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Technologies for Education and Technologies for Learners: How Information Technologies Are (and Should Be) Changing Schools

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Technologies for Education and Technologies for Learners: How Technologies Are (and Should Be) Changing Schools

The revolution in information technologies is changing the ways we think about education. The role of public education today is to organize learning *for* students, and to measure student success in terms of compliance with school expectations for learning. We already know what students need to know, that schools need to control access to the range of what is worth knowing, and that disciplinary mastery is the condition for successful student learning go unquestioned. Information technologies call the traditional relation of educators and learners into question (Collins and Halverson, 2009). Traditional learning environments are organized by educators; new technologies allow for the creation of environments by learners. New media technologies begin with learner interest, and exist to help learners explore interests as pathways to learning activities (Jenkins, Clinton, Purushotma, Weigel & Robison, 2007).

Open access to information resources, and the opportunity to build skills through engagement with data, present contemporary education with significant challenges to its status quo. One view is that schools and classrooms should simply reject the potential of information technologies to change instructional practices. In this view, the value of status quo practices simply outweighs the transformative power of new technologies. Researchers in this tradition conclude that there is little evidence that computer-aided instruction improves classroom outcomes at scale (e.g. Campuzano, Dynarski, Agodini & Rall, 2009; Angrist & Lavy, 2002; Goolsbee & Guryan, 2005; Rouse, Krueger & Markham, 2004). The lack of evidence that technologies improve learning, taken together with the stubbornly traditional practices of the classroom, led Larry Cuban to observe that when the computer meets the classroom, the classroom wins (Cuban, 1994). Schools would be well advised, under this view, to bypass advances in learning technologies and to focus on developing lo-tech practices that help students achieve the learning goals we value.

One problem with this view is that showing that *classrooms* resist technologies is not the same as showing that *schools* are equally resistant. The leading policy changes over the past 10 years, sparked by the No Child Left Behind law and the Race to the Top initiative, have pushed schools to embrace the world of information technologies (Burch, 2009). All K-12 public schools are required to have the capacity to collect and use student achievement data to improve learning outcomes. By 2007-08, 99% of all districts had a student information system; 77% had a data warehouse, and 64% had instructional or curriculum management systems (Means, Padilla & Gallagher, 2010). The overwhelming adoption of sophisticated data technologies has deeply influenced how school and district leaders consider their everyday work. The rhetoric of data-driven decision-making pervades every aspect of public school life. Initiatives ranging from the What Works Clearing House, Measures of Effective Teaching and Response to Intervention emphasize the increasing role that student performance data play in instruction, staffing and special education. Even if classrooms remain relatively immune to the effects of new technologies, accountability policies have completely soaked the environment with consequential data systems designed to compel instructional change.

This paper explores the curious ways in which new technologies have, and have not, been taken up by schools. We begin with an exploration of how digital technologies have transformed everyday learning and entertainment practices, and though classrooms have been relatively unaffected by these new technologies, school management practices have been completely transformed by data technologies. We propose that these two levels of reform provide the basis for an illustrative contrast between technologies for *education* and technologies for *learners*. The differences in adoption are not, we argue, a result of *kinds* of technology at play. Rather, we suggest that the patterns of adoption result from differing *cultures of use*: schools adapt technologies in *accountability* cultures, and learners adapt technologies in *participatory* cultures. Organizational theorists have long observed how institutions adapt innovations to uses that are consistent with existing cultures and practices (Argyris & Schön, 1996). The same kinds of technologies can support a wide range of practices depending on how users frame the problems that need to be solved (Orlikowski, 2000). Our contrast between technologies for education and for learners is intended to highlight the how the cultures of use in schools and in the world explain the ways that technologies have, and have not, flourished in schools, and point toward productive opportunities for schools to embrace the power of new technologies.

Technologies for Education; Technologies for Learners

Technologies for education describe tools that policy makers and leaders use to measure the process and quality of academic work in schools. Technologies for education assume that the goals (or outcomes) of teaching and learning are stable, and that the challenge of technological innovation is to fashion efficient, viable, and successful means to reach these goals. Tools include technologies that (a) create and store data that document progress toward educational outcomes, (b) structure learning processes that enable students to meet outcomes, and (c) organize teaching practices in ways that lead toward student learning goals. Examples of technologies for education include student information systems, learning management systems, benchmark assessments, computer-guided instructional tools, and state accountability systems. Technologies for education are designed, as far as possible, to resist interference from the local conditions of implementation, and when correctly used, reliably guide learning and produce evidence that correctly documents learning outcomes. Technologies for education are designed to make a predictable impact on the greatest number of students. Efficacy and fidelity of implementation are the marks of successful technologies for education. With technologies for education, the path of information flows away from the learner and toward system management. This is true in the case of accountability systems, where data flows from the classroom and to administrators, and true of formative feedback systems, where data flows from the learner to the teacher. Technologies for education have proliferated widely in schools, and have come to define the contemporary discourse of data-driven instructional change in schools.

Technologies for learners, on the other hand, are designed to support the needs, goals, and styles of individuals. While schools have exploited the potential of technologies for education, technologies for learners have exploded in the worlds of entertainment, social networking and information access outside of schools. Technologies for learners include digital media production tools, such as word processors, presentation software, blogging tools, and video editing tools, but also include technology-mediated activities such as video games, fantasy sports, fan fiction, and on-line stock trading. They are designed to be flexible, customizable, and adaptive to learner needs, and are best suited to fit learner-selected goals. Learner technologies are often adapted, discarded, and replaced by other tools as learners select new goals. Technologies for learners are typically embedded in distributed communities of practice and social organizations that allow novices to lurk in the margins until they are ready to join experts in conducting central organizational tasks. Adaptability and market share are the marks of successful technologies for learners. Technologies for learners have not proliferated widely in school instructional programs because they challenge the standards-based, institutionally controlled agenda for data-driven instructional change in schools. With technologies for learners, information flows toward the user/player/learners and informs the learning process.

Technologies for education and for learners both rely on similar forms of distributed database systems linked across Internet-based technologies; both generate information that can document and describe learning; and both can be adapted to meet the needs of existing learning goals. However, the social organization of knowledge use differs sufficiently in and out of schools to make technologies for education acceptable, and to push technologies for learners to the margins of schools. While school districts invest heavily in school information systems, they continue to hesitate approving student cellphone use, and ban Facebook and gaming in classrooms. The social and organizational practices that allow schools to embrace data-driven decision making also prohibit schools from investigating how technologies for learners can enhance education. Defining the legitimate use of technologies in terms of accountability-driven data systems has led educators to stigmatize the potential of technology for learners.

The next sections of the paper outline what we know about technologies for education and technologies for learners. The paper concludes with suggestions for research agendas that might help researchers and reformers integrate the two uses of data technologies in ways that bring about a new generation of teaching and learning in schools. Both approaches to technology –related change have transformed how we think about the delivery, measurement, and organization of learning in and out of schools. The debate about the kinds of tools necessary for research and reform belies the underlying similarities across technologies for education and for learners. The debate between technologies for education and for learners comes down what we expect from the future of schooling. If we think that we already have adequate methods for improving learning for all students, and that progress in education reform is simply a matter of better implementation and better assessment, then we should continue to invest in technologies for education. If, however, we believe that the way we have been organizing schooling is inadequate to meet the needs of all students, and if we think that we can learn from how technologies have been used outside of education, then we should move toward investing in technologies for learners.

Technologies for Education

The advent of data-driven technologies, such as school information systems, formative assessment systems, statewide school information networks, and computer-adaptive testing, has come to redefine 21st century public education. K–12 schools are increasingly organized to guide student learning toward more commonly accepted outcomes, such as competence in reading, writing and mathematics as well as goals that emphasize completion, such as graduation. These outcomes are seen as important for college admission and career success. School success at producing core learning outcomes is thus seen as a social good necessary for passing on knowledge and skills and for economic vitality. Technologies for education serve these system goals, and seek to guide leaders, teachers, and students toward meeting desired outcomes for learning. These technologies generate, collect and distribute information on the degree to which students meet learning goals, and the practices of data-driven decision practices organize technologies to create feedback loops that can guide instructional practices in light of student achievement.

Contemporary public school work is dominated by accountability culture. Accountability cultures focus institutional efforts on producing and documenting desired outcomes. Accountability-driven schools talk about “using data” to “improve teaching and learning.” The contemporary discussion of data use in schools has been dominated by an accountability logic that uses information to measure the school’s ability to produce learning goals. The accountability logic is grounded in (a) clearly defining the common standards towards which learning should be directed, (b) developing assessments that measure the degree to which education systems achieve standards, and (c) providing feedback to schools on the gaps between current and expected achievement outcomes. Accountability logic guides the design of new tools and practices that, in time, are routinized in ways that establish an accountability culture. Ideally, accountability measures are organized to hold schools responsible for student performance on statewide tests (Fuhrman, 2003). The accountability logic in education emphasizes the following assumptions:

1. Learning is defined as the mastery of predefined content.
2. Content standards (defined by society in the form of professional advisory committees) provide the goals for what is to be learned.
3. Successful school instruction implements instructional materials and practices that produce desired learning outcomes.
4. Assessments detail the degree to which domain knowledge is transferred to students.
5. Teachers and schools should be judged (and rewarded) on the degree to which assessments measure the quality of instruction.

Much of our recent national discussion as education policy makers, researchers, and practitioners has focused on assumption #5. The recent Race to the Top policy debate, for example, considers how assessment information should be used, which interventions "work," and how teachers and school leaders should be rewarded for producing desired student learning results. Often, the academic debate spills over into #4 in conversations about which assessments should be used, how current assessments are misused or lead to unintended consequences, how one set of assessments should be compared to another, or about how to improve assessment practices. But the overall structure of the accountability argument remains in place, and has come to define the discourse about public schooling and the cultures of local school communities.

Technology use in accountability cultures focuses on how data systems allow members to monitor progress toward producing outcomes. Accountability systems have sparked new forms of data-driven decision making as a model for using technologies to improve teaching, learning and leadership practices in schools. The advent of data-driven accountability has closed a loop about the role of standards and assessments in schools. In the 1990s, content standards recommended instructional practices to schools. Standards were developed largely independently of specific assessment practices, and designers expected local schools to use standards as guidelines for the development of local instructional, assessment, and professional development practices (Ravitch, 1995). Teachers framed instructional practices in terms of standards, to be sure, but without common assessments it was difficult to rein in (or evaluate) the diversity of instructional practices. Data-driven decision making links standards, assessments and instruction into a system through which data on performance can flow. Attending to data-driven decision making practices requires educators to rein in the considerable amount of information generated by assessments, and to focus attention on efforts that relate data directly to student learning (Hamilton et al., 2009). Data-driven decision making practices hold organizational outcomes constant (i.e. learning goals for the system and for the students) and cultivate the ability of local actors and learners to organize and select the appropriate instructional means and assessments. Schools and districts orchestrate new forms of professional interaction to translate data-driven diagnoses into new practices (Honig, Copland, Rainey, Lorton, & Newton, 2010). Savvy school leaders created data-driven instructional systems by structuring and sequencing activities such as data collection, data reflection, program alignment, program implementation, formative feedback and test preparation to form an assessment-driven school-wide information loop (Halverson, Grigg, Prichett, & Thomas, 2007; Boudett, City, & Murnane, 2005). The role of information technologies is to provide the capacity to collect and distribute information to support accountability.

The multiple layers of information management necessary for successful accountability practices play a central role using data to improve school performance. From the outside, summative assessments (e.g. standardized tests) provide public testimony on the school's effectiveness in meeting learning goals. From the inside, school leaders and teachers create an ecosystem of formative assessments to monitor the progress of instructional practices toward helping students meet learning goals. Data technologies, such as school information systems, benchmark assessment systems, computer-guided instructional tools and learning management systems, store and distribute assessment information to relevant stakeholders. Taken together, the technologies bind monitoring practices into the resilient "accountability systems" that have come to define early 21st century public schools (Fuhrman & Elmore, 2004). Schools across the USA purchased information technologies, which originated in the business world, to meet the accountability-driven reform agenda. While states invest in the assessments, schools are expected to furnish information systems that capture, store, and track student performance on standardized tests (Burch, 2009).

In the following sections, we highlight three types of technologies for education that have been used widely in recent public school reforms: a) school information systems, b) assessment technologies, and c) instructional programs and systems. Each of these technologies has been adapted to fit within the constraints of accountability logic. School information systems collect, organize and distribute the information necessary to engage in data-driven decision making; assessment technologies (such as benchmark assessments, and related efforts on core standards and learning progressions) aim to produce better information to guide educator action; and instructional programs (e.g. cognitive tutors and computer-guided instruction) and systems (e.g. learning management systems) seek to optimize the organization of instruction materials and practices.

School Information Systems

The defining technologies for education collect, store, distribute, and provide analytic tools on student performance data. The most ubiquitous type of technology for learning is the *school information system*. The district-wide data system provides the information technology conduit network through which accountability information flows. School information systems (SIS) provide the archetypal technologies for education. A primary function of a K–12 accountability system is to capture, store and analyze student-level assessment data. SIS are typically third-party, commercial database systems that provide real-time access to student attendance, demographics and performance; warehouses that store and provide access to information; and analytic tools that allow users to interpret data in various ways (Wayman, 2005). SIS often also include components that organize curricula and instructional materials, manage financial information, provide planning tools, coordinate scheduling and student services, and open the data system for public access. Because different vendors often provide these components, over 60% of school technology leaders continue to face the challenge of integrating information flow across platforms (Means, Padilla, & Gallagher, 2010).

The primary use of the student information system is to provide districts (vs. schools) with the information necessary to document school system performance to external audiences. The SIS takes information from students, classrooms, teachers and schools and reports it to state agencies, board members and policy makers. Thorn (2002) described how school information systems are designed to organize data for administrative purposes, that is, for school leaders to measure and monitor the success of the instructional system. In Thorn's view, the function of the school information system is to analyze information taken from the school and classroom context in order to render judgment on the instructional quality. Thus the SIS reinforces the tendency of technologies for education to support the information needs of systems managers (administrators), rather than system participants (teachers and students).

The focus of school information systems has recently shifted toward tools that provide teachers with the information they need to guide instruction. Means, Padilla, & Gallagher (2010) note that while 90% of districts capture student performance and attendance information, less than half can link outcome data to instructional or teacher practices. Teachers are largely left to their own (typically low-tech) devices to organize the disparate data sources that need to be managed in successful classrooms. Teachers use data in different ways than system administrators. In classrooms, educators consider student problems individually (rather than collectively) and think carefully about the relation between interventions and individual student outcomes (Confrey & Makar, 2005). And, of course, the only role for students in the typical SIS is to contribute information. Generated by accountability pressures, the contemporary SIS responds mainly to the custodians, not the customers, of the education system.

Assessment Technologies

Assessments provide the bulk of the performance data in contemporary accountability systems. The assessments required by NCLB have transformed the data landscape for local schools and districts. NCLB required all public schools to test students in Grades 3–8 and one year in high school, in reading, math, and sciences. The tremendous amounts of data generated by required testing sparked the need for school information system technologies. It also sparked public critique of current testing practices and learning standards.

The widespread implementation of high-stakes assessments has illustrated the inherent (and often tacit) flaws of test-driven accountability practices. The five testing companies that controlled 90% of the testing market faced critical problems of quality control as the NCLB-driven market ramped up (Toch, 2006). The bigger problem, though, was that the standardized tests adapted by states for NCLB were not designed as accountability measures. Koretz (2008) highlighted the corrupting tensions inherent in the simultaneous use of a single standardized test as a measure of learning and as a standard of accountability. The pressure to produce higher scores can lead educators to game assessment systems at the expense of investing in real learning gains. Further, the use of state-wide tests for improving local teaching and learning practices confronted a considerable time gap between the testing and teaching. If a state conducted testing in the fall (capturing what students learned the previous year), and schools received test results in the spring, then the reformed teaching practices would take place in the following fall. (This two-grade-level gap is 20% of a third-grader's life!) The temporal gap highlighted the distance between testing and instructional practices, and led policy-makers to investigate new ways to tightly couple curriculum, teaching, and assessments.

The press to reform assessment led in two directions – toward reforming what students need to know (standards) and to develop new approaches to testing. One reform direction was to develop new national standards that could bring together the diverse state-based learning standards. The Common Core Standards Initiative,[1] for example, re-wrote K–12 learning standards into statements that are readily translatable into measurement activities. Although the Core Standards are not designed to prescribe the curricula that schools teach, the ease with which the standards can be turned into assessments influences the choice of school instructional programs. The need to articulate national learning standards into measurable learning outcomes has also led the development of learning progression research (Heritage, 2008). Learning progressions trace the development of student understanding in a discipline, and predict the trajectories students follow to gain knowledge over time (Stevens, Shin, Delgado, Krajcik, & Pellegrino, 2007). Understanding learning development at the disciplinary level also helps teachers anticipate the misunderstandings that typically arise in the course of learning (c.f. Norman, 1983). Articulating learning progressions affords more targeted assessments that can provide formative data on the micro-processes of learning (Alonzo & Gearhart, 2006). SIS technologies make it possible to think about collecting and organizing the kinds of data that make such refined assessment practices feasible in classrooms.

Computer-adaptive assessments present a new form of technology-driven testing that provide timely information to document student learning. Computer-adaptive tests tailor the difficulty of exam items to the individual test-taker. This allows for a more efficient test-taking experience, and the computer-based testing provides instant feedback. These tests give new currency to formative assessment research (e.g. Black & Wiliam, 1998) as educators and reformers consider how to generate and use testing data to improve instructional practices. Benchmark assessments, such as the Northwest Evaluation Association's *Measures of Academic Progress* (MAP) or CTB McGraw Hill's *Acuity*, are computer-adaptive tests that provide timely feedback on student learning in terms of content standards. To be sure, the emergence of formative assessment tools has not been smooth. Shepard (2010) notes that interim assessment systems narrow the curriculum to the knowledge evaluated by standardized tests, and Blanc, Christman, Liu, Mitchell, Travers & Bulkley (2010) suggest that successful use of interim assessment technologies requires robust professional capacity to use data for instruction. Still, the widespread use of benchmark assessments (by 2008, 79% of US districts had benchmark assessment systems (Means et. al. 2010)) point toward a significant investment in computer-adaptive testing.

Evidence-centered design (Mislevy & Haertel, 2006) further develops computer-adaptive testing environments around tasks that provide evidence to support claims about learner competencies. These tasks trace an arc through a complex learning domain, and provide adaptive assessments that capture the degree to which learners master the skills used to engage in task elements (Shute, 2009). Curriculum-embedded assessments, for example, aim to reduce the gap between learning and testing assessment by structuring curricula to yield immediate feedback on task performance (Shavelson, Young, Ayala, Brandon, Furtak, Ruiz-Primo & Yin, 2008). These technologies assume that differences between learners can be measured in relation to a specified

[1] http://www.corestandards.org

domain map, and that learning technologies can provide customized support to guide learners toward desired learning goals. Mislevy, Steinberg, and Almond (2002) argue that advances in technology have made it possible for researchers and practitioners to manage the large amounts of data involved in providing evidence for performance-based assessments.

New assessment technologies for education are also being adapted for mobile devices. Early literacy tools, such as DiBELS, served as models for easy-to-administer assessment on student learning progress. Developers have responded to this interest by building handheld versions of formative assessments. Wireless Generation's mClass products operationalize early reading assessments into handheld tools to help teachers manage assessment data and link performance data to the school information system (Penuel & Yarnall, 2005). Classroom response systems, such as clickers, provide another level of whole class feedback on instruction. The digital interaction of classroom response systems not only provides instant feedback to students; it also leaves a record of interaction that teachers can view as evidence of student understanding and participation (Crawford, Schlager, Penuel, & Toyama, 2008).

Instructional Technologies

Technologies are also used to organized and deliver instructional content in schools. In some ways, learning management systems (LMS) are the instructional counterparts of school information systems. A typical LMS automates course administration, provides user-guides to learning resources, organizes and provides access to learning content, and personalizes learning tools in terms of user preferences (Ellis, 2009). An LMS mediates interaction between instructors and learners through resources, such as discussion boards, drop-boxes, chat tools, visualizations, and wikis to support learning. Online learning management systems, such as Blackboard and Moodle, have become quite popular in secondary schools and at universities. LMSs support a range of interactions including collaborative student-teacher wiki construction, discussion forums, student polling, interactive online texts, and online quizzing/testing. A typical LMS affords "teachers generating content, teachers gathering resources, teachers grouping and sequencing information, and teachers giving the information to students" (Mott & Wiley, 2010). LMS tools are typically used extend the reach of the classroom; teachers cannot easily see work in past classes, cannot easily adapt and re-use each others' content, and cannot help students to build upon the work of others who have come before them because past years/semesters' work is usually made inaccessible. The controls of the LMS are in the hands of the educators, not the students.

While the LMS is used to coordinate learning activities toward school learning goals, other technologies have emerged to guide instruction in the classroom. Computer assisted instruction (CAI) structures activities for individual learners. CAI systems can range from page-turning programs that replicate the structures of textbooks to videogames that scaffold learning activities toward desired outcomes. Schools have long made investments in comprehensive computer assisted learning platforms, such as PLATO and Read180, to provide supplemental instructional support for struggling learners. Virtual schools draw on the capacities of LMSs and CAI to provide course content for millions of students.

Some of the most interesting computer-assisted instructional activities come from learning sciences research. The learning sciences emerged in the 1990s as a field that drew together cognitive scientists, computer scientists, and education researchers around socio-cognitive methods to study the design and evolution of learning environments (Sawyer, 2006). Learning sciences research has resulted in a wide variety of information technologies designed to improve student learning. Cognitive tutoring systems, for example, represent cutting-edge versions of computer-assisted learning tools (Koedinger & Corbett, 2006). Cognitive tutors can teach students to solve complex problems (typically in math) by tracing a sequence of steps; can provide specific, context-dependent feedback on student work; and can select subsequent problems based on established levels of learner performance. Receiving feedback from a cognitive tutor, rather than from a peer or a teacher, has proven a successful model for delivering feedback and for improving outcomes for struggling learners (Morgan & Ritter, 2002; Sarkis, 2004). These tutoring systems, which are closely aligned to a top-down control systems view of technology for learning, provide reliable, tested examples of how technology-based learning environments can be tethered to serve existing learning goals.

School information systems, new approaches to assessment, and instructional technologies are defining types of technologies for education. Each technology supports the goals of educators dedicated to teaching students toward system outcomes. Each takes the disciplinary organization of knowledge as a starting point, and assumes that the goal of an instructional system is to organize resources as means toward these valued social ends. However, the list seems heavy on technologies that administer education and that draw information away from teachers, and especially, from learners. We turn next to the kinds of technologies that flourish outside the classroom, and that put the control of the learning environment firmly in the grasp of the learner.

Technologies for Learners

Technologies for learners are organized to support the needs of users, not system designers, administrators, or educators. The vast and expanding realm of entertainment and consumer technologies is dominated by technologies for learners. Many technologies for learners are Internet-based new media tools. Technologies such as social networking, video gaming, Wikipedia, Google, fantasy sports, and mobile devices flourish by serving the needs of their users. Tools that are difficult to use, have arcane interface designs, limited customizability, or awkward conditions of use are cast aside in favor of tools that give what users want. Goals are chosen by the learner, not by the system in which the learner participates. The technology is designed to aid the user in choosing goals, as well as providing compelling and entertaining means to achieve the goals. There is no successful use, for example, of Facebook. Rather Facebook serves a wide variety of user goals. Some people use Facebook to network for jobs, others play online games, and others to engage in hybrid spaces that allow multiple paths for interaction with friend networks (boyd, 2008). Instead of information being generated for system administrators to assess system success, here information is generated to serve the interests of users.[2] Technologies for learners give users control of relevant information, and provide systems to manage cognitive load so that users can focus on the appropriate information to facilitate activities.

It may seem odd to label these largely consumer tools as "technologies for learners." After all, users are not students, and the motivations for use of new media tools may seem to have little to do with learning. Many of these tools are chosen based on user convenience, and are used for mainly for entertainment or for everyday aims. If we equate learning with disciplinary mastery, then it would be difficult to maintain that Google or the iPhone are technologies for learning. Further, many schools and institutions of learning have either banned or marginalized these technologies from everyday use. However, a key point our argument is how information technologies are changing the boundary of what counts as learning. Revising the necessary relation between schooling and learning means that we can now see the ubiquity of learning outside the school context; and how information technologies have radically redefined this wider world of learning. A simple Google search for a recipe is a quest to learn the answer to a question; a contribution to Wikipedia on the exchange value of the Yuan is participation in a learning community. Participating in a fantasy football league is an on-going effort to learn who are the best players in professional sports. Because new technologies are built around the distribution of information, users interact with the technologies as interested consumers and generators of information. These information uses are driven by users' multiple goals in that they participate in order to learn, to socialize, and to have fun. These fundamental human goals are simultaneously realized through participation in informal media. New media technologies help users learn what they want when they want, and do not demand disciplinary mastery as a condition for successful participation.

The shifting definition about what counts as learning has not gone unnoticed. Researchers and writers have remarked how new media distract us from the educational and social goals we value. Because, in many cases, learners would rather participate in new media environments, advocates of schools have dismissed and downplayed the potential of these technologies. We read about the detrimental effects of new media technologies on our students: how Google makes them stupid (Carr, 2008); how Facebook makes them sad (Jordan, Monin, Dweck, Lovett, John & Gross, 2011) and more likely to become bullies (Cross, Piggin, Douglas & Vonkaenel-Flatt, 2012); how Wikipedia leads to plagiarism (iParadigm, 2007); and how video games make them violent (Anderson, Shibuya, Ihori, Swing, Bushmna, Sakamoto, Rothstein & Saleem, 2010) and

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[2] Of course, we recognize the public debate that surrounds the potential of new media companies like Google, Facebook and Apple to collect user information to advance the goals of the technological system. Like technologies for educators, new media tools generate considerable information about users, as well as for users. Our point is that the widespread proliferation of new media tools depends crucially on the value that the information tools provide to system users. Technologies for learners flourish (when they do) in open systems that depend on the perception of value that users attribute to the system. This attention to the user experience creates the conditions for new media technologies to focus on issues such as user interface design and the accessibility of valued features in typical user experience.

poor readers (Weis & Cerankosky, 2010). Seen from the perspective of the status quo, new media threatens the motivation of learners to participate in business as usual school practices.

One way to think about the potential of technologies for learners is to understand the (notoriously hard to define) role of institutional culture in supporting technologies. Michael Cole (2010) refers to culture as "an accumulated body of knowledge and practices essential to the process of raising children in a manner that will secure the future of the social group." (p. 462) Because cultures provide access to previously developed ideas, they play an inherently conservative role of situating new practices in terms of existing norms, values and routines. It is not surprising, then, that the technologies that fit in with existing institutional practices flourish, while those that challenge existing norms flounder. However, the additional inference that technologies for learners *damage* users, that is, make users anti-social, lonely, violent, and sad, cries out for a new conception of culture better fitted to the practices of new media.

The idea of participatory culture (Jenkins et. al., 2007) challenges the disparaging, antisocial narratives of the effects of new media on users. Participatory cultures emerge as the social expression of new media environments in which members use, create, and share content and strategies for engagement. Rather than conceiving of new media participation as an isolating, antisocial experience, participatory cultures draw attention to the range of social interactions created by participation with new media. Jenkins et. al., propose that participatory cultures afford four forms of engagement (p. 3):

- *Affiliations* — memberships, formal and informal, in online communities centered around various forms of media, such as Facebook, message boards, and game guilds;
- *Collaborative problem-solving* — working together in teams, formal and informal, to complete tasks and develop new knowledge, such as Wikipedia, alternative reality gaming, and fantasy sports;
- *Expressions* — producing new creative forms, such as digital sampling, digital media production, fan fiction, and modding;
- *Circulations* — shaping the flow of media, such as remix, mash-ups, podcasting, Flickr and blogging.

When stated as positive venues for interaction, each form of engagement in participatory cultures has obvious value to contemporary education discussions. Affiliations, for example, complement the disciplinary focus of schools, and engage participants in affinity spaces (Gee, 2004) to tackle difficult content. Expressions give new ways to access the power of student representation and authentic feedback as learning tools. Collaborative problem-solving is perhaps the defining 21st century skill. Problem-solving highlights how participatory cultures engage users in building knowledge about unknown problems (such as, for example, which slugger will emerge for the Twins (fantasy sports), identifying the best sushi in Biloxi (Yelp!), or crowd-sourcing protein folding to cure AIDS (Foldit.com)). Circulations provide a model of student work as "knowledge assembler" rather than as a single-source content generator. Participatory cultures typically have low barriers to expression and engagement, multiaged membership and informal mentors who pass along experience to novices, a shared belief that contributions matter, where members feel a social connection with one another. Together, these forms of interaction provide actual, living examples of contexts for "new literacies" that allow learners to engage in socially recognized ways of generating, communicating, and negotiating meaningful content and participating in socially recognized discourse practices (Lankshear & Knobel, 2006)

There is no guarantee that any given technology for learners will successfully lead to a participatory culture. The recent technology development world is littered with games, environments, and initiatives that failed to spark cultures of play and practice. However, understanding technologies for learners in terms of participatory cultures helps see how media tools can flourish in valued socio-technical contexts. Designers interested in sparking participatory cultures pay attention to the symbiotic relation of new media to user engagement. An incredible variety of robust, formative data links users and tools in participatory cultures. Data on participation levels, friend presence, and new content motivates engagement in affiliation spaces; feedback data from interested audiences, and formative data from the creative process, fuel participation in expression spaces. Data on project goal achievement, and information on tool availability, sparks participation in collaborative problem-solving spaces, and the digital environment provides a feedback rich context for involvement in circulation spaces.

The contrast in data use and generation is clear. Technologies for education generate data *for* system administrators; technologies for learners generate data *for* learners. Participatory cultures thrive with data technologies designed to provide users with rich information on system performance, activity goals, learning resources, social interaction and identity status within the system. For schools to integrate technologies for learners, schools will need to come to terms with the challenges, the costs and the value of reforming school cultures as participatory cultures

Examples of Technologies for Learners

In the next sections of the paper, we provide three examples of the kinds of participatory cultures sparked by technologies for learners: social networking, Wikipedia and video gaming. These wildly popular innovations were sparked by new technologies that scaffold user participation, provided multiple channels of data to guide user interaction, and facilitate learning and fun. Participants in each culture elect to participate with the technologies, and choose to stay engage as long as the culture helps them to address desired outcomes. Understanding the interaction of technology design and user culture point toward how schools might adapt technologies for learners to current education contexts.

Social networks. Social networks provide the prototypical example affiliation-based participatory cultures. It is difficult to grasp just how extensive social networking has become. As of December 2011, Facebook claims 845 million active users, with 483 million active daily users. 80% of Facebook users are outside the US or Canada; and Facebook is available in more than 70 languages.[3] The professional-oriented social network LinkedIn has 150 million registered users in 200 countries.[4] Social networks highlight the value of interest-driven and peer-driven social groups in everyday life. Networks provide ongoing access and a dynamic visualization of valued social connections. Social networks illustrate the power of weak ties (e.g. friends of friends) to open opportunities for incidental learning and affinity affiliation. People use social networks to maintain contact with friends and relatives, engage in education and professional practices, and to become aware of new knowledge, arts and cultural practices. Facebook and Twitter have become the news feeds for the new media generation as breaking stories often trend before being released by broadcast media.

Early social networks, most notably Friendster and MySpace, began as vital hubs of youth culture, having replaced malls as the public place of-choice for hanging out (boyd, 2008). These networks supported a wide range of friendship expressions; allowing users to make friends, extend friendship networks, and share information and opinions across friend networks. Members learn to perform delicate negotiations with friends about mutual best friend identification and to smooth over upset caused by publicly delisting or demoting friendships (boyd, 2007). Among the consequences of this activity are public or semi-public data depicting not social groups as they have typically been conceived (e.g., “jocks” and “geeks”) but egocentric networks over time.

Social networks have homework and academic support (Grockit.com), professional networking (linkedin.com) and do-it-yourself affinity based networks (ning.com; Google Groups). However, it has proven difficult for many of these “designed” networks to take root in existing organizational structures and result in vibrant social interaction. This is because social networks are built on existing affinity group, friendship or family connections. The underlying trust shared among members of a group leads users to join networks. Seeing updates by friends of friends allows users to participate in an extended trust network. When built around existing affinity spaces, social networks can support users in constructing and picking up social norms, tastes, knowledge, and culture through expressions of preference exchanged while hanging out online. For example, *RemixWorld*, created by the Digital Youth Network (DYN), is a social network used by youth to share, critique, assess, and discuss digital media products. *RemixWorld* mentors use the system to support mutual engagement in the creation of new media art; it is not only the way in which work is submitted to mentors and community, but a site of public critique and discussion and for the apprenticing of youth into a community of artists. Moreover, RemixWorld is linked to a standards-based formative assessment system so that students’ work, and related instruction, may be systematically evaluated with respect to a common set of standards during DYN professional development (Shapiro, Nacu, Gray, Lee, & Pinkard, 2010).

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[3] http://newsroom.fb.com/content/default.aspx?NewsAreaId=29

[4] http://press.linkedin.com/about

Unfortunately, the extremely restricted use of social networks in schools has limited the benefits of networking to out-of-school interactions. The institutional discomfort (legal, moral, and practical) for integrating student social lives into the classroom has thwarted efforts to bridge the divide between networks and schools. Facebook use in schools has been stigmatized as a catalyst for sexting, bullying, and for sparking inappropriate relationships between faculty and students. Appropriate use policies and software censors at many schools simply ban Facebook access from school networks. Casting social networking in detrimental terms curtails the extraordinary potential for social networking tools to transform learning in schools. Social networking provides a channel for students to construct and maintain representations of their identity that persist within and outside the institution.

Social networks can also allow students to create virtual opportunities to study together and get homework help, to participate in expert networks, and to build the kinds of new academic relationships, based on weak ties, which are vital to academic success. When schools opt out of the social networking discussion (by banning the tools), students are then left to their own devices to determine methods for appropriate use and interaction. Savvy students who understand the power of studying together and the value of weak ties to distal communities (e.g. high schoolers who are aware of the value to friend students or participate in groups from desired colleges and occupations) create an even greater gap between students who use social networks solely for entertainment and diversion. By opting out of evolution of social network uses, schools exacerbate an already growing divide between students who understand the value of networks for advancing personal and career interests, and students who do not.

Wikipedia. Wikipedia is the leading example of a collaborative problem-solving participatory culture. Like Facebook, the scope of activity in Wikipedia is astounding. Wikipedia currently has over 3.8 million articles in over 200 languages. Over 1000 new topics are added every day. Wikipedia is the world's largest collaborative writing project. Each Wikipedia article is written and edited by some of the 16 million registered users. There have been over 500 million page edits on Wikipedia, with an average of 20 edits per page.[5] Even though the reliability of Wikipedia has been questioned by teachers and librarians, the quality of Wikipedia entries has been shown to rival the Encyclopedia Britannica (Giles, 2005), and the scope of Wikipedia articles greatly surpasses any other encyclopedia source. Like Facebook and Google, the Wiki has spawned a vocabulary and technology of its own as the name for a website that supports asynchronous user contributions and collaboration through simple text editors and threaded contributions.

Wikipedia provides a clear example of how socio-technical systems can facilitate the organization of data to support and critique the work of individual learners. Forte et al. (2005) describe how Wikipedia functions as a fluid community of practice that continuously moves novice participants from peripheral participants to more central roles. This movement is accompanied by learning about topical interests and technological tools, as well as an increased

[5] http://en.wikipedia.org/wiki/Special:Statistics

role in organizational maintenance. Novice Wikipedians generally begin participation in the community by choosing to write or edit an article (or a piece of an article) about a topic of personal interest, such as a favorite rock band, author, or place. While topical interest motivates to Wikipedia participation, many Wikipedians' interests' grow over time as they begin to take ownership in the community. In other words, Wikipedia functions as a community of practice with pathways from legitimate peripheral participation to community leadership (Lave & Wenger, 1991). This pathway is reflected not only in what Wikipedians choose to do, but also in how they use the wiki tools to do so. To become a Wikipedian is to focus on the community through conversation with other Wikipedians through "talk pages," e-mail, and through "watchlists," pages that alert the user to changes in pages about personally meaningful content.

A key to Wikipedia's success as a participatory culture is the systematic integration of formative feedback into the user experience. Black and Wiliam (1998) argued formative feedback that involves direct commenting and coaching on student's work is among the most effective strategies for improving learning. The Wikipedia community, like the fanfiction and open source software development communities, are structured for massive communities of practice to correct, suggest, and adjudicate disputes about posted content. Users typically receive feedback on entries within 24 hours, and are expected to use the feedback to re-craft their writing. Crowd-sourcing authorship affords multiple channels of formative feedback on author contributions. Like an enormous massively multiplayer game, Wikipedia users are rated by the success of their contributions and the quality of their challenges. Participation in legendary Wikipedia entry disputes (on topics such as scientology, abortion, and the correct spelling of Gdansk/Danzig) establishes the status of power users. The Wiki community makes editing decisions and records of participation public as a model of information transparency as well as to encourage new user participation. Wikipedia is a leading example of how formative feedback practices can be implemented at scale to produce high-quality writing.

The underlying wiki tools of the Wikipedia community have considerable potential to structure learning in education environments. But the reliance on opening contributions to crowdsourcing as a critical data channel for effective formative feedback remains a problem for school implementation. Forte and Bruckman (2007, 2010) attempted to port the Wikipedia model of learning and writing to the science classroom. Science Online was designed to be a publicly accessible living textbook, created and refined by students over time as high school students learned about different science content. Science Online was used extensively; students typically made hundreds of changes to dozens of different pages (Forte & Bruckman, 2007, p. 37). Forte and Bruckman (2010) report that knowing that their work would be a resource for others motivated students to produce high quality work for Science Online; this is consistent with motivation in Wikipedia. However, the institutional concerns of education, mainly the need to protect students' privacy, led teachers to shield students' contributions from the public (Forte & Bruckman, 2007). Without access to a wider formative feedback community, teachers expressed frustration with the difficulty of determining the value of student contributions, and resorted to assigning individual grades for quality work. Reich, Murnane and Willet (2012) found that the majority of wiki use in schools focused on making established classroom routines more efficient, and that only 1% of school-based wikis featured collaborative student projects. Innovations like Wikipedia thrive when formative feedback structures can be teamed with crowd-sourcing the editing process, and can devolve to support ordinary education practices when trimmed to fit within school cultures.

Video games. Video games are the *bête noire* of formal education. Often taken as diversions at best, and as evil at worst, it is difficult for many educators, and even more difficult for education researchers, to consider video games as a model for how to organize learning. The video game market is expected to grow from $54 billion in 2009 to an anticipated $86 billion by 2014,[6] exceeding the film market and doubling the music market. The average child spends over an hour playing video games every day. (Rideout, Foehr & Roberts, 2009). Jane McGonigal (2011) describes how the 11 million *World of Warcraft* players have collectively spent 5.93 million years in the massively multiplayer on-line game – roughly the same amount of time that humans have been on earth. The political and social debates of the value of this extraordinary new kind of entertainment has often degenerated into stereotypes of involving lonely adolescent boys, up too late at night, eating junk food, not doing homework, and becoming inspired to commit violent acts as a result of playing violent games. It can seem as though the only cultural "community" to which such players belong is a shared consumer ethos that exchanges isolating diversion for money.

Caricaturing game players, however, leads educators to overlook the extraordinary internal design elements of video games that can serve as models for technology-driven learning environments. As Gee (2003) notes, games provide challenges that progress in difficulty or content in order to support the development of players' expertise as they inhabit in-game roles and make decisions; that is, players develop expertise as they discern the underlying rules of the game played (Squire, 2006). Successful games scaffold player progression seamlessly by moderating the difficulty of in-game challenges and by providing well-designed data displays that offer relevant formative feedback. Games allow players to inhabit alternative realities and to experiment with possible selves. Players can take on the role of pilots or presidents, raise families, design creatures, or to engage in fantasy/role play. In these identities, players make consequential decisions within the game world and receive feedback about the quality of their decisions. Game play can develop players' content expertise, computer programming skills, social-organizational experience, and writing skills (Gee, 2003). The design of contemporary video games provides the leading model how interface design, task articulation, and assessment design can be used to structure virtual learning tasks.

Contemporary game researchers who study the actual conditions of game play have been able to demonstrate two kind of participatory cultures that emerge in and around play. The primary mode of participatory culture has grown in the "third spaces" (discussion boards and wikis) that emerge around game play. Kurt Squire's work on *Civilization* provides an example

[6] http://www.cinemablend.com/games/Video-Games-Market-Grow-From-52-Billion-2009-86-Billion-By-2014-30363.html

of how a real-time strategy game can spark research-based third spaces (Squire, 2011). Squire describes how *Civilization* was brought into several urban school environments and was used to teach middle- and high schoolers about history, geography, economics, and politics. The intent of the intervention was that, rather than teaching history as "a myth or heritage," the experience should instead show history as a series of situated decisions, an "emergent property of a simulated system." The class used the tools to explore historical hypotheticals, such as what might have happened had Native Americans colonized Europe, and to focus on regions of personal interest (e.g., students who focused on Chinese/Japanese history). The press for players to compete in the game helped establish third spaces for players to first exchange strategies, then to do research on the actual historical features of the civilizations depicted in the game. The game served as a catalyst for students to use historical insights, such as crucial role of iron and horse procurement in motivating the expansion of civilizations, as successful strategies for in-game play. Players also began to participate in on-line communities, such as Apolyton.com, for game-play strategies. Several students then became active participants in the classes and forums offered by Apolyton. For these students, game play motivated the establishment of third spaces designed to improve game-play, and that resulted in increased interest in historical understanding.[7]

The third spaces that develop around video game play give rise to several forms of participatory cultures. Many games, such as *World of Warcraft* (WoW) immerse players in a shared virtual place where players must actively coordinate with one another to achieve success. WoW is simultaneously played by millions of people on a monthly subscription model that provides players access to a rich, multi-level virtual world. WoW players interact with other players in guilds (larger, coordinated groups in which players are assigned specific roles) to engage in quests (long missions to achieve specific goals that result in rewards relevant to game play). WoW technologies facilitate the game-play process, and provide constant feedback to players on the success (or failure) of individual and collaborative play. The technology system in WoW is designed to support the transition from individual to group play, and to provide feedback for players throughout the game context.

The third spaces that develop around such shared game spaces give rise to theorycrafting activities (Nardi, 2010) in which players design strategies in terms of the tacit mathematical models that guide game play. Participating in theorycrafting discussions can help players to develop scientific habits of mind, models for social interaction in affinity spaces, as well as strategies for successful play (Steinkuehler & Duncan, 2008). In addition to shaping game outcomes through decisions during play, many (though certainly the minority) players also modify ("mod") games. This is done both through "soft modding"—informally agreeing with other players to alter the rules of a game or "hard modding"—modifying the software that underlies a game, such as by introducing new characters, worlds, or programmatic rules for

[7] Jeremiah McCall's site Teachinghistory.org demonstrates how schools and students can use a variety of historical simulation games to spark deep insights into historical, economic, military and social systems. For a an overview of this work, see McCall (2010)

interaction. Both of these approaches often require social coordination, such as between soft-modding players and one another or between spontaneously formed teams of programmers who work together to create new game versions. In both cases, this coordination requires participations to analyze and articulate dimensions of the game experience that they wish to change, to formulate specific modifications, and to agree upon them with one another. In addition to being technically impressive, this requires learning and enacting new production-based literacy skills (Steinkuehler & Johnson, 2009).

Integration Challenges

We have argued that the accountability and participatory cultures have resulted in significantly different approaches to technological innovation. The differing roles of technologies *about* learning and technologies *for* learners creates a significant divide in the ways these tools have been used in and out of schools.

A central challenge, of course, is the role that disciplinary learning plays in technologies for learning. Ostensibly, participatory cultures could be organized to motivate learners to delve more deeply into traditional disciplinary knowledge domains. Environments such as Wikipedia, Quest Atlantis and theorycrafting discussion forums provide promising evidence that participatory cultures can motivate this sort of inquiry. But the demand of accountability cultures presses for all participants to engage in the same content, not just those lured by affinity groups. Seen from this perspective, participatory cultures are meritocratic systems that reward those who invest time and attention, and leave behind those who lose interest. Custodians of accountability cultures have not accepted this dependence on learner commitment to the disciplinary mastery as a condition for learning environment design. Instead, schools have moved in the direction of technologies that can reliably improve learning for all students in traditional disciplines (e.g. Read180), and have chosen to avoid investigating new media technologies, such as video games or digital media production initiatives, with high learning curves and unreliable outcomes.

The appropriate use of data on learning also plays a defining role in the two approaches to technology adoption. Technologies for education generate data on learning to measure and guide system progress, while technologies for learners generate data to guide user progress. One approach for future technology development in schools may be to simply recognize the gap and to focus on technologies for education as the approved path for thinking about data use in schools. This approach would result in a research agenda that focused on topics such as (a) improving assessments of learning, (b) reconciling differences across different learning measures, (c) improving organizational capacity to use data on learning to reshape instructional practices, and (d) developing data systems that can better track students through the education system. Each of these research agendas promises to fill in significant gaps in how we, as a research and practice community, can optimize technologies for education and move toward institutional reforms that can improve standardized learning outcomes for all students.

There is another path, however, that could explore how the research and education community can shift the discourse from the (now-)traditional accountability-driven data use discourse to embrace how technologies for learners could transform public education. Several efforts (notably the Digital Promise initiative and the MacArthur Foundation Digital Media & Learning programs) have explored a range of practices to organize learning environments. However, most of the MacArthur-funded work has focused on out-of-school learning environments, and the gaps between the national accountability-driven education policies (e.g. Race to the Top) and the participatory cultures that drive new media development are as wide as ever. Thinking about bringing the two approaches to technology use together will require carefully considered designs for future schools. Here we present three areas of possible investigation/design that may create bridges over which schools can begin to work the full range of information technologies: (a) orchestrating convergence of administrative technologies, (b) designing participatory media production spaces, and (c) bridging assessment of learning with assessment for learners.

Orchestrating convergence. The technologies that support student information systems, learning management systems, and social network systems are quite related. Each involves coordinating access to distributed databases; each involves customizable user profiles, querying tools, and context organization. To be sure, the proprietary nature of each database design creates linkage problems for local technology designers that often limit ideal information exchange. Further, issues of who controls which kinds of data, and which data are appropriate for which context, can thwart efforts to link information across systems. However, each kind of technology system is situated in a culture of practice that admits a certain range of uses, but prohibits others. Student information systems, for example, are organized largely around security concerns designed to protect information about minors. Database access, then, is organized around who gets to see which information, and who gets to draw on which databases for which information. While some of these systems include portals for student access, the information is more frequently *about* students, instead of *for* students. SIS user profiles encode permissions about which *information about others* users are allowed to see.

Social networking technologies represent the other extreme of organizing access. Social network systems (SNS) allow the user to create a local information cluster in order to customize who gets to see what kinds of information in the user profile. The persistent agent profile allows users to customize how they appear to others on the network (creating a medium through which users can design the interface for what William James called the “social me”). Users can join affinity groups, participate in collective action (multiuser gaming communities, photo-sharing), or simply keep up with friend information feeds. Friending, an elective procedure, creates the information pathways through which information circulates. The illusion of the user-created network confidentiality is a source of on-going struggle for information control (a large-scale version of the battle for preserving SIS confidentiality). Still, social network user profiles encode permissions about which *information about themselves* others are allowed to see.

Learning management systems (LMS) may provide a bridge between institution-controlled (SIS) and user-controlled (SNS) data-exchange. LMS connect persistent user profiles with institutional learning resources through technologically mediated opportunities for interaction. As described above, LMS technologies in schools, especially in higher education environments, have been almost completed co-opted as technologies to coordinate learning. Still, the capacities of the LMS technologies allow for meaningful linkage between SNS and SIS. Social network profiles could serve as links into an LMS in which content and certain information about learners (course enrollment, instructor, and learning goals, etc.) are provided by the SIS. SNS motivation structures, such as customizing presentation of self, point- and merit-based participation rewards, and scaffolded task structures, could inform the learning process and provide multileveled opportunities to coordinate social interaction around learning. Students could retain a self-created, persistent self-image (avatar) across learning environments that would feed information about success and failure back into the (properly secured) SIS. Maintaining a context for persistent interaction among digital selves would provide students with another "channel" for participation in learning and might well inject a measure of institutional influence (and civility!) into the currently self-policing adolescent social network communities. Research into the next generation of learning management systems might well create the kinds of technologically facilitated interaction that would produce better information on learning *and* information for learners.

Designing participatory learning spaces. Homework presents a chronic problem in schools. Homework is the central product of most learning activities, and typical homework assignments can be directly linked to expected school learning outcomes. Homework typically involves the rehearsal, or repetition, of known content as a demonstration that learners have met the learning goals (of others). Even if it is collaboratively produced, the design constraints in which homework assignments are developed prohibit much meaningful learning production. Meaningful production, however, is a central feature of participatory cultures. If we are to utilize technologies for learners in school contexts effectively, we must revisit the challenge of homework as an opportunity for students to engage in authentic production. How can meaningful production opportunities be designed, in the context of schools, which produce both information on learning and information for learners?

The current focus on basic literacy and math skill development in K-12 schools provides a window for school teachers and leaders to explore the development of participatory cultures in non-tested subjects, such as technology, the arts, social studies and physical education. Youth media arts organizations, for example, provide models of how students can develop new literacy skills through making sophisticated media products to share with authentic audiences. Organizations such as *ReelWorks*, *Street Level*, *Appalshop* and *In Progress* have already established programs that guide youth through the challenging course of creating, critiquing, and sharing authentic new media products (Halverson, 2010). Reframing media arts or technology development courses in terms of these vibrant participatory cultures presents a viable option for high school program design. Similarly, technologies for learners are transforming civic participation around the world. The majority of youth already get their political information, hear and voice perspectives, and learn norms of public interaction and participation in online spaces (Kahne, Ullman & Middaugh, 2011). Online participation in nonpolitical participatory cultures provides youth with models for public interaction that can be leveraged to support engagement in traditional political and social arenas. Situating civic education in participatory communities, such as Wikipedia editing, can help teach students norms for appropriate public interaction with authentic audiences that can carry outside the school experience. Exploring the (relatively) unmonitored subject areas in the typical school program provides a unique opportunity to experiment with technologies for learners in schools.

Assessment. Assessment plays a defining role in the ways technologies are used in schools. Assessment for accountability focuses on summative assessment of the quality of system outputs; assessment for participation focuses on formative assessment to guide the learner process. The similarities in underlying assessment technologies, however, suggest ways in which new practices can emerge if we can change the cultures in which practices are embedded. Video games provide the most compelling examples of how information technologies organize data for learners. The typical game interface is a dashboard of essential system information organized to produce direct feedback on game play. The connection between action and outcome is so tight in games that the ability to proceed to the next challenge *is* the evidence of successful learning. The tight connection between action and outcome is also the problem with assessment in video games. When we want the learning process to lead to distal outcomes (e.g. standards), it is difficult to generate the information necessary to provide evidence for learning gains.

A central problem in using in-game/in-environment data as evidence for learning is the self-referential nature of technology for learning performance data. The data generated in conquering an army or reaching a character development goal in a participatory culture is of use only to the player or the player's group within the culture. It has proven difficult to marshal these data of evidence for anything other than in-game performance. Jim Gee's 21st Century Assessment Project[8] explores how technologies for learners can be structured to yield the information relevant for learning; and also how technologies for learners can begin to reshape technologies for education. A key design challenge in his work has been the exploration of "data-channels" that convert in-game play processes and outcomes to out-of-game learning goals. The goal of this work is to create data structures that translate evidence of player/user mastery of learning goals within the game/environment structure into representations that are convincing to nonparticipants.

Badges have played in important role in thinking through this "evidence translation" process (McGonigal, 2010). Traditional badges, such as diplomas, certificates, and degrees, serve as legitimacy markers that communicate the value of achievement across domains. New media badges seek to serve a similar function in communicating the quality of in-environment achievements to out-of-environment audiences. "Badging" serves the function of communicating

[8] http://www.macfound.org/site/c.lkLXJ8MQKrH/b.5852881/k.CD8/ReImagining_Learning__Assessing_ Learning.htm

the legitimacy of accomplishment across domains. For example, a reliable badge system would allow out-of-game observers to use badged in-game accomplishments as evidence of successful learning or skill development. The Digital Youth Network[9] platform *YouMedia* creates a multi-faceted badging system to certify student efforts to make, critique, and share new media products. It relies on underlying data-channel technologies that allow both players and system managers to trace the development of user skills and achievements over time. Players customize their in-game avatar with badges to publicly demonstrate skill and knowledge accomplishments. The next goal for learning design would be to validate whether (and how) badges can support inferences about the mastery of learning goals outside the system. Research on building badge-based assessment "bridges" that translate the value of in-community achievement to out-of-community audiences point to new areas for how educators can integrate participatory cultures in to everyday schooling activities.

Conclusion

Wanda Orlikowski (2000) notes that it is a mistake to think about technologies as objects that will restructure practice, because the structural affordances of technologies are only realized through their use in practice. The perception of which affordances will be emphasized in a given context depends, in large part, on the culture of practices in which the tools are implemented. In the case of accountability and participatory cultures, the distinctions in use depend on the expectations of who will get to use the information generated by the technologies. Technologies for education produce information that provides feedback to guide the work of system managers. Technologies for learners produce information that provides feedback to guide the work of technology users. The apparent chasm between technologies for learners and learning, displayed as the separation between education and information technologies, is mainly a question of "for whom" information is produced.

We have argued that the current preoccupation with technologies for education has limited school reformers/designers from exploiting the incredible variety of technologies used to support the interests and goals of learners. Our aim is not to suggest that we abandon accountability cultures in favor of participatory cultures. The public commitment to standards-based learning in which all students have the opportunity to learn in a high quality school should be an unconditionally valued goal of any public education system. Public schools continue to provide a shining opportunity to collectively redress what Gloria Ladson-Billings (2006) called the education debt by positioning schools as the institutional foundation stone in a shared social and economic investment to create access to a better future for all children and families. Better technologies for education will help to create better information on where our education system is strong, where it is weak, and the degree to which the wide variety of initiatives being tried in in schools are actually improving learning for students. We are suggesting, though, that the exclusive focus on technologies for education in the contemporary accountability culture is effectively shutting out the tremendous potential of technologies for learners to reinvigorate the

[9] http://iremix.org/

learning experience in school. The systematic push for "what works" *despite* student interests is at considerable odds with the widespread success of participatory cultures defined *by* student interests. What is now a forbidding gap between education and entertainment technologies should, in our view, be transformed into a complementary partnership between those who run schools and those who learn in schools. Developing new designs to integrate technologies for learners into public schools may help to bridge the gap and demonstrate how digital technologies can reshape learning in and out of schools.

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