Friends of Papertian Constructionism

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Abstract

The expressed desire of the Constructionism Conference organizers to expand its horizons beyond Logo programming invites scholars to seek connections to others engaged in similar work and identify powerful ideas consistent with the theory of constructionism. This paper is intended to help raise awareness of constructionism beyond the Logo community while providing opportunities for constructionists to "think about thinking" through the prisms created by with a similar educational stance and the expansion of our community of practice. Each of the approaches explored in this paper are worthy of further study. Educology offers a lens through which to explore constructionism in a wider context.

Keywords

Progressive education, school reform, constructionism, El Sistema, Reggio Emilia, One Laptop Per Child, Generation YES

Introduction

Seymour Papert's contributions to education and the "big tent" of constructionism were striking during the Constructionism 2010 Conference in Paris. Papert's presence was palpable despite his physical absence. Each conference delegate represented a small piece of Papert's interests and intellectual output. There were the software designers, the teacher educators, the toy makers, the school reformers, the people concerned with how students understand a specific mathematical concept, those concerned with social justice, proponents of play, arts advocates and much more. When each of these constituent parts are stitched together as a complex quilt, Papertian constructionism extends beyond a theory of how learning most efficaciously occurs and represents a stance about education.

An oft-overlooked aspect of Papert's work was his interest in educology. In *A Critique of Technocentrism in Thinking About the School of the Future*, Papert uses the term educology as a plea for a more holistic theory of education of which constructionism is one branch. (Papert 1990)

> "The word educology reminds us that we need a theory of education. One might say theories already exist. There is educational psychology; there is a theory of instruction; there are courses on the theory of how to administrate schools. But these are not theories of education as a whole. They are theories of small aspects of what happens in the educational process. By focusing on these small aspects, these trees and shrubs, we have gotten lost in the jungle.
>
> … I will take an example from my own work. People have asked, "What is the effect of Logo on learning mathematics -- or on planning skills or whatever?" Some experimenters have come up

> with very positive answers, some with negative ones. But they are barking up the wrong tree. They are following the methodology of studying the effect of something by varying one thing while keeping everything else constant.
>
> Such methods do quite well for studying the effect of a drug or a treatment for plants. But in the case of Logo, one sees its absurdity in the fact that the whole point of Logo is to make everything else change. One does not introduce Logo into a classroom and then do everything else as if it were not there. Such an approach completely misses the point. Logo is an instrument designed to help change the way you talk about and think about mathematics and writing and the relationship between them, the way you talk about learning, and even the relationships among the people in the school -- between the children and the teacher, and among the children themselves.
>
> The traditional methodology for studying innovation in education may have been adequate at a time when only small changes were possible, when in fact one did change an aspect of the mathematics curriculum and keep everything else the same. But we need a different methodology altogether when we envision radical changes in education." (Papert 1990)

Situating constructionism in the context of a larger educology demands a more ecological view on learning – something Papert often discussed. Increased awareness of allies practicing constructionist-like approaches to education assists advocates of constructionism popularize their efforts and offers opportunities to learn the lessons of others engaged in sympathetic efforts. Constructionism matures when its practitioners have a greater range of contexts to consider and constructionism becomes more viable as an educational approach when its advocates develop alliances with similar movements.

Friends of Papertian Constructionism

Any proposed list of "friends of constructionism" would be incomplete, subject to debate and beyond the scope of this paper. However, Papert reminds us that "The most powerful idea of all is the idea of powerful ideas." (Papert 1980) A recognition that we stand on the shoulders of giants and are not alone in our attempts to create productive contexts for learning (Sarason 1990; Sarason 1996; Sarason 1998; Sarason 2001; Sarason 2004) offers sustenance to the constructionism community and aspires to achieve a greater impact than would be possible on our own.

Computers are critical to several of these "friend" while others might find their efforts enhanced by the addition of computational technology to their educational practice and objects-to-think-with. (Papert 1980; Ackermann 2010)

> "One of my central mathetic tenets is that the construction that takes place "in the head" often happens especially felicitously when it is supported by construction of a more public son "in the world" – a sand castle or a cake, a LEGO house or a corporation, a computer program, a poem, or a theory of the universe. Part of what I mean by "in the world" is that the product can be shown,

> discussed, examined, probed, and admired. It is out there." (Papert 1993)

"Learning by doing" improves upon traditional educational practice reliant on instructionism. (Papert 1985; Papert 1991) However, constructionism takes that one step forward with an emphasis on "learning by making."(Papert 1980s; Papert 1980s; Papert 1999)

The "friends of constructionism" described below represent many aspects of educology including technological empowerment, curricular improvement, authentic learning environments, kid power and the reinvention of what Papert would call School (with the capital S). They serve, as reminders that technological progress creates opportunities to amplify the potential of each learner and that John Dewey's ideas are alive and well. Things need not be, as they seem.

One Laptop Per Child

One Laptop Per Child (OLPC), the effort to invent a durable, affordable and powerful "children's machine" for kids in developing nations is the direct descendant of Papert's work and constructionist theory. After three million computers have been been given to children, the project remains as controversial as when it was first proposed. While there are legitimate criticisms of logistical and technical aspects of the initiative, OLPC continues to be attacked by those critical of the technology or its advocates. Papert and Negroponte have long predicted how institutions, such as schools, often display an immune response to new technologies and approaches to teaching and learning.

Since Alan Kay sketched his "dynabook" in 1968 following a visit to Papert's Logo Lab at MIT, members of the Logo/constructionism community have been committed to a personal computer for every child to be used as an intellectual laboratory and vehicle for self-expression. (Papert 1993; Johnstone 2003) OLPC's laser-like focus on learners, rather than schools casts its lot with constructionism over instructionism. OLPC has never been about schools or schooling. In some cases, schools were merely the distribution channel for children to receive laptops they can learn with anytime, anywhere.

> "The OLPC concept measures [sic: matches] with the idea that children can take charge of their own learning.
>
> Making videos, communicating, creating their own programs, our children will take charge of knowledge. I believe that having the individual computers–each child owns a computer and has it all the time–is the only way we can empower really learner-centered learning." (2006)

The "problems" attributed to the OLPC experiment are predominantly criticisms of politics, leadership or the intransigence of school rather than of constructionism or personal computing for poor children. (Warschauer, Cotten et al. 2011) Nicholas Negroponte and Sugata Mitra's audacious experiment to drop computers from a helicopter over a remote African village is based on a belief in constructionism. (Hruska 2011; Venkatraman 2011; Warschauer, Cotten et al. 2011)

> "The computer greatly expands what is in the culture of the child's life. What the computer does is to make it possible for natural learning, which really means learning without teaching, without being taught, to be extended [exposed] to a much greater range of knowledge. I think we see when kids learn by themselves, to use

> the computer and to play very complex games, and overcome technical problems, we see them exercising the same natural learning abilities that enable them to learn to speak, learn to get around their parents, find the way around the house and find the way around the parents et cetera, all the stuff they learn outside of school. That's the natural learning.
>
> I agree completely with the suggestion [that] when they learn the computer, they are able to exercise that natural learning skill. But the conditions of school forces them to use more artificial ways of learning. So the big impact of putting out more computers under the control of children is to promote learning, learning. We will promote the learning of being a better learner, and that's the most important skill in a rapidly-changing world." (2006)

Generation YES

Founded by veteran Logo educator, Dennis Harper, Generation YES is a US non-profit that create materials to support student empowerment around computer use. Generation YES employs kid power (Papert 1996; Papert 1998) to serve their community through the provision of teacher professional development, technical support and peer certification of technological literacy. Papert praised the program as one of the best things the United States Department of Education ever funded. (Generation_WHY 1998)

Fab and Personal Fabrication

Neil Gershenfeld, a colleague of Papert's at the MIT Media Lab directs the Center for Bits and Atoms and teaches a course entitled, "How to Make Almost Anything." Gershenfeld's book, *Fab: The Coming Revolution on Your Desktop--from Personal Computers to Personal Fabrication (Gershenfeld 2007)*and subsequent articles (Mikhak, Lyon et al. 2002; Gershenfeld 2005; Johnson 2005; Malone and Lipson 2007) predict that the next major innovation in technological progress will be personal manufacturing – creating the technology *you* need to solve *your* problems. Such self-reliance, personal empowerment and agency over technology have been at the core of Papert's work for forty-five years based on the question of whether the computer programs the child or the child programs the computer? (Papert 1980)

> "I thought of giving children the power to program computers as a tiny first step in a complex process whose details could not be anticipated."
>
> (Papert 1997)

Throughout his career, Papert has not only advocated children owning personal computers, but maintaining, repairing and even building the computer themselves. Fab brings us one step closer to that ideal.

> "Looking at the complex texture of Logo development provides a new perspective on the problem of deciding not only whether Logo succeeded or failed, but whether all endeavours in the field have succeeded or failed.
>
> The problem is not so much solved as dissolved: the real problem is not whether Logo "succeeded," but understanding the growth of a

> computer learning culture in which Logo plays an important, but not determining, part. Does this mean we can simply drop Logo? Yes but only when Logo is given its ultimate success by the evolution of the next stage of programming systems for children." (Papert 1997)

Precedents for the much more technologically sophisticated fabrication predicted by Gershenfeld and represented by the exploding "maker" community of tinkerers and inventors promoted by *Make Magazine* may be found in the creation of programmable LEGO robotics materials (Resnick and Ocko 1991; Resnick and Ocko 1991; Papert 1993; Resnick 1993; Kafai and Resnick 1996; Resnick, Bruckman et al. 2000). Papert's affection for bricolage (Papert and Franz 1987; Papert 1991; Turkle and Papert 1992; Papert 1997) as an important element of knowledge construction is well represented by the hobbyists and children engaging with increasingly sophisticated technology in a personally expressive fashion.

The growing popularity and expanding network of community-based "hacker spaces" are high-tech "samba schools" (Papert 1980) where expensive fabrication hardware and expertise is shared with bricoleurs of all ages. (Schlesinger ; Lahart 2009; Raison 2010; Baichtal 2011; Hunsinger 2011; Holt and Braun 2012) Arduino, Lilypad Arduino and other new robotics construction kits have deep ties to Papert, his colleagues and constructionism. (Schelhowe ; Resnick 1993; Resnick, Bruckman et al. 2000; Eisenberg, Eisenberg et al. 2005; Buechley, Eisenberg et al. 2008; Katterfeldt, Dittert et al. 2009; Dittert and Schelhowe 2010)

The popularity of reality television is in no small part based on the sharing of what Papert called learning stories. (Papert 1993; Papert 1993) Papert's prediction of a knowledge machine as exemplified by a preschooler asking the computer, "How do giraffes sleep?" (Papert 1993; Papert 1993) becomes more of a reality each day due to the availability of the Web, YouTube and reality television. Expertise is more easily accessible than at any time in history. Knowledge and apprenticeship experiences are but a screen away. Coupled with the ability to use technology to invent solutions to personally meaningful problems, learners not only have access to information, but a greater ability to shape their world. Personal fabrication furthers Papert's vision that "If you can use technology to make things you can make a lot more interesting things. And you can learn a lot more by making them." (Stager 2006)

Samba Schools

The Brazilian samba school is one of the most enduring metaphors in *Mindstorms*. (Papert 1980) The samba school is where people of all ages come together to prepare for their dance in the annual carnival parade. Young and old learn to dance together with a shared purpose and rich community of practice. Papert asserted that computer-rich environments such as where Logo was being used had a great deal in common with the samba school.

> "Logo environments are like samba schools in some ways, unlike them in other ways. The deepest resemblance comes from the fact that in them mathematics is a real activity that can be shared by novices and experts. The activity is so varied, so discovery-rich, that even in the first day of programming, the student may do something that is new and exciting to the teacher. John Dewey expressed a nostalgia for earlier societies where the child becomes a hunter by real participation and by playful imitation. Learning in our schools today is not significantly participatory—and doing

> sums is not an imitation of an exciting, recognizable activity of adult life. But writing programs for computer graphics or music and flying a simulated spaceship do share very much with the real activities of adults, even with the kind of adult who could be a hero and a role model for an ambitious child." (Papert 1980)

Although Papert acknowledges that Logo environments are "too primitive" (Papert 1980) to satisfy the ideals of the samba school, at least three "friends of constructionism" have created learning environments that approach that standard of deep intergenerational learning.

"LOGO environments are not samba schools, but they are useful for imagining what it would be like to have a "samba school for mathematics." Such a thing was simply not conceivable until very recently. The computer brings it into the realm of the possible by providing mathematically rich activities which could, in principle, be truly engaging for novice and expert, young and old. I have no doubt that in the next few years we shall see the formation of some computational environments that deserve to be called "samba schools for computation." There have already been attempts in this direction by people engaged in computer hobbyist clubs and in running computer "drop-in centers." (Papert 1980)

Computation is not integral to 826 Valencia, El Sistema, Reggio Emilia or the Big Picture Schools. However, these projects have demonstrated a scalable and sustainable model for creating rich environments where children work alongside of adults in mutually beneficial learning adventures. Regardless of whether the leaders of these movements are aware of constructionism, their projects embody it at a scale constructionists should envy.

826 Valencia

826 Valencia is a community writing center started in 2002 by Nínive Calegari and best-selling novelist Dave Eggars in a diverse San Francisco neighborhood. Children spend their afterschool and weekend hours there writing alongside real writers. One could think of 826 Valencia as the literary equivalent of Papert's "Mathland."(Papert 1980) Kids are taught to be writers rather than taught about writing, just as in Mathland children are taught to be mathematicians rather than being taught math. (Papert 1972) They write for deeply personal purposes and for publication through regularly published anthologies and engage in many forms of writing including poetry, novels, non-fiction, criticism, journalism, social activism and more utilitarian artifacts, such as college essays. Volunteers, many of whom are professional writers, support the youngsters in the writing process. Notable authors occasionally sponsor the publication of a writing anthology organized around a specific theme and join their younger peers by contributing a work of their own in the same volume. (826Valencia)

The setting of 826 Valencia and its growing network of other centers (currently eight in the United States) is critical to its success in creating productive contexts for learning. The original San Francisco writing center is in the back of a pirate supply store, complete with planks, eye patches, a "fish theatre," scurvy medicine, hooks and any other provision a swashbuckler might need. Other 826 Valencia centers are built around themes such as time travel and super hero supplies. The whimsical settings are inviting to children, honors their playful spirit and creates a place in which they feel safe making their thinking visible via the often vulnerable act of writing. 826 Valencia also organizes and prepares thousands of volunteers to work in public schools as writing mentors in the cities they serve. (TED 2008)

The Big Picture

In 1995, serial American public school transformer, Dennis Littky, and his partner Elliot Washor the MET School in a poverty-ravaged neighborhood in Providence, Rhode Island. The MET and other similar schools became the basis for the Big Picture Schools, of which there are now more than sixty around the world.. (Big_Picture_Company) As in El Sistema, Reggio Emilia, 826 Valencia, Generation YES and the samba schools, Big Picture Schools rely on relationships between students and teachers who know and care for each other. While many of the other "friends of constructionism" discussed in this paper are informal learning spaces, the Big Picture Schools are a complete reinvention of secondary education.

Big Picture schools typically serve grades nine through twelve. Approximately fourteen students are assigned to an advisor who remains with them for four years. The advisor is responsible for educational progress and well being of a student while also serving as the student's primary teacher *at school*. Students do not attend school at all two days a week. They engage in internships in the community based on anything that interests them. The curriculum back at school, Monday, Wednesday and Friday is anything that the student needs to know in order to do better what they do Tuesday and Thursday. No distinction is made between vocation and avocation, academic areas or vocational skills. Any passion the student follows in real-world settings with a mentor form the basis for their university-preparatory education. The Big Picture Schools also keep coercive practices such as grading to a minimum. Students present exhibitions of their work to the community of peers, advisors and mentors in a public setting as a way of demonstrating competency in the spirit of Ted Sizer's work with the Coalition of Essential Schools. (Sizer, National Association of Secondary School Principals (U.S.) et al. 1984; Sizer 1992; Sizer 1996)

Despite this unorthodox approach to secondary schooling, students in the Big Picture Schools enjoy a very high percentage of entry to higher education and impressive academic. Most importantly, students who spend four years creating their own path not only develop the habits of mind to become competent lifelong learners, but they develop the social capital usually reserved for peers of much greater wealth and privilege. Littky has recently expanded the model to address high rates of higher education attrition among economically disadvantaged students through the creation of *College Unbound* while there are elementary schools exploring how the Big Picture principles may apply to primary education.

El Sistema

In 1975, Venezuelan economist and musician, José Antonio Abreu created El Sistema (The System) as a vehicle to create social cohesion in Venezuelan society in response to widespread poverty and violence. Abreu believed that once you give a violin to a child she is "no longer poor" (TED 2009) and "unlikely to pickup a gun." Students from preschool through secondary school age study in community-based instrumental music, singing and music theory in community based nucleos across Venezuela, many in the poorest of communities. Each nucleo has one or many orchestras through which students progress based on ability. El Sistema also provides opportunities for students to play in regional and national orchestras. Being productive citizens is the goal of El Sistema, not the creation of professional musicians even though Venezuela is gaining a reputation for creating some of the finest musicians and orchestras in the world. (Smaczny and Stodtmeier 2009)

In the case of El Sistema, music is the object to think with. By being a musician in an orchestra, you learn about discipline, democracy, perseverance, excellence, listening, culture, precision,

beauty, history and more. You are part of something larger than yourself. In a poor nation such as Venezuela, necessity is the mother of invention. A scarcity of instruments has led El Sistema to create "luthiers," workshops where young people learn to build, repair and maintain musical instruments. The luthiers share much with Fab Labs and the construction of guitars in Papert's Constructionist Learning Laboratory. (Stager 2006) Older students often teach lessons for less experienced children and even conduct orchestras. Students are expected to teach each other informally during orchestra rehearsals.

Once you receive an instrument you are in an orchestra playing classical music. If you only know how to play one note, a part will be written for you so that you can play that note on cue. The orchestra may be playing Mahler or Beethoven, but you *are* a musician in a *real* orchestra from day one. Abreu is driven by a belief that "poor children do not deserve poor music." (Tunstall 2012) Such principles and pedagogical techniques should resonate with constructionists and share much with the other "friends of constructionism."

El Sistema and The Big Picture Schools have achieved the holy grail of innovation – scale. Close to a half million children participate in El Sistema annually and the global popularity of "The System" has been amplified by the Los Angeles Philharmonic's hiring of Gustavo Dudamel at twenty-five years old as its principle conductor. Acclaim for the energetic, charismatic and gifted Dudamel has helped spread El Sistema based on his outspoken promotion of "The System." His evangelism is rooted in the fact that he was a child who came up though El Sistema and at such a young age is now considered one of the world's premiere conductors. Dudamel presides over a version of El Sistema in Los Angeles.

Reggio Emilia

Perhaps the most outstanding implementation of constructionism may be found in the more than thirty infant-toddler centers and preschools in the Italian city of Reggio Emilia. Fifty years ago, Loris Malaguzzi led a group of educators who wished to rebuild their post-war city based on the rights and competency of its youngest citizens. "The Reggio Approach" is built on a child's curiosity, interest and passion. It is only an accident of bureaucracy that the Reggio Approach is so closely associated with preschool education. Its powerful ideas have application to education at all levels.

> "It is close to 40 years since I fell in love with the idea that a technologically rich environment could give to children who love ideas access to learning-rich idea work, and to those who love ideas less the opportunity to learn to love them more. But many ideas are more easily loved than implemented. What is idea work? How can it be made accessible to young children?" (Papert 2000)

Reggio Emilia has done more to make idea work accessible to children than perhaps anywhere else in the world and they have done it for half a century. In Reggio, the teacher's primary role is as a researcher who makes each child's thinking visible through careful listening, documentation and analysis with colleagues. The teachers then prepare the environment to be the "third teacher" supporting further inquiry. Malaguzzi, one of the great educational philosophers of the past century said that the learning environment should be comprised of one thousand laboratories designed carefully to support the hundred languages of children. Students in Reggio centers learn free of coercion and express their intellect and creativity through artifacts and projects of staggering beauty and complexity. They use real materials to solve authentic problems. "Knowing Reggio" is as complex or difficult as knowing Papertian constructionism and requires

much more space than this paper allows. However, a growing number of books and DVDs illuminate why *Newsweek* called the Reggio preschools among the best schools in the world. (Kantrowitz 1991)

Papert was fond of El Sistema, although I am unaware of whether he ever met Maestro Abreu. I do know that he had visited Reggio Emilia, but am uncertain if he ever spoke with Malaguzzi.

Abreu, Littky, Malaguzzi, the educators of Reggio Emilia and Seymour Papert share the same critical trait; a steadfast refusal to succumb to incrementalism. The municipal preschools of Reggio Emilia have achieved a sort of longevity that should be admired by constructionists everywhere. Advocates of constructionism have much to learn from progressive educators engaged in similar work, regardless of whether computation is involved, while constructionist theory will find a larger audience through alliances with those similarly inclined. Such bridge building contributes to a more mature educology benefitting us all.

References

(2006). Professor Papert Discusses One Laptop Per Child Project. United States State Department International Information Programs. Washington D.C., United States Department of State.

826Valencia. "History." Retrieved March 20, 2012, from http://826valencia.org/about/history/.

Ackermann, E. K. (2010). Constructivism(s): Shared roots, crossed paths, multiple legacies. Constructionsm 2010. J. Clayson. Paris**:** 9.

Baichtal, J. (2011). Hack This: 24 Incredible Hackerspace Projects from the DIY Movement, Que Pub.

Big_Picture_Company. Retrieved March 15, 2012, 2012, from http://www.bigpicture.org/schools/.

Buechley, L., M. Eisenberg, et al. (2008). The LilyPad Arduino: using computational textiles to investigate engagement, aesthetics, and diversity in computer science education, ACM.

Dittert, N. and H. Schelhowe (2010). TechSportiv: using a smart textile toolkit to approach young people's physical education, ACM.

Eisenberg, M., A. Eisenberg, et al. (2005). Mathematical Crafts for Children: Beyond Scissors and Glue, Citeseer.

Generation_WHY (1998). Seymour Papert on Generation WHY and Kid Power.

Gershenfeld, N. (2005). "A Customer Base of One." Scientific American.

Gershenfeld, N. (2007). Fab: the coming revolution on your desktop--from personal computers to personal fabrication, Basic Books (AZ).

Holt, M. and E. Braun (2012). "Hacking Reality: The Hackerspace Project and the Farming of Innovation."

Hruska, J. (2011). "Apocalypse Now: New OLPC tablets to be airdropped on third world children." Retrieved March 15, 2011, 2012, from http://www.extremetech.com/mobile/103291-apocalypse-now-new-olpc-tablets-to-be-airdropped-on-third-world-children?print.

Hunsinger, J. (2011). "The Social Workshop as PLE: Lessons from Hacklabs."

Johnson, G. (2005). "A Customer Base of One." SCIENTIFIC AMERICAN **292**(6): 110-112.

Johnstone, B. (2003). Never Mind the Laptops: Kids, Computers, and the Transformation of Learning. Seattle, iUniverse.

Kafai, Y. B. and M. Resnick (1996). Constructionism in practice: designing, thinking, and learning in a digital world. Mahwah, N.J., Lawrence Erlbaum Associates.

Kantrowitz, B., Wingert, P. (1991). The Best Schools in the World. Newsweek.

Katterfeldt, E. S., N. Dittert, et al. (2009). EduWear: smart textiles as ways of relating computing technology to everyday life, ACM.

Lahart, J. (2009). "Tinkering Makes Comeback Amid Crisis." I: Wall Street Journal.

Malone, E. and H. Lipson (2007). "Fab@ Home: the personal desktop fabricator kit." Rapid Prototyping

Journal **13**(4): 245-255.

Mikhak, B., C. Lyon, et al. (2002). Fab Lab: An alternate model of ICT for development.

Papert, S. (1972). "Teaching children to be mathematicians versus teaching about mathematics." International Journal of Mathematical Education in Science and Technology **3**(3): 249-262.

Papert, S. (1980). Mindstorms: children, computers, and powerful ideas. New York, Basic Books.

Papert, S. (1980s). Constructionism vs. Instructionism.

Papert, S. (1980s). Constructionism vs. instructionism.

Papert, S. (1985). Computer Criticism vs Technocentric Thinking. Logo 85 Theoretical Papers. Cambridge, MA, MIT**:** 53-67.

Papert, S. (1990). A Critique of Technocentrism in Thinking About the School of the Future. M.I.T. Media Lab Epistemology and Learning Memo. Cambridge, M.I.T. Media Lab.

Papert, S., Ed. (1991). Situating Constructionism. Constructionism. Norwood, NJ, Ablex Publishing Corporation.

Papert, S. (1993). The Children's Machine: Rethinking School in the Age of the Computer. NY, Basic Books.

Papert, S. (1993). "Obsolete skill set: the 3Rs; literacy and letteracy in the media ages." Wired (May-June 1993) **50**.

Papert, S. (1996). The connected family: bridging the digital generation gap. Atlanta, Georgia, Longstreet.

Papert, S. (1997). Educational Computing: How Are We Doing? T.H.E. Journal**:** 78-80.

Papert, S. (1997). "Why School Reform is Impossible." Journal of the Learning Sciences **6**(4).

Papert, S. (1998). Child Power: Keys to the New Learning of the Digital Century [lecture transcript]. Eleventh Colin Cherry Memorial Lecture on Communication, Imperial College, London, UK.

Papert, S. (1999). Introduction: What is Logo and Who Needs It? Logo Philosophy and Implementation. LCSI. Montreal, Quebec, LCSI**:** v-xvi.

Papert, S. (2000). "What's the Big Idea? Toward a Pedagogical Theory of Idea Power." IBM Systems Journal **39**(3&4): 720-729.

Papert, S. and G. Franz (1987). "Computer as Material: Messing About with Time." Teachers College Record **89**(3).

Raison, D. (2010). Hackerspaces, postmodern learning spheres beyond the virtual?

Resnick, M. (1993). "Behavior Construction Sets." Communications of the ACM **36**(7).

Resnick, M., A. Bruckman, et al. (2000). Constructional Design: Creating New Construction Kits for Kids. Robots for Kids : Exploring New Technologies for Learning. A. Druin, Hendler, James. San Francisco, Morgan Kaufmann.

Resnick, M. and S. Ocko (1991). LEGO/Logo: Learning Through and About Design. Constructionism: research reports and essays, 1985-1990. S. Papert, I. Harel and M. I. o. T. E. L. R. Group. Norwood, N.J., Ablex Pub. Corp.

Resnick, M. and S. Ocko (1991). Xylophones, Hamsters and Fireworks: The Role of Diversity in Constructionist Activities. Constructionism: research reports and essays, 1985-1990. S. Papert, I. Harel and MIT E&L Group. Norwood, N.J., Ablex Pub. Corp.

Sarason, S. (2001). American Psychology and Schools - A Critique. NY, Teachers College Press.

Sarason, S. B. (1990). The predictable failure of educational reform: can we change course before it's too

late? San Francisco, Jossey-Bass.

Sarason, S. B. (1996). Revisiting "The culture of the school and the problem of change". New York, Teachers College Press.

Sarason, S. B. (1998). Political leadership and educational failure. San Francisco, Calif., Jossey-Bass Publishers.

Sarason, S. B. (2004). And what do you mean by learning? Portsmouth, NH, Heinemann.

Schelhowe, H. Using Construction Kits : Just Learning How to Programme a Computer - Or is There More Educational Benefit?

Schlesinger, J. Founding a Hackerspace, Worcester Polytechnic Institute.

Sizer, T. R. (1992). Horace's school: redesigning the American high school. Boston, Houghton Mifflin Co.

Sizer, T. R. (1996). Horace's hope: what works for the American high school. Boston, Houghton Mifflin Co.

Sizer, T. R., National Association of Secondary School Principals (U.S.), et al. (1984). Horace's compromise: the dilemma of the American high school. Boston, Houghton Mifflin.

Smaczny, P. and M. Stodtmeier (2009). El Sistema: Music to Change Life Euroarts.

Stager, G. S. (2006). An Investigation of Constructionism in the Maine Youth Center. Department of Education. Melbourne, The University of Melbourne. **Ph.D.:** 455.

TED (2008). Dave Eggers' wish: Once Upon a School.

TED (2009). Jose Abreu on kids transformed by music.

Tunstall, T. (2012). Changing Lives: Gustavo Dudamel, El Sistema, And the Transformative Power of Music. New York, W.W. Norton & Company.

Turkle, S. and S. Papert (1992). "Epistemological Pluralism and the Revaluation of the Concrete." Journal of Mathematical Behavior **11**(1): 3-33.

Venkatraman, V. (2011). I Want to Give Poor Children Computers and Walk Away. NewScientist.

Warschauer, M., S. R. Cotten, et al. (2011). "One Laptop Per Child Birmingham: Case Study of a Radical Experiment."