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# A Systemic Integration of Technology for New-Paradigm Education

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Educational reform efforts have failed to create widespread improvement. The authors argue that rather than trying to improve the existing system of education, a new learner-centered paradigm is needed that supports individualized learning. Such a significantly different system of education will require the systemic application of technology to support all stakeholders throughout the entire learning process. A vision for such a technology, called the personalized integrated educational system (PIES), is described, and a narrative of its application is presented. Such a technology is not only necessary but can itself help to transform education systems.

## Introduction

Calls for significant change to the way we approach education are not new. For decades, critics have been highlighting the shortcomings of K–12 education in particular, and perhaps never have the calls been so vocal or the chagrin at the quality of education so visible. Documentary movies criticizing public schools and comparing a student getting a quality education to winning the lottery have been widely watched and discussed in the media. Policy has shifted to focus on “accountability” measures that seek to push low-achieving teachers out of the classroom and punish or close low-achieving schools. Many schools have sought to establish one-to-one laptop programs and tablet computer programs to ensure that their students have access to the computers in school that are so much an integral part of society outside of school. Waves of charter schools have sprung up seeking to create models for what an information-age school should look like.

Despite the growing public pressure for change, and programs and policies focusing on further standardizing curriculum, increasing availability of computer technology, and holding schools and teachers more accountable, little has changed in either the approach to or the effectiveness of current K–12 education. Systemic-change advocates



argue that a systemic view needs to be taken in understanding this complex problem—for a complex problem requires a complex solution that addresses change on many interrelated fronts. Furthermore, they argue that rather than trying to change our existing system of education, a new system of education needs to be designed specifically for today's needs and challenges.

The current model of education, originally designed to meet the needs of the industrial age, focuses on sorting students into *management* (those able to learn the given content in the given amount of time) or *workers* (those unable to learn in the amount of time they are granted, who acquire compounding learning deficiencies and do poorly or fail (Reigeluth, 1994). By holding time constant and grouping students by age group, rather than skill or knowledge level, performance is forced to vary. Information-age careers require problem solvers, collaborators, communicators, and critical thinkers—not line workers—and so a new paradigm of education is needed that focuses on learning and mastery of skills and knowledge, rather than on comparing and sorting students (McCombs & Whisler, 1997; Watson & Reigeluth, 2008). This new paradigm of education will need to be customizable and student-centered if time to learn is allowed to

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vary, and the systemic application of technology to the learning process will therefore be needed to support all stakeholders.

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## Personalized Integrated Educational Systems

We believe that a new-paradigm approach to learning requires new learning technology that can be applied systemically to support all stakeholders of the learner-centered learning process. We call this technology a “personalized integrated educational system” (PIES) (Reigeluth, Watson, & Watson, 2012). A new technology is needed because the current dominant technologies, such as course management systems and learning management systems, tend to function primarily from the perspective of the institution, rather than the learner (Attwell, 2007), and are largely structured to serve the teacher-centered paradigm of the traditional classroom (Bush & Mott, 2009).

We envision PIES as supporting user customization of the interface and personalization of functionality through the ability to house modules, much as Web 2.0 sites like Facebook or iGoogle allow users to supplement their personal site with externally developed modules, and iPhones allow users to download apps developed by an extensive community of developers for free or for a fee. In order to support this sort of customization, PIES will need to be developed as interoperable and preferably as open source. This will allow PIES to have a more focused, smaller development scope, and support community development, customization, and shared development costs. Bush and Mott (2009) argue that open technology is “a critical enabling factor in the transformation and improvement of learning” (p. 4).

PIES will offer four primary functions (see **Table 1**) and four secondary functions (see **Table 2**) in order to support new-paradigm learning (Reigeluth *et al.*, 2008). While a detailed description of each of these functions and their sub-functions can be found in the referenced article, it is beyond the scope of this article. However, an overview of these functions shows full support for a learner-centered paradigm of education.

Learning is customized, and each learner progresses according to a personal learning plan, meeting standards, completing instruction that is authentic, collaborative, and structured around learner interests and skills, while being assessed and creating evidence of attainments that presents clear demonstrations of what the learner has learned and is capable of performing, as opposed to the vague comparison-based letter grades currently in use.

Teachers are supported in facilitating and monitoring student learning. The content, record-keeping, and report-generating features make their jobs easier rather than adding to their overloaded schedules. A teacher-centered environment puts the burden for learning on the teacher, rather than the student. In the learner-centered paradigm,



**Table 1.** PIES primary functions.

<b>1. Record keeping for student learning</b>	1.1 Standards inventory
	1.2 Personal attainments inventory
	1.3 Personal characteristics inventory
<b>2. Planning for student learning</b>	2.1 Long-term goals
	2.2 Current options
	2.3 Short-term goals
	2.4 Projects
	2.5 Teams
	2.6 Roles
	2.7 Contracts
<b>3. Instruction for student learning</b>	3.1 Project initiation
	3.2 Instruction
	3.3 Project support
	3.4 Instructional development
<b>4. Assessment for (and of) student learning</b>	4.1 Presenting authentic tasks
	4.2 Evaluating student performances
	4.3 Providing immediate feedback
	4.4 Certification
	4.5 Developing student assessments

**Table 2.** PIES secondary functions.

<b>5. Secondary Functions</b>	5.1 Communication
	5.2 General student data
	5.3 School personnel data
	5.4 PIES administration

teachers function very differently as the proverbial “guide on the side,” focusing on coaching and guiding learning, while some of the development and implementation of instruction and assessments can be done by the community at large. PIES likewise will contribute to the professional development of teachers; just as evidence of student performances is stored, teachers will be able to put together a portfolio demonstrating evidence of their positive impact on students.

Parents and community members are also supported by PIES. Student projects can be guided by and have an impact on the community, and community members can

act as valuable resources. And parents are involved in monitoring, supporting, and encouraging the learning process. The following section will further explain our vision for PIES and the new paradigm of learning by providing a description of PIES’ everyday use in a K–12 school system.

### **A Story of New Paradigm Learning: PIES Applied**

We have taken a narrative approach to illustrate how PIES might typically be utilized by a variety of stakeholders in the K–12 educational process: Sarah, a student; Tom, a teacher; Paul, a parent; Alice, an administrator; and Connie, a community member.

#### **Student**

Sarah, the student, logs in to PIES and uploads her digital video project to submit to her teacher to meet social studies and English standards, and checks the next steps on her personal learning plan. She uploads several resources to share with her project group members and then attends a meeting with the director of the local children’s museum and several of her peers to discuss work on their project, which ties to math and science standards, accessing the resources she previously stored. During this meeting, she realizes she lacks a strong understanding of Newton’s Laws of Motion, so she logs in to her PIES personalized home page, clicks on the “learn” tab, searches for relevant instruction, and accesses a combination simulation and tutorial that is highly recommended by users and one of her fellow group members in the meeting. She downloads the app for the simulation in her “instruction” panel, within the science folder, and then drags the icon for the instruction to her calendar, scheduling a reminder to complete it in the evening, following her glee club practice.

That evening, Sarah uses PIES to access the laws of motion simulation, which helps her to develop an intuitive understanding of Newton’s Laws by making predictions, manipulating variables, and solving problems, with the support of a tutorial. She continues to work on this simulation/tutorial until she has reached level-4 mastery, and certification of that mastery is automatically added to her inventory of attainments. In the process, she gets some great ideas for developing her team’s exhibit for the children’s museum and quickly dictates them into her e-notebook in PIES. She then checks her messages and sees feedback from her teacher that the social networking site she set up for tracking animal rights legislation to meet some of her civics standards is complete and may be captured to her portfolio as evidence of attainment. A text message from her father pops up, congratulating her on her score on that morning’s Math test, which has just been added to her assessment record. She then embeds a whiteboard app to support design sketches for a future meeting with her game design project group, and access-



es a project she completed last year to show to the group of students she peer tutors for service credit and to demonstrate continued mastery of the skills and knowledge she was assessed on last year.

### Teacher

Tom, the teacher, accesses PIES to review activity feeds of his students, seeing what projects have been submitted, what he needs to provide feedback on, and what feedback has been submitted from student peers and community members sponsoring student projects. He sees a flagged chemistry module on a student's recent activity and sends an invitation to the student to meet to discuss ways she might overcome any obstacles in the area. He reviews his calendar, and sees that he has a meeting scheduled that day with his student, Jason, and his parents to review Jason's long-term learning plan, discuss how well he is doing on his short-term projects, and make plans for future projects Jason might complete to meet the current standards he is pursuing. Tom notes a post in one of his news feeds from a colleague on a new tool for digital storytelling creation and drags the app into a panel on his home page to try it out.

A reminder window pops up and notifies Tom that he is due to assess one of his student's performances in 15 minutes. He takes his tablet computer with him and walks to the science lab, where he observes an experiment and listens to a presentation on the experiment results by one of his students. During the performance, he utilizes a rubric in PIES to assess the performance and store his assessment in the system, updating the student's assessment record and learning inventory as well as Tom's record of assessments performed. His assessment notes that the student has again passed specified science standards, demonstrating mastery of these concepts and skills, but still needs some work on communication skills and will need to revisit and satisfy those with a future project.

Returning to his office, Tom finds a chat request from one of his students' parents; Tom accepts the request and they discuss the student's newfound obsession with sci-fi and how they might parlay this into several interesting topics tied to the student's personal learning plan. Tom concludes the chat, and enters notes for himself into that student's file, and adds a reminder to his calendar to meet with the student the next morning.

Tom accesses his development panel and pulls up an algebra module he has been working on, and adds a few final touches before saving it to his local development library and uploading it to an online database. After the upload is complete, he selects the "Link to Professional Portfolio" option so that the module is stored in his portfolio of professional activity, along with other teachers' reviews of it for his promotion document. On a whim, he clicks to access his portfolio, and reviews his profile, including a state-level teaching award he recently received. Finally, he schedules a meeting with a group

of students studying poetry to discuss their workshop results.

### Parent

Paul, a parent, has been traveling for the past several days for business but wants to check in on his son's academic progress. He accesses PIES and also his son's recent activity, seeing that he has been attending school regularly and recently demonstrated mastery in a set of calculus standards. Paul sees that he has received a message from his son's teacher. He is very familiar with this teacher, as she has been facilitating his son's learning for the past two years. The message concerns the project for a small group of students, including his son, who are high-performing in science and math that Paul volunteered to manage. As an aeronautics engineer, Paul is able to offer insights from his experience in the industry and present real-world problems to the students. They have been constructing a wind tunnel to test their design models.

An alert pops up in his display that indicates that someone has responded to a discussion post he placed in a STEM physical resources board. He clicks the alert, and it pulls up the discussion where a professor at the state university has responded to his query for access to a 3D manufacturing printer. Paul and the students will be able to send over their designs to be printed out in plastic, for a small fee. The university will then mail the designs so that they can test them in their wind tunnel. He posts a thank you response, and shares the discussion thread with another parent across the country who has been working on a similar project. He sends a message to his son's teacher, updating her on the project's progress.

### Administrator

Alice, a school administrator, is the lead teacher of a new-paradigm elementary school. PIES is integrated into every aspect of her school. She accesses her PIES personalized home page and selects the "Staff" tab after seeing an alert flag on it. PIES loads a staff profile page, which displays the most recent staff activity. Alice sees that one of her best teachers has recently completed a professional development online workshop on learning and he is requesting a letter of recommendation from Alice in order to have his own workshop (for teachers on facilitating problem-based learning environments). Alice writes the letter and sends it as a response to the request, while also retaining it as a link in her digital folder regarding that teacher.

She then clicks on her "Students" tab and selects "Reporting." She generates a report on current learning standards progress for all of the students in her school. She then sorts the report by performance progress and highlights the students who have been flagged by their teachers or the assessment system as struggling to meet their current learning goals. After looking over the report, she saves it so she can take it with her to the meeting she



is having with her teachers later that day.

Alice then pulls up an e-mail she received from a parent whose child will be transferring into the school next week. She reviews the e-mail, adds a few notes, and takes it with her to her meeting with that parent. During the meeting, she uses PIES to update the child's information, and sends a number of school-related resources to the parent for later review.

### School Staff

Gary, a school counselor, is a member of the school staff, and although not a teacher or an administrator, utilizes PIES in his daily activities. Gary connects to PIES and reviews his schedule for the day on his home page. He sees a new message from a teacher giving him an update on the status of a student. The teacher, who has been mentoring the student for several years now, has been filing regular reports. The student, Lilly, has been struggling since her parents lost their jobs, and the teacher has asked Gary to speak with her several times. Using PIES, he pulls up her file, making notes, and sends her an updated plan they have developed together for stress management. He sends a meeting request to the teacher so that the two can discuss Lilly and her progress in more detail as it has been a few weeks since they met to talk in person.

### Community Member

Connie is a local business owner who has partnered with a group of students working on a project that will benefit a local non-profit group. Connie uses PIES to manage communication with the students, to store project notes, and to submit assessments to their teacher on their project work. She has previously worked with students from the school, and her PIES profile identifies her availability and expertise to the schools in the area and helps her stay connected with the teachers and students she supports.

### Conclusion

Dissatisfaction towards education has perhaps never been so visible. The federal government in the United States has become more engaged in improving education than ever before, and states are also elevating their efforts at implementing sustainable changes to the process of education; however, large-scale, significant change remains elusive. A new learner-centered paradigm of education must be realized, and technology that is systemically applied to the entire learning process and that focuses on this new paradigm must be available if the transformation is to be successful and timely.

PIES is a learning technology that is ambitious in scope—envisioned as a support system for all stakeholders in the learning process. As the new paradigm will be learner-centered, PIES will facilitate a very different model of education—one where students are active throughout their learning process, taking ownership over

the planning of their learning, the selection of instruction, collaborating with their peers, parents, and community members as they focus on mastering standards for skills, knowledge, dispositions, and social and emotional development. PIES likewise will support teachers in guiding students and parents as they create personalized learning plans, in identifying and creating engaging projects, instructional modules, and assessments, and in assessing and reporting on student learning, while also managing their own professional development. Parents will have easy and instant access to reports on their child's learning progress, and community members will be able to engage as partners with the school to extend learning beyond the physical walls of the school, and school and community mutually will benefit one another.

Given the scope of the application, some might argue that PIES will be too complex or expensive to develop. However, the interoperable, open, and modular nature of PIES precludes a single, giant application and instead seeks a community-developed, customizable, collection of component software connected to a central framework, thus distributing costs and reducing complexity. Furthermore, we point to the cost of the current inefficiencies of an obsolete educational system. Investments in an infrastructure designed to facilitate a new-paradigm model of education could result in far greater gains than continuing to waste money trying to fix a system that was never conceived of nor designed to meet the new needs and demands of students and communities in the information age. □

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