolhouse commercializing trends, 2014-2015* (pp. 17-18). Boulder, CO: National Education Policy Center. Retrieved October 8, 2018, from http://nepc.colorado.edu/publication/schoolhouse-commercialism-2015

109 Nearpod (2018, May 25). *Privacy policy* [webpage]. Retrieved December 13, 2018, from https://nearpod.com/privacy-policy

110 Nearpod (2018, May 25). *Privacy policy* [webpage]. Retrieved September 28, 2018, from https://nearpod.com/privacy-policy;

Nearpod (n.d.). P*rivacy and security FAQ*. Retrieved September 28, 2018, from https://nearpod.com/privacy-faq;

Nearpod (2016, November 12). *Terms and conditions*. Retrieved September 28 2018, from https://nearpod.com/terms-conditions/

111 The Nearpod Team (2016, July 11). Personalized learning with Nearpod. *Nearpodblog*. Retrieved November 29, 2018, from https://nearpod.com/blog/personalized-learning-with-nearpod/

112 For description of reflections as personalized learning, see:

Guyon, L. (2018, July 25). Making personalized learning possible. *Nearpodblog*. Retrieved November 29, 2018, from https://nearpod.com/blog/personalizing-learning/

113 Common Sense (n.d.). *Teacher reviews for Nearpod* [webpage]. Retrieved September 26, 2018, from https://www.commonsense.org/app/nearpod-teacher-review/3971526

114 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

115 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan

Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

116 Instructure (2018). *A learning management system is…* [webpage]. Retrieved September 26, 2018, from https://www.canvaslms.com/k-12/

117 Crunchbase Inc. (2018). *Instructure* [webpage]. Retrieved December 12, 2018, from https://www.crunchbase.com/organization/instructure

118 SIIA (2018). *Canvas by Instructure – Instructure* [webpage]. Retrieved December 12, 2018, from http://www.siia.net/codie/About-the-Awards/Past-Winners/2018-Winners/Details/nID/221

119 Lea(R)n, Inc. (2018). *EdTech Top 40: 2017-2018 school year*. Author. Retrieved October 8, 2018, from https://learnplatform.com/edtech-top-40

120 SIIA (2018). *Canvas by Instructure – Instructure* [webpage]. Retrieved December 12, 2018 from http://www.siia.net/codie/About-the-Awards/Past-Winners/2018-Winners/Details/nID/221

121 Shen, D. (2017, April 20). Improve student achievement with Hattie and Canvas [blogpost]. *Extra Credit: The Canvas Blog*. Retrieved September 26, 2018, from https://blog.canvaslms.com/en/evidence-based-student-achievement-hattie

122 Instructure (2018, July 25). *Canvas announces badges powered by Badgr for all Canvas users* [press release]. Retrieved September 26, 2018, from https://www.canvaslms.com/news/pr/canvas-announces-badges-powered-by-badgr-for-all-canvas-users&122693;

PlayPosit (n.d.). *Increase learner…* [webpage] Retrieved September 26, 2018, from https://learn.playposit.com/learn/

123 Future of Privacy Forum and The Software & Information Industry Association (2018). *K-12 school service provider pledge to safeguard student privacy*. Author.

Retrieved March 29, 2019, from https://studentprivacypledge.org/privacy-pledge/;

Future of Privacy Forum and The Software & Information Industry Association (2016). *Student privacy pledge: Signatories* [webpage]. Retrieved November 28, 2018, from https://studentprivacypledge.org/signatories/

124 Instructure, Inc. (201, November 17). *Instructure privacy policy*. Author. Retrieved October 5, 2018, from https://www.instructure.com/policies/privacy/

125 Narayanan, A. & Shmatikov, V. (2008). Robust de-anonymization of large sparse datasets. *SP '08 proceedings of the 2008 IEEE symposium on security and privacy*, pp. 111-125. Retrieved October 8, 2018, from https://www.cs.utexas.edu/~shmat/shmat_oak08netflix.pdf

126 See our discussion of data anonymization:

Boninger, F. & Molnar, A. (2016). *Learning to be watched: Surveillance culture at school—The eighteenth annual report on schoolhouse commercializing trends, 2014-2015* (pp.19-20). Boulder, CO: National Education Policy Center. Retrieved October 8, 2018, from http://nepc.colorado.edu/publication/schoolhouse-commercialism-2015

For further discussion of data anonymization, see also:

Wheaton, K. (2015, March 23). Hocus pocus! Your data has been anonymized! Now they'll never find you! *Advertising Age*. Retrieved October 8, 2018, from http://adage.com/article/ken-wheaton/data-anonymized-find/297713/

For an example of how tech companies use customer use data in product development, see:

Mac, R. (2018, August 7). Internal Facebook note: Here is a "psychological trick" to target T=teens. *Buzzfeed.News*. Retrieved October 5, 2018, from https://www.buzzfeednews.com/article/ryanmac/facebooks-teens-tbh-psychological-trick-memo

127 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

128 Instructure, Inc. (2018). *Partner portfolio*. Author. Retrieved October 5, 2018, from https://partners.instructure.com/directory/;

Concentric Sky (2018, June 12). *Concentric Sky announces BadgeRank - a new search engine for digital badges* [press release]. Retrieved December 11, 2018, from https://www.prweb.com/releases/2018/06/prweb15549778.htm;

Inkerz (n.d.). *Inkers* [webpage]. Retrieved December 11, 2018, from https://inkerz.com/education/;

Germer, S. (n.d.). Stepping off the stage: Our journey to personalize learning. *Extra Credit: The Canvas Blog* [blogpost]. Retrieved December 11, 2018, from https://blog.canvaslms.com/en/our-journey-personalize-learning-edtech;

Racheva, V. (n.d.). Virtual Classroom – reach and engage more students! *Extra Credit: The Canvas Blog* [blogpost]. Retrieved December 11, 2018, from https://blog.canvaslms.com/en/virtual-classroom-reach-and-engage-more-students

129 The Student Privacy Pledge has recognized weaknesses. For explication, see:

Boninger, F. & Molnar, A. (2016). *Learning to be watched: Surveillance culture at school—The eighteenth annual report on schoolhouse commercializing trends, 2014-2015* (pp. 17-18). Boulder, CO: National Education Policy Center. Retrieved April 17, 2019, from http://nepc.colorado.edu/publication/schoolhouse-commercialism-2015

130 We tried to contact Instructure to find out if the company has a privacy document that addresses child users. First, in a 12.3.18 chat with an Instructure "help desk" employee, we received some text from an unidentified internal document that said that "Instructure's Privacy Policy states, 'If you are under the age of 13, your school's privacy policy applies to you and we provide the Site and Services on behalf of your school.'" This language may have been in an earlier version of the privacy policy; the November 17, 2017 policy currently in use does not contain any language that addresses children under the age of 13. We emailed the address provided on the privacy policy (three times, on 12.3.18, 12.7.18, and 12.11.18), privacy@instructure.com, asking for documents that specify privacy policies for K-12 users of Canvas, and received no response.

Instructure, Inc. (2017, November 17). *Instructure privacy policy*. Author. Retrieved October 5, 2018, from https://www.instructure.com/policies/privacy/

131 Instructure, Inc. (2017, November 17). *Instructure privacy policy*. Author. Retrieved October 5, 2018, from https://www.instructure.com/policies/privacy/

132 Instructure, Inc. (2017, November 17). *Instructure privacy policy*. Author. Retrieved October 5, 2018, from https://www.instructure.com/policies/privacy/

133 Shen, D. (2017, April 20). Improve student achievement with Hattie and Canvas. *Extra Credit: The Canvas Blog*. Retrieved September 26, 2018, from https://blog.canvaslms.com/en/evidence-based-student-achievement-hattie;

Canvas Doc Team (2018, September 15). How do I use MasteryPaths in course modules? *Canvas*. Retrieved October 1, 2018, from https://community.canvaslms.com/docs/DOC-10442

134 https://blog.canvaslms.com/en/evidence-based-student-achievement-hattie;

https://www.canvaslms.com/downloads/2017_1_StudentAchievementCollateral_WEB_Canvas.pdf

135 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

136 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

137 Instructure, Inc. (n.d.). *EduAppCenter.com* [webpage]. Retrieved October 2, 2018, from https://www.eduappcenter.com/;

Instructure, Inc. (2018). *Partner portfolio*. Author. Retrieved October 5, 2018, from https://partners.instructure.com/directory/

138 Instructure (2018). *Instructure privacy policy*. Author. Retrieved October 2, 2018, from https://www.instructure.com/policies/privacy/

139 Future of Privacy Forum and The Software & Information Industry Association (2016). *Student privacy pledge: Signatories* [webpage]. Retrieved November 28, 2018, from https://studentprivacypledge.org/signatories/

140 Pearson (2019). *Schoolnet* [webpage]. Retrieved April 22, 2019, from https://www.pearsonassessments.com/large-scale-assessments/district-assessment/schoolnet.html

141 In February 2018, an *Education Week Market Brief* reported that Pearson is trying to sell its K-12 curriculum component of its business, which is relatively less lucrative than its $1.2 billion U.S. assessment business. Its U.S. assessment business grew seven percent in the number of digital tests administered in 2017. *Education Week* reported that Pearson claimed to be the market leader in this segment, with a market share of more than 35 percent.

Molnar, M. (2018, February 26). Pearson set to sell K-12 curriculum business, but not assessment. *Editorial Projects in Education, Inc*. Retrieved August 30, 2018, from https://marketbrief.edweek.org/marketplace-k-12/pearson-set-sell-k-12-curriculum-business-not-assessment/

See also:

Davis, M.R. & Molnar, M. (2018, March 5). Educators carefully watch Pearson as it moves to sell K-12 curriculum business. *Education Week*. Retrieved August 31, 2018, from https://www.edweek.org/ew/articles/2018/03/07/educators-carefully-watch-pearson-as-it-moves.html

Pearson Education, Inc. (2018). *Pearson system of courses math and literacy assessment*. Author. Retrieved August 30, 2018, from https://www.pearsonschool.com/index.cfm?locator=PS31Jc&PMDBSOLUTIONID=6724&PMDBSITEID=2781&PMDBCATEGORYID=806&PMDBSUBSOLUTIONID=&PMDBSUBJECTAREAID=&PMDBSUBCATEGORYID=&PMDbProgramID=133561&elementType=asset&elementID=Custom%20Bucket%203

142 Pearson Education, Inc. (2018). *Pearsonalized learning* [webpage]. Retrieved September 21, 2018, from https://www.pearsonschool.com/index.cfm?locator=PS2s1n&PMDbSiteid=2781&PMDbSolutionid=6724&PMDbSubSolutionid=&PMDbCategoryid=62421&PMDbSubcategoryid=62422&&filter_423=24902&

143 Pearson Education, Inc. (2015). *Schoolnet Instructional Improvement System: Powering classroom achievement (*p. 2). Retrieved September 4, 2018, from https://images.pearsonassessments.com/images/Assets/schoolnet/pdf/Schoolnet_OverviewBrochure.pdf

144 Pearson (2019). *Schoolnet* [webpage]. Retrieved April 22, 2019, from https://www.pearsonassessments.com/large-scale-assessments/district-assessment/schoolnet.html

145 Pearson (2019). *Schoolnet* [webpage]. Retrieved April 22, 2019, from https://www.pearsonassessments.com/large-scale-assessments/district-assessment/schoolnet.html

Pearson North America (2017, March 15). Transforming education with edConnect NJ [YouTube video]. Retrieved September 4, 2018, from https://www.youtube.com/watch?v=OhlsJTX8MNw

A Schoolnet salesperson predicted that adaptive features are likely in the next version of Schoolnet, likely to be released in 2019.

Zahodnik, A. (2018, September 7). Personal communication (telephone) with Faith Boninger.

146 Pearson Education, Inc. (2015). *Schoolnet Instructional Improvement System: Powering classroom achievement* (pp. 2-3, 7-9). Retrieved September 4, 2018, from https://images.pearsonassessments.com/images/Assets/schoolnet/pdf/Schoolnet_OverviewBrochure.pdf;

Pearson Education, Inc. (2018). *Schoolnet – Reporting* [webpage]. Retrieved September 5, 2018, from https://www.pearsonassessments.com/largescaleassessment/products-services/schoolnet/schoolnet-reporting.html;

Pearson Education, Inc. (2018). *Schoolnet - Curriculum and instruction tools* [webpage]. Retrieved September 21, 2018, from https://www.pearsonassessments.com/largescaleassessment/products-services/schoolnet/schoolnet-instruction.html

147 See, for example:

Pearson Education, Inc. (2018). *Schoolnet – Reporting* [webpage]. Retrieved September 5, 2018, from https://www.pearsonassessments.com/largescaleassessment/products-services/schoolnet/schoolnet-reporting.html

Pearson North America (2017, March 15). Transforming Education with edConnect NJ [YouTube video]. Retrieved November 28, 2018, from https://www.youtube.com/watch?v=OhlsJTX8MNw

148 Bill & Melinda Gates Foundation, Afton Partners, Eli & Edythe Broad Foundation, CEE Trust, Christensen Institute, Charter School Growth Fund, EDUCAUSE, iNACOL, The Learning Accelerator, Michael & Susan Dell Foundation, Silicon Schools (2014). *A working definition of personalized learning*. Retrieved March 29, 2019, from https://assets.documentcloud.org/documents/1311874/personalized-learning-working-definition-fall2014.pdf

149 Pearson Education, Inc. (2014). *Student profile* [webpage]. Retrieved November 28, 2018, from https://docs.schoolnet.com/webhelp//161/myschoolnet/content/student_profile/student_profile.htm

150 Future of Privacy Forum and The Software & Information Industry Association (2016). Student privacy pledge: Signatories [webpage]. Retrieved November 28, 2018, from https://studentprivacypledge.org/signatories/

151 We exchanged emails with a representative from Schoolnet on 12.3.18-12.12.18. When we asked a sales representative for Schoolnet for a privacy policy, she told us that each district and state that contracts with Schoolnet negotiates an Acceptable Use Policy that addresses protections for student data, and that although she could not share such policies with us, we could look online for acceptable use policies posted by districts. We

did find a policy publicly posted by Denver Public Schools, and on 12.11.18 we emailed the address in that document to ask for documents that specify policies for how information about K-12 students is collected, used, and protected. The address was nonfunctioning. A second representative emailed us the privacy and terms of use policies applicable to the Pearson website about Schoolnet, but these policies do not appear to apply to use of the product itself. It appears that Pearson has no privacy policy that the company shares publicly about how it gathers, shares, disseminates, and protects student data, and that the only way to find out what privacy policy is in force with respect to a given district is to go to the district to ask what they've agreed to.

Denver Public Schools (2018). About Schoolnet [webpage]. Retrieved December 11, 2018, from https://schoolnet.dpsk12.org/about.aspx;

Sulerzyski, V. (2018, December 12). Personal communication (email) with Faith Boninger;

Zahodnik, A. (2018, December 3-12). Personal communication (email) with Faith Boninger.

For the policies applicable to the Pearson website, retrievable from https://www.pearsonassessments.com/largescaleassessment/products-services/schoolnet.html#, see:

Pearson Education (2018). *Privacy policy* [webpage]. Retrieved December 13, 2018, from https://www.pearsonassessments.com/privacy-policy.html;

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Noble, D.D. (1996). Mad rushes into the future: The overselling of educational technology. *Education Leadership, 54*(3), 18-23. Retrieved December 13, 2018, from http://www.ascd.org/publications/educational-leadership/nov96/vol54/num03/Mad-Rushes-Into-the-Future@-The-Overselling-of-Educational-Technology.aspx

For discussion of companies promoting the ideology of personalized learning, see:

Watters, A. (2016, December 19). Education technology and the ideology of personalization. *Hack Education* [blog]. Retrieved December 13, 2018, from https://hackeducation.com/2016/12/19/top-ed-tech-trends-per-

sonalization

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160 InnovateEDU (2018). Project Unicorn: A data interoperability *initiative [webpage]*. Retrieved October 8, 2018, from https://www.projunicorn.org/

161 Bill and Melinda Gates Foundation (2018). *How we work: Communities in Schools of Georgia* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2003/03/OPP26999

162 Bill and Melinda Gates Foundation (2018). *How we work: University of Kentucky Research Foundation* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2016/11/OPP1160411;

Bill and Melinda Gates Foundation (2018). *How we work: North American Council for Online Learning*. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2017/06/OPP1172886;

Bill and Melinda Gates Foundation (2018). *How we work: MindWires, LLC*. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2017/04/OPP1172701

163 Dates, amounts, and webpages for each grant to Summit Public Schools are provided below:

June 2017 - $10,000,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2017/06/OPP1172842

October 2016 - $2,329,062

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2016/10/OPP1157300

October 2015 - $50,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2015/10/OPP1142844

August 2015 - $1,100,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2015/08/OPP1137884

October 2014 - $700,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2014/10/OPP1117088

June 2014 - $500,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/

Grants/2014/06/OPP1113123

November 2013 - $20,000,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2013/11/OPP1095601

October 2013 - $250,000

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September 2013 - $75,000

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September 2013 - $40,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2013/09/OPP1099403

June 2012 - $100,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2012/06/OPP1065229

November 2011 - $50,000

Bill and Melinda Gates Foundation (2018). *How we work: Summit Public Schools* [webpage]. Retrieved December 13, 2018, from https://www.gatesfoundation.org/How-We-Work/Quick-Links/Grants-Database/Grants/2011/11/OPP1051514

164 Barnum, M. & Darville, S. (2018, September 10). Lifting the veil on education's newest big donor: Inside Chan Zuckerberg's $300 million push to reshape schools. *Chalkbeat*. Retrieved October 8, 2018, from https://www.chalkbeat.org/posts/us/2018/09/06/chan Zuckerberg-education/;

Herold, B. (2017, June 7). Gates, Zuckerberg philanthropies team up on personalized learning. *Education Week*. Retrieved October 10, 2018, from https://blogs.edweek.org/edweek/DigitalEducation/2017/06/gates_Zuckerberg_philanthropy_personalized_learning.html

For an interesting comparison between Bill Gates and Mark Zuckerberg, see:

Fisher, A. (2018, August 1). Playing monopoly: What Zuck can learn from Bill Gates. *Wired*. Retrieved December 10, 2018, from https://www.wired.com/story/playing-monopoly-what-zuck-can-learn-from-bill-gates/

165 For insightful analysis of the Chan Zuckerberg Initiative, see:

Saltman, K.J. (2018). *The swindle of innovative educational finance* (pp.53-74). Minneapolis, MN: University of Minnesota Press.

166 Matt Barnum and Sarah Darville, writing in *Chalkbeat*, noted that the Chan Zuckerberg Initiative (CZI) provided money to Summit Public Schools to launch and operate a teacher residency program, to buy and build school facilities, to distribute its Personalized Learning Platform to schools, to conduct free trainings for educators, and to pay for mentors who coach schools in their use of the platform. The Silicon Valley Commu-

nity Foundation, through which CZI passes its grants in a "donor-advised fund," lists grants of $35 million, $20 million, and $16 million made to Summit Public Schools in 2016 and 2017, but because the foundation's tax forms are not required to specify which fund makes each donation, it is not clear that these donations were made by CZI.

Barnum, M. & Darville, S. (2018, September 10). Lifting the veil on education's newest big donor: Inside Chan Zuckerberg's $300 million push to reshape schools. *Chalkbeat*. Retrieved October 8, 2018, from https://www.chalkbeat.org/posts/us/2018/09/06/chan Zuckerberg-education/

167 Summit Learning (2018, October 12). *The Summit Learning Program today and tomorrow, a message from Summit Public Schools CEO Diane Tavenner* [blog]. Retrieved October 16, 2018, from https://blog.summitlearning.org/2018/10/summit-learning-program-today-and-tomorrow/

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Education Week (2016, March 7). *Tangled web: Zuckerberg & Chan's education grants, investments*. Author. Retrieved August 8, 2018, from https://www.edweek.org/ew/section/multimedia/Zuckerberg-chan-education-grants-investments.html

Semuels, A. (2018, May 14). The 'black hole' that sucks up Silicon Valley's money. *Atlantic*. Retrieved August 8, 2018, from https://www.theatlantic.com/technology/archive/2018/05/silicon-valley-community-foundation-philanthropy/560216/

A 2014 *Inside Philanthropy* article offered that If this money had been placed in a typical foundation, that foundation "would rank among the top 30 foundations in the United States—bigger than places like Mott, Knight, Carnegie, and Hilton."

Callahan, D. (2014). Mark Zuckerberg's $2.5 billion foundation. *Inside Philanthropy*. Retrieved August 8, 2018, from https://www.insidephilanthropy.com/home/2014/7/25/mark-Zuckerbergs-25-billion-foundation.html

169 An LLC cannot own more than 10% of a company's stock, so "99%" and its associated valuation is a promise, not a realized donation.

Dolan, K.A. (2015, December 4). Mark Zuckerberg explains why the Chan Zuckerberg Initiative isn't a charitable foundation. *Forbes*. Retrieved August 8, 2018, from https://www.forbes.com/sites/kerryadolan/2015/12/04/mark-zuckerberg-explains-why-the-chan-zuckerberg-initiative-isnt-a-charitable-foundation/#e07229770c5e

170 Clark, J. & McGoey, L. (2016, November 19). The black box warning on philanthrocapitalism. *The Lancet, 388* (10059), 2457-2459;

Dolan, K.A. (2015, December 4). Mark Zuckerberg explains why the Chan Zuckerberg Initiative isn't a charitable foundation. *Forbes*. Retrieved August 8, 2018, from https://www.forbes.com/sites/kerryadolan/2015/12/04/mark-zuckerberg-explains-why-the-chan-zuckerberg-initiative-isnt-a-charitable-foundation/#e07229770c5e

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172 Crunchbase, Inc. (2018). *Panorama Education*. Author. Retrieved August 8, 2018, from https://www.crunchbase.com/organization/panorama-education/investors/investors_list#section-investors;

Crunchbase, Inc. (2018). *BYJU's*. Author. Retrieved October 11, 2018, from https://www.crunchbase.com/organization/byju-s#section-overview;

Education Week (2016, March 7). *Tangled web: Zuckerberg & Chan's education grants, investments*. Author. Retrieved August 8, 2018, from https://www.edweek.org/ew/section/multimedia/Zuckerberg-chan-education-grants-investments.html;

Watters, A. (n.d.). *CZI's investments*. Retrieved August 8, 2018, from https://hack-education-data.github.io/chan Zuckerberg-initiative/investments.html

173 Barnum M. & Zhou, A. (2018, September 6). Mark Zuckerberg's education giving so far has topped $300 million. Here's a list of where it's going. *Chalkbeat*. Retrieved October 9, 2018, from https://www.chalkbeat.org/posts/us/2018/09/06/czi-education-donations-list/;

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Additionally, in 2017, Facebook introduced artificial intelligence to scan all posts for patterns of suicidal thoughts. The ostensible purpose for implementing this technology was to provide early warning of possible suicides. However, Facebook did not indicate to which other uses the information might be put, although Mark Zuckerberg wrote about his aspirations for Facebook's artificial intelligence to collect and interpret additional information, for example information that might be related to bullying and hate. Users cannot opt out of this feature.

Constine, J. (November, 2018). Facebook rolls out AI to detect suicidal posts before they're reported. *TechCrunch*. Retrieved October 18, 2018, from https://techcrunch.com/2017/11/27/facebook-ai-suicide-prevention/

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Callahan, D. (2016, June 13). A top community foundation pulls back the curtain on donor-advised funds—

to a point. *Inside Philanthropy*. Retrieved October 9, 2018, from https://www.insidephilanthropy.com/home/2016/6/13/a-top-community-foundation-pulls-back-the-curtain-on-donor-a.html

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181 Google provided Digital Promise $6.5 million "to research and implement a professional development model that uses coaches to help teachers optimize the use of technological resources in classrooms." Launched in 2017, the Dynamic Learning Program continues to work with Google to create trainings, tools and resources to support districts in creating and/or building coaching programs that encourage teachers to use technology in their classrooms.

Abamu, J. (2017, July 28). Google and Digital Promise reimagine teacher tech training with new national program. *EdSurge*. Retrieved October 18, 2018, from https://www.edsurge.com/news/2017-07-28-google-and-digital-promise-reimagine-teacher-tech-training-with-new-national-program;

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CK-12 Foundation (2018). 100% free, personalized learning for every student [webpage]. Retrieved October 12, 2018, from https://www.ck12.org/student/

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Google (n.d.). *Richardson West Junior High Arts and Technology Magnet School creates a culture of innovation*. Author. Retrieved October 12, 2018, from https://edu.google.com/latest-news/stories/richardson-west/?modal_active=none

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See also:

Singer, N. (2017, May 13). How Google took over the classroom. *New York Times*. Retrieved July 23, 2018, from https://www.nytimes.com/2017/05/13/technology/google-education-chromebooks-schools.html;

Wang, L. (2018, October 9). Mobile apps, mobile teachers with Classroom. The Keyword [blog]. Retrieved October 12, 2018, from https://www.blog.google/outreach-initiatives/education/mobile-apps-mobile-teachers-classroom/

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Watters, A. (2015, February 25). How Steve Jobs brought the Apple II to the classroom. *Hack Education* [blog]. Retrieved August 15, 2018, from https://hackeducation.com/2015/02/25/kids-cant-wait-apple

185 See Google for Education's twitter feed for the many ways Google encourages teachers to use its products: https://twitter.com/GoogleForEdu;

Abamu, J. (2018, January 23). Google's education suite Is still free, but new add-ons for administrators come with a fee. *EdSurge*. Retrieved July 23, 2018, from https://www.edsurge.com/news/2018-01-23-google-s-education-suite-is-still-free-but-new-add-ons-for-administrators-come-at-a-price?utm_content=buffer5e76d&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer;

Molnar, M. (2018). 40 most popular ed-tech tools in K-12 identified in new analysis. *Education Week*. Retrieved July 23, 2018, from https://marketbrief.edweek.org/marketplace-k-12/40-popular-ed-tech-tools-k-12-identified-new-analysis/ [subscription required to access underlying report]

186 Chromebooks prices start at $149 each (paid to manufactures such as Samsung and Acer). Google charges a $30 per device management charge. Additional costs may include those for insurance and cases for the devices, adequate wifi to run them, and support for the use of software not compatible with the Chromebooks;

Gumdrop (2017). *Costs of Chromebooks in schools*. Author. Retrieved July 24, 2018, from https://www.gumdropcases.com/blogs/news-1/costs-of-chromebooks-in-schools;

Singer, N. (2017, May 13). How Google took over the classroom. *New York Times*. Retrieved July 23, 2018, from https://www.nytimes.com/2017/05/13/technology/google-education-chromebooks-schools.html

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National Center for Education Statistics. Digest of Education Statistics, Table 203.10 (Enrollment in public elementary and secondary schools, by level and grade: Selected years, fall 1980 through fall 2026). Author. Retrieved August 15, 2018, from https://nces.ed.gov/programs/digest/d16/tables/dt16_203.10.asp

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Google (n.d.). *If your school doesn't have G-Suite for Education, don't worry. It's free, and we'll help your administrator get started* [web form]. Retrieved August 15, 2018, from https://edu.google.com/learn-how/tools-referral/ Accessed from https://edu.google.com/k-12-solutions/g-suite/;

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Ressler, G. (2017, March 15). Google Classroom: Now open to even more learners. The Keyword [blog] Retrieved August 15, 2018, from https://www.blog.google/outreach-initiatives/education/google-classroom-now-open-even-more-learners/

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Google (n.d.). G Suite Services Summary [webpage]. Retrieved August 15, 2018, from https://gsuite.google.com/intl/en/terms/user_features.html

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Gilulla, J. (2015, December 2). *Google's student tracking isn't limited to Chrome Sync.* Electronic Frontier Foundation. Retrieved August 15, 2018, from https://www.eff.org/deeplinks/2015/12/googles-student-tracking-isnt-limited-chrome-sync

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Lea(R)n, Inc. (2018). *EdTech Top 40: 2017-2018 school year*. Author. Retrieved October 8, 2018, from https://learnplatform.com/edtech-top-40

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Google (n.d.). *G Suite for education (online) agreement*. Author. Retrieved July 23, 2018, from https://gsuite.google.com/intl/en/terms/education_terms.html;

Google (n.d.). *G Suite for education privacy notice*. Author. Retrieved July 23, 2018, from https://gsuite.google.com/terms/education_privacy.html;

Google (May 25, 2018). Google privacy policy. Author. Retrieved Juy 23, 2018, from https://www.gstatic.com/policies/privacy/pdf/20180525/853e41a3/google_privacy_policy_en.pdf

For analysis, see:

Cope, S. & Cardozo, N. (2018, January 29). It's time to make student privacy a priority. Electronic Frontier Foundation. Retrieved July 23, 2018, from https://www.eff.org/deeplinks/2018/01/its-time-make-student-privacy-priority;

Gillula, J. & Cope, S. (2016, October 6). *Google changes its tune when it comes to tracking students*. Electronic Frontier Foundation. Retrieved July 23, 2018, from https://www.eff.org/deeplinks/2016/10/google-changes-its-tune-when-it-comes-tracking-students

194 For an example of instructions to graduating seniors, see:

Bridgeport Public Schools (n.d.). Migrate data from BOE Google account to personal account [webpage]. Retrieved November 18, 2018, from https://sites.google.com/a/bridgeportps.net/google-apps-and-chromebooks/migrate-data-from

For Google's instructions, see:

Google (2018). *Allow graduating students to transfer their data*. Author. Retrieved August 15, 2018, from https://support.google.com/a/answer/6364687?hl=en

195 The director of Google's education apps group, Jonathan Rochelle, told the *New York Times* that according to the privacy policy, after graduation, personal Gmail accounts may serve ads but that Google does not scan files in Google Drive for the purpose of showing ads.

Singer, N. (2017, May 13). How Google took over the classroom. *New York Times*. Retrieved July 23, 2018, from https://www.nytimes.com/2017/05/13/technology/google-education-chromebooks-schools.html

196 A persistent identifier can be used to recognize a user over time and across different Web sites or online services. Examples include a customer number held in a cookie, an Internet Protocol (IP) address, a processor or device serial number, or unique device identifier. The Federal Trade Commission (FTC) regards persistent identifiers as personally identifiable because they "can be reasonably linked to a particular person, computer, or device," and included persistent identifiers in its definition of "personal information" in its 2013 amendments to the Children's Online Privacy Protection Rule. In a 2016 blog post, the director of the FTC's Bureau of Consumer Protection noted: "Even without a name, you can learn a lot about people if you use a persistent identifier to track their activities over time on a particular device. You also can communicate with them." She warned the online advertising industry, "If you're collecting persistent identifiers, be careful about making blanket statements to people assuring them that you don't collect any personal information or that the data you collect is anonymous."

Rich, J. (2016, April 21). *Keeping up with the online advertising industry*. Federal Trade Commission. Retrieved November 18, 2018, from https://www.ftc.gov/news-events/blogs/business-blog/2016/04/keep-

ing-online-advertising-industry

197 Counsel for Center for Digital Democracy and Campaign for a Commercial-Free Childhood (2018, April 9). In the matter of request to investigate Google's YouTube online service and advertising practices for violating the Children's Online Privacy Protection Act [Complaint filed with Federal Trade Commission]. Retrieved August 15, 2018, from https://www.commercialfreechildhood.org/sites/default/files/devel-generate/tiw/youtubecoppa.pdf

Children's Online Privacy Protection Act,15 U.S. Code Chapter 91. Retrieved August 15, 2018, from http://www.law.cornell.edu/uscode/text/15/chapter-91

198 Golin, J. (2018, November 21). Personal communication (email) with Faith Boninger.

199 For discussions of concerns about possible future uses, see:

Boninger, F. & Molnar, A. (2016). *Learning to be Watched: Surveillance culture at school—The eighteenth annual report on schoolhouse commercializing trends, 2014-2015*. Boulder, CO: National Education Policy Center. Retrieved July 23, 2018, from http://nepc.colorado.edu/publication/schoolhouse-commercialism-2015

Saltman, K.J. (2016, April 19). Corporate schooling meets corporate media: Standards, testing, and technophilia. *Review of Education, Pedagogy, and Cultural Studies, 38*(2), 105-123.

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