TECHNOLOGY AND THE HUMAN CONNECTION

Examining the Role that Digital Technology Plays in Enhancing Interpersonal Interaction in Education

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Introduction

by Steven L. Paine

Each year The Harold W. McGraw, Jr. Prize in Education recognizes outstanding educational leaders whose accomplishments have significantly improved the quality of American education and made a lasting difference in the lives of countless students. The pantheon of previous McGraw Prize winners constitutes a virtual "Who's Who" in American education. This year we sought out individuals who are using technology to advance the learning sciences and transform education. Therefore, we now have the pleasure of honoring three great educational entrepreneurs: Robert Beichner, Mitchel Resnick and Julie Young.

When asked how they felt technology was changing education, we heard a number of anecdotes that demonstrate how it was improving relationships among students, and between students and their teachers and parents. The insights and experiences of the 2011 Harold W. McGraw, Jr. Prize in Education recipients underscore that while the technology itself is credited with transformation, the reality is that technology and digital tools are effective because they enable richer human interactions among learners, teachers and parents.

It is especially important to understand the value of these human interactions when the benefits of technology-enhanced learning are challenged. A recent article by Matt Richtel in *The New York Times*, "In Classroom of the Future, Stagnant Scores,"[i] suggested that, despite significant investment and enthusiastic participation, technology-rich classrooms are not improving teaching and learning in our nation's schools. The article described a conundrum faced by Arizona's Kyrene School District where, despite a $33 million investment in educational hardware and software since 2005, reading and math scores remained stagnant. Richtel suggested this "high-tech gamble," involving billions of federal, state, and local dollars earmarked for educational technologies is unsupported by research or data that can justify it. Reacting to the *Times* article, some have countered that the real problem with the current state of technology-based education is that schools spend billions on high-tech tools but don't know how to use them to their fullest potential, and that the systems to measure the types of gains that education technology fosters have not yet evolved. "Digital Promise," an independent non-profit recently created by Congress to advance both the implementation and evaluation of education technology, will hopefully begin to address these concerns.

Still, answers won't come overnight. In the meantime, our 2011 Prize winners are witnessing the positive effects of technology every day – specifically when technologies are used to support and enhance human interaction. They are not the first to recognize and appreciate the ways personal interaction is critical to learning. Almost two decades ago, at the dawn of the digital revolution,

Alexander Astin (1993)[ii] shared his research about the importance of human interaction. In a longitudinal study spanning from 1985 through 1989, Astin surveyed some 25,000 college students from more than 200 four-year colleges and universities. He asked the students about their satisfaction with and the perceived benefits of college attendance in an effort to understand the impact of higher education on their personal, social, and vocational development.

Astin verified that the single most powerful source of influence on the undergraduate student's academic and personal development was his or her peer group. Student-to-student interaction, such as discussing course content with other students, working on group projects for classes, tutoring other students, and out-of-class experiences like participating in campus social activities, had strong, positive correlations to leadership, initiative, and overall academic development, as well as self-reported growth in problem-solving skills, critical thinking skills, and cultural awareness. He also found that, next to the peer group, interaction with faculty represented the most significant aspect of the student's undergraduate development. Astin wrote, "The sheer amount of interaction between the individual student and the faculty has widespread effects on student development." He found that student-faculty interactions were positively correlated with every important academic attainment outcome: college GPA, degree attainment, graduating with honors, and enrollment in graduate or professional school. Astin's research indicated that the quality of human interaction, both among students and between students and faculty members, was the single most critical factor in college success. He points out that cooperative learning structures can seize the power of peer group influence to improve student learning. These structures can also increase direct contact between students and faculty, which Astin's study links to positive effects on student development. Content, curriculum, and research were not nearly as important as the quality and quantity of human interaction.

At the time Astin published his book, *What Matters in College: Four Critical Years Revisited*[iii], many educators feared the impact of networked technologies on education. Some suspected that the Internet would replace teachers or interfere with the valuable bonds they created with their students. Others viewed technological tools as distracting toys or crutches that could make learners weak or lazy. Parents, witnessing their children's intense engagement with everything digital, worried that their children would become part of a lonely generation who learned from machines instead of people. Given the lack of both anecdotal and academic data at the time, it seemed reasonable to worry that networked technology could have a negative impact on the learning process.

These anxieties about the integration of technology into classrooms gradually abated due to the work of visionary leaders both inside and outside of traditional educational structures who began to effectively introduce technology into educational settings. Over the next two decades, approaches that seized the power of networked educational technologies were scaled-up into pervasive virtual schools, out-of-school computer programs, global online learning communities, and

flexible educational software. The extensive technological options available today not only help teachers complete administrative tasks more efficiently, but they also improve the depth and breadth of content they can deliver. This increased efficiency and flexibility gives teachers more quality time with students, allowing them to lead students through challenging content while leaving the delivery of the content to the technology. Technology also invites parents into the process, allowing them to learn with their children at home. As you'll see in the examples below, many teachers, parents, and learners have come to embrace the transformative power of technology-enhanced education and appreciate how it allows more time for meaningful personal interaction.

Elementary: Informal Learning Environments

by Mitchel Resnick

At the Media Lab at the Massachusetts Institute of Technology our goal is to design technologies that empower people to explore, experiment, and express themselves in new ways. My Lifelong Kindergarten group develops tools that engage people in creative learning experiences, emphasizing the type of interest-driven, collaborative activities that traditionally exist in kindergarten. We are inspired by the way kindergarten students learn through a spiraling process in which they imagine what they want to do, create a project based on their ideas, play with their creations, share their ideas and creations with others, and reflect on their experiences – all of which leads them to imagine new ideas and new projects. This iterative learning process is ideal preparation for today's fast-changing society in which people must continually come up with innovative solutions to unexpected situations in their lives.

We work to develop new technologies that, in the spirit of the blocks and finger paint of kindergarten, expand the range of what people can design, create, and learn – thus sowing the seeds for a more creative society. Our goal is to help children learn to think creatively, reason systematically, work collaboratively, and learn continuously – essential skills for success in the 21st century. We are developing a new generation of technologies that not only enable children to connect with new concepts and ideas but also enable them to connect with other people, providing new pathways for sharing, collaborating, and empathizing with one another.

Examples from two of my projects – Scratch and the Computer Clubhouse – illustrate this point.

Scratch is a graphical programming environment that makes it easy for children ages eight and up to create their own interactive stories, games, animations, and simulations – and then share their creations with one another online. Roughly one million children have joined the Scratch online community (http://scratch.mit.edu), where they share more than 2,000 new Scratch projects each day.

The way students use this online community provides a compelling example of how valuable human connections can be fostered by new digital tools. Participants in the

Scratch community serve alternately as peers and teachers, solving problems and perfecting programs together. The following excerpt from *A New Culture of Learning: Cultivating the Imagination for a World of Constant Change,* a recent book by Doug Thomas and John Seely Brown,[iv] describes the experiences of nine-year-old Sam, who uses Scratch to create his own animations and games:

> *Scratch has an additional element that takes the experience to a different level: a collective, a community of similarly minded people who helped Sam learn and meet the very particular set of needs that he had. When Sam posted his game online to that community, it became accessible to thousands of other kids who were also working with Scratch, and that's when some very interesting things started to happen. The other players were able not only to play Sam's game, but also, with the click of a button, to download it into the Scratch interface, see the code, and modify it if they wished.*
>
> *Perhaps the most important aspect of all, however, was the users' ability to comment on projects they liked by clicking a "Love it?" button. What Sam found when he joined the online community was that he was no longer simply creating animations or games; he was part of a larger conversation. He was excited about receiving his first comment, of course. But when we asked Sam what it meant to be a good member of the Scratch community, we were surprised by his answer. It had nothing to do with building games or posting animations. Instead, Sam told us that the single most important thing was to "not be mean" in your comments and to make sure that you commented on something good when you came across it, as well. The game does not just teach programming; it cultivated citizenship...*
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> *Sam made perhaps the most revealing comment, one that tells us the most about the new culture of learning, when we asked him what he looks for in other people's programs. He told us, "something really cool that you could never know yourself." While playing Scratch, Sam has learned a lot about programming and a lot about participating in online communities. But what he has learned most of all is how to learn from others.*

The following example[v] illustrates how a 13-year-old girl, identified as "BalaBethany", learned to program through interactions with peers online:

> *BalaBethany enjoys drawing anime characters. So when she started using Scratch, it was natural for her to program animated stories featuring these characters. She began sharing her projects on the Scratch Web site, and other members of the community responded positively, posting glowing comments under her projects (such as "Awesome!" and "OMG I LUV IT!!!!!!"), along with questions about how she achieved certain visual effects (such as "How do you make a sprite look see-through?"). Encouraged, BalaBethany then created and shared new Scratch projects on a regular basis, like episodes in a TV series.*

She periodically added new characters to her series and at one point asked why not involve the whole Scratch community in the process? She created and uploaded a new Scratch project that announced a "contest," asking other community members to design a sister for one of her characters. The project listed a set of requirements for the new character, including "Must have red or blue hair, please choose" and "Has to have either cat or ram horns, or a combo of both."

The project received more than 100 comments. One was from a community member who wanted to enter the contest but said she didn't know how to draw anime characters. So BalaBethany produced another Scratch project, a step-by step tutorial, demonstrating a 13-step process for drawing and coloring anime characters.

Over the course of a year, BalaBethany programmed and shared more than 200 Scratch projects, covering a range of project types (stories, contests, tutorials, and more). Her programming and artistic skills progressed, and her projects clearly resonated with the Scratch community, receiving more than 12,000 comments.

Our group at MIT also founded the Computer Clubhouse project, an international network of 100 after-school centers where low-income youth ages 10-18 learn to express themselves creatively with new technologies. With support from adult mentors, participants create interactive stories, music videos, and robotic constructions. The following excerpt[vi] underscores how technology can help children forge their identities and establish themselves as part of a community:

Consider Mike Lee, who spent time at the original Computer Clubhouse in Boston. Mike first came to the Clubhouse after he had dropped out of high school. His true passion was drawing. He filled up notebook after notebook with sketches of cartoon characters. At the Clubhouse, Mike developed a new method for his artwork. First, he would draw black-and-white sketches by hand. Then, he would scan the sketches into the computer and use the computer to color them in. His work often involved comic-book images of himself and his friends.

Over time, Mike learned to use more advanced computer techniques in his artwork. Everyone in the Clubhouse was impressed with Mike's creations, and other youth began to come to him for advice. Some members explicitly mimicked Mike's artistic style. Before long, a collection of "Mike Lee style" artwork filled the bulletin boards of the Clubhouse. "It's kind of flattering," said Mike.

For the first time in Mike's life, other people were looking up to him. He began to feel a new sense of responsibility. He decided to stop using guns in his artwork, feeling that it was a bad influence on the younger Clubhouse members. "My own personal artwork is more hard core, about street violence. I had a

close friend who was shot and died," Mike explained. "But I don't want to bring that here. I have an extra responsibility. Kids don't understand about guns; they think it's cool. They see a fight, it's natural they want to go see it. They don't understand. They're just kids."

Mike began working with others at the Clubhouse on collaborative projects. Together, they created an Online Art Gallery on the Web. Once a week, they met with a local artist who agreed to be a mentor for the project. After a year, their online art show was accepted as an exhibition at Siggraph, the world's premiere computer-graphics conference.

As Mike worked with others at the Clubhouse, he began to experiment with new artistic techniques. He added more computer effects, and he began working on digital collages combining photographs and graphics, while still maintaining his distinctive style. Over time, Mike explored how he might use his artwork as a form of social commentary and political expression.

As he worked at the Clubhouse, Mike Lee clearly learned a lot about computers and about graphic design. But he also began to develop his own ideas about teaching and learning. "At the Clubhouse, I was free to do what I wanted, learn what I wanted," said Mike. "Whatever I did was just for me. If I had taken computer courses [in school], there would have been all those assignments. Here I could be totally creative." Mike remembers – and appreciates – how the Clubhouse staff members treated him when he first started at the Clubhouse. They asked him to design the sign for the entrance to the Clubhouse, and looked to him as a resource. They never thought of him as a "high-school dropout" but as an artist.

After several years of volunteer work at the Clubhouse, Mike earned his high-school equivalency diploma, then landed a job as a graphic designer at a high-tech company near Boston, designing graphics for the company's web pages, stationery, catalogs, and brochures.

Mike's experiences at the Computer Clubhouse illustrate the power of human interaction and digital learning to support and encourage a learner who felt alienated by his traditional school experience. With access to the technology and social support at the Computer Clubhouse, Mike learned how to develop his artistic skills, to share his expertise with others, and to become an active and productive member of his community.

Secondary: Learning Any Time, Any Place, Any Path, Any Pace

by Julie Young

Networked technologies and digital tools allow today's learners to benefit from connected learning environments despite physical distance. Online schools meet the needs of students of all ages who choose or need to learn in alternative settings,

and provide otherwise isolated students with access to plentiful and beneficial human interaction.

When I started Florida Virtual School (FLVS) in 1996 I had no idea it would emerge as the one of the most innovative and successful distance learning schools in the United States. While I would love to take full credit for its growth and popularity, the reality is that the flexibility and convenience offered by the technology makes this format a win-win for many students. FLVS is the nation's first statewide virtual public school, providing free, media-rich, one-to-one online instruction to more than 130,000 students in grades Kindergarten-12. Our students live in all 67 Florida school districts, 49 states, and 46 countries. Courses include core subjects, honors classes, world languages, electives, Advanced Placement courses and even physical education. That's right--online gym class!

We use no textbooks; all content is posted online. Instruction is delivered through a carefully crafted combination of online course management software, Skype, email, Instant Messaging, and telephone conversations. The tools allow students and their parents to connect with FLVS teachers regularly, one-to-one, synchronously and asynchronously. Online students connect with each other through discussion forums, instant messaging, and conferencing software. Many students report that they feel more connected to their FLVS teachers and classmates than they ever felt with their teachers and peers in traditional schools. Our 2010-2011 student survey indicated the 98% of our students said their teacher demonstrates "personal interest and concern for their success."

The following example is a heartfelt note written by a student named Audrey to Mr. Smith, her FLVS American History teacher:

> "You have been amazing. We've had discussion-based assessments that were a half an hour long! And it never felt like an assessment, it just felt like a talk about history. Whenever I didn't get a concept, or there was a fuzzy part in the timeline in my head, I would ask and you would elaborate on it. You would talk about the causes and effects, and more importantly, how it fit in to the grand scheme of things. Many times have I been in a class where you just memorize facts, but the reason I love history is that it is so much more than facts. It's a giant storybook, and that's how it felt. It felt like I was reading a tale about power struggles, mighty warriors, and how everything came to be. If you just memorize dates and names, you're missing the part that makes it so great. I personally appreciated how, in the discussion based assessments, that you didn't ask "What was the year the Cold War started?" but instead asked who was in the Cold War, what were they fighting about, and who won. It really gave me a grip on the events leading up to today. When you only know the facts, then you're losing the purpose and the meaning of it all. The meaning is what makes it interesting and important. I'm so passionate about history, and I'm so glad that I had a teacher that was passionate about what they teach, as well. You're one of my favorite teachers and I haven't even met

you!"

Parent engagement and relationship with the teacher is just as critical as the relationship between teacher and student. In so many ways families are involved in the FLVS experience alongside their child. The following notes from parents express their relief in seeing their child succeed:

> "My Janean has been struggling for the past two years, and this is the first time in a really long time that we hear good news about her progress.... She has been working very, very hard and we finally see good results.... We are very grateful that you are a sweet and wonderful teacher!!!!!" - *Carmen & Alexander Prince, Parents*

> "I want to thank you so very much for giving my son such a positive experience with your class. He was not happy at first, but changed his attitude quickly as your interactions with him increased. Your calm, patient, clear explanations of the topics really made a difference! I especially, appreciate your enthusiasm while speaking to him about projects; your dedication shines through. I am grateful to you for making this such a great experience for my son." - *Doly Rexach - Parent*

Our students do not adhere to the traditional school calendar, which is usually 8 a.m. until 3 p.m., Monday thru Friday, fall through spring. Rather, students select the month they start the class, and we match them with an instructor, who is available from 8 a.m. to 8 p.m. on weekdays, and sometimes on weekends. Courses typically last 16 to 18 weeks, although students may opt to move more quickly or slowly. Students review material at their own pace "24/7," 365 days a year. FLVS also offers extracurricular activities such as competitions, a history club to explore history topics, and a science club to prepare students for an annual Science Fair.

This approach provides unprecedented options for students, parents, schools, and school districts. Students can access large numbers of courses at a suitable pace. Schools can supplement their course offerings, providing students with a custom blend of traditional and online courses, a "best of both worlds" option. Furthermore, online classes can help cash-strapped school districts ease overcrowding, offer courses with more personalized instruction, and conserve resources.

Interestingly, students who felt marginalized or alienated from traditional, brick-and-mortar schools, often find respite at FLVS. Those who have somehow lost belief in themselves – whether due to bullying, physical illness, or disabilities – have a hard time separating the learning aspect from the social aspect of school. Although a student may be highly capable, he/she can't always overcome the impact of stressors in the learning environment. FLVS teachers are prepared to help students in these situations learn how to learn again. Mary, who was diagnosed with leukemia and had trouble going to school, began taking courses at FLVS in the 6th grade and was behind in her class work. Three years later, she is still with FLVS and

is keeping pace with her peers. If students like Mary can find a comfortable place and way to learn without interference or undue stress, they will regain confidence, graduate and continue to find their way in the world.

Technology can foster parental involvement in the learning process as well. Many online and traditional schools offer online portals where parents can check in and review their child's work, check test results and homework, and receive updates from teachers. Having this access to this information helps parents stay involved in their child's education, but we often find that parental involvement goes a bit further with online courses -- parents often ask if they can take courses alongside their child. This kind of interest goes beyond just being "involved" in their child's course work, elevating it to the shared experiences that inspire the kind of natural out-of-class interaction that Astin cited in his research. Some want to take courses like Spanish or physical education with their child. The idea that a parent and a child could be practicing their Spanish vocabulary while taking a run for their physical education class is just one exciting potential outcome of this trend. I can see this option also being especially beneficial for parents who never finished school themselves and are now inspired to learn along with their children because technology makes it accessible, convenient and affordable.

At FLVS, we believe in high tech, but we also believe in "high touch," which is just another term for the human connections we're identifying here. While content may be delivered by "tech", the "touch" is delivered by instructors. At FLVS we won't be losing sight of the fact that no matter how much the education landscape changes, teachers, and the relationships formed around them, are the key components of success.

Higher Education: Creating Classroom Connections

by Robert Beichner

I see one of the primary benefits of technology as the potential –which is now becoming a reality in many classrooms– to free up teachers' time so they can do what they do best: establish relationships with their students and motivate them toward excellence.

As a physics professor and director of the STEM (science, technology, engineering and math) education initiative at North Carolina State University, I've put this theory to the test. My classroom design is not unique in providing laptops, interactive whiteboards, and presentation screens. What is unusual are the seven-foot round tables, each seating three teams of three students. These tables foster critical connections and interactions among students, the benefits of which neither I, nor any computer, could replicate.

When I first introduced this replacement to traditional introductory science lectures, it was seen as a radical move, but now the approach has been widely adopted by over 100 colleges and universities around the country. The blend of digital

technology with research-supported teaching methods such as hands-on activities, simulations, and roundtable discussions has transformed students from passive absorbers of information to active, engaged learners who are taking part in and helping direct their own higher education experiences.

SCALE-UP stands for "Student-Centered Active Learning Environment for Undergraduate Programs." While students work in teams, the instructor is free to roam around the classroom, enabling him/her to ask questions, send one team to help another, or challenge students who came up with opposing answers to work together toward resolution. There is no separate lab class and most of the "lectures" are actually class-wide discussions. No longer constrained by what I call the "tyranny of content delivery," teachers can focus on helping students work through the more difficult aspects of the curriculum. The social interactions occurring between students and their teachers are actually the key ingredient to the program's success. In spaces that look more like restaurants than college lecture halls, SCALE-UP classrooms facilitate communication between teams of college students as they collaborate to answer questions, solve problems, and simulate real world challenges.

This approach is used in introductory physics, chemistry, math, biology, astronomy, engineering, and even literature and language courses at over 100 colleges and universities around the country. At the concept's core is an inverted instruction model that allows instructors of introductory courses to spend more time solving problems with students, and less time lecturing to them. Students gather most of the basic course content outside of the classroom and reserve their class time to actively work with their peers and instructors to apply the new ideas they are learning. Teachers use the time they save collecting and distributing material to support students as they grapple with challenging material. The SCALE-UP website[vii] provides the following example of how the program works:

> *Three teams (named a, b, and c) sit at a round table and have white boards nearby. Each team has a laptop in case they need web access. The teacher picks some current event, say the Attorney General's Congressional testimony. The "a group" at each table would see how MSNBC covered the event. The "b groups" read the Fox News coverage, while the "c groups" are directed to the BBC website. Students then compare the reports. As a follow-up, they are sent on a search to find as much as they can about some other event. They then write a news story as if they were working for one of the three media outlets. Their teammates have to discern their employer based on how the story reads.*
>
> *Whether the topic is current events or chemistry, the basic idea is the same. Students work while teachers coach. Note that this requires extensive preparation by the students. We make sure the chapter has been read and simple homework finished before students come to class to ask questions and work on interesting activities.*

Many of the educational institutions that have adopted the SCALE-UP model note that the technology is just a helpful device, while the meaningful student-to-student and student-to-faculty relationships that Astin cited as critical for a meaningful college experience, are the central focus. Clemson University's website[viii] states:

> *Although technology initiatives were the catalyst for development of SCALE-UP at Clemson, SCALE-UP is an instructional method that is totally independent of technology. It focuses on guided inquiry and interaction among students, groups, teaching assistants, and the instructor in the regular class period. Some instructors choose to use various technologies to enhance the learning experiences, but these are secondary. Active learning and communication are the key elements.*

I think "active" is the key word here. Creating an environment where students are intrinsically (i.e. internally) compelled (rather than obligated) to participate and cooperate creates the most positive energy amongst human interactions. Attendance, which is not required, has averaged over 93% for the past decade. If a group member is missing from class, his or her teammates are texting them to find out why. Technology does help, of course. For example, using a computer to accept answers from one member of a group as representing the answers of all team members reinforces team roles. Used a different way, having the computer deliver the same problem to each team member (but with different details like initial conditions, etc.) motivates the team to work together to share ideas.

SCALE-UP is an example of a teaching model that is gaining traction in classrooms for all ages, and is being accelerated with the increasing adoption of more and more technology tools. While the format is highly effective at the post-secondary level, setting the stage early will help young student develop habits that turn them into natural, lifelong learners such as independently acquiring background knowledge and foundational skills online. Skillful instructors can facilitate critical thinking experiences instead of leaving higher-level thinking to homework assignments where students may become discouraged without the energy of the classroom and their peers to motivate and guide them.

The University of Minnesota developed its Active Learning Classroom (ALC) program as an adaptation of the SCALE-UP program. The classrooms support the types of student-to-student and student-to-faculty interactions that we know support student learning. The university's website says that each of its 14 ALCs feature a 360 degree marker board, multiple flat-panel displays and projection systems, round tables that accommodate nine students each, and a central teaching station that allows selection and display of table-specific information. The ALCs offer:

- cooperative learning environments that encourage student collaboration and peer teaching.

- technology that allows students to easily present work for review by peers and instructors.
- furniture designed to facilitate small-group work.
- the ability for instructors to interactively coach students during activities.
- new options for student interaction and class structure.[ix]

Preliminary data about the program was published in a 2007 report, "Active Learning Classrooms Pilot Evaluation."[x] The report featured quotes from participants who were involved in biology and engineering classes in the ALCs. A student participant said, "When we're working on a group project, we were able to look up information and display it on the screen above the table...This also allowed us all to remain engaged..." A participating instructor noted, "The round tables—the fact that they are looking at each other—instantly changes their relationship with each other. That's the main thing the room does; it changes the relationship that faculty have with students and the relationship that students have with one another." Since the pilot in 2007, 14 additional ALCs were built at the University of Minnesota's Student Teaching and Services Building. The classrooms are used in a wide variety of disciplines and serve thousands of students. Within its first year of operation, more than a third of the University's students have benefited from these state-of-the-art classrooms.

Conclusion

by Steven L. Paine

Of course, the impact of new technologies on learning varies because teachers and learners use them in different ways. This is another example the "human factor" described so clearly in this paper. Technology doesn't exist in isolation and it will not create isolation unless we allow it to do so. That said, situations certainly exist where technology reduces high-quality human interaction and separates learners. Yet the examples cited here by Resnick, Young, and Beichner demonstrate the positive interpersonal outcomes of technology-supported education. Technology can indeed enhance the bonds between learners, parents, and teachers. If we assume that Alexander Astin's findings apply to all learners, then we can assume that with careful design, technology and digital tools can improve the learning experiences of learners, parents, and teachers everywhere.

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[i] Richtel, M. (2011, September 3) *The New York Times*, "*In Classroom of Future, Stagnant Scores*." Retrieved from http://www.nytimes.com/2011/09/04/technology/technology-in-schools-faces-questions-on-value.html?_r=1&pagewanted=all

[ii] Astin, Alexander W. (1993). *What Matters in College? Liberal Education,* 79 *(4)*, p.4, 12p.

[iii] Astin, Alexander W. (1997). *What Matters in College?: Four Critical Years Revisited.* San Francisco: Jossey-Bass.

[iv] Thomas, D., and Brown, J.S. (2011). *A New Culture of Learning: Cultivating the Imagination for a World of Constant Change.* CreateSpace.

[v] Resnick. M (2009) "*Scratch: Programming for All*," MIT Media Lab. Retrieved from http://llk.media.mit.edu/

[vi] Resnick, M. (2002). *"Rethinking Learning in the Digital Age."* In *The Global Information Technology Report: Readiness for the Networked World*, edited by G. Kirkman. Oxford University Press.

[vii] North Carolina State University Physics Education R & D Group (2011). SCALE-UP (2011). Retrieved from http://scaleup.ncsu.edu/

[viii] Clemson University (2011). Academic Programs - SCALE-UP. Retrieved from http://www.clemson.edu/academics/programs/scale-up.html

[ix] University of Minnesota (2011). Office of Classroom Management. Retrieved from http://www.classroom.umn.edu/projects/ALCOverview.html

[x] University of Minnesota – ALC Pilot Evaluation Team (2007). Active Learning Classrooms Pilot Evaluation: Fall 2007 Findings and Recommendations. Retrieved from http://www.classroom.umn.edu/projects/alc_report_final.pdf

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