Introduction

Growing Up With Radio

I grew up with radio, listening to reports from London and the Pacific theaters of World War II. The voices of Edward R. Murrow ("This . . . is London.") and H. V. Kaltenborn were my link to the outside world from Hartsdale, New York, where I was an elementary school student.

After the war came black-and-white television, with a huge magnifying lens mounted in front of the nine-inch screen (maybe a little more or less). I watched with intense inquisitiveness news events of the early 1950s such as the Army-McCarthy hearings about communists lurking in our government (Look it up if you don't remember these dramatic events from high school history class. It's worth it!) and the Democratic and Republican conventions of 1952. Eisenhower and Stevenson were nominated.

Finally, we got a color television, and I thought the whole world had changed. There were my favorite teams—the New York Yankees and the Notre Dame football team—and all our beloved comedians—Jackie Gleason, Milton Berle, Sid Caesar, and others—in vivid color.

Slowly, the technologies began to change even more.

While I was teaching at Montclair State University, my colleagues and I were called into an auditorium one day to see the latest: what a computer could produce on a screen. And what was that? The roster from a class at a California university, perhaps a class in science or the humanities. Shortly thereafter a colleague showed a friend and me, from her own desktop machine, pictures from various Parisian hotels, rooms, salons, dining areas, and the like. This was rather cool!

The World Wide Web had expanded from California to encompass so many wonders!

Now, my nephew Benjamin Gleason is embarking on a new adventure; with two children and a wife, he's in a doctoral program in educational technology at Michigan State University. He and I have had several

conversations about what an exciting field this will be. (When I contemplated a similar doctorate at Teachers College, Columbia University, in the 1970s, what we had in the way of technology for educators was television—the sets [or monitors], the cameras, the portapacks [for remote recording], the lighting, the whole works!)

I mention this brief history because when I began this project on 21st century learning, I conceived of the skills or capacities requisite within our new century as the same as those of the 20th, the 19th, and the 18th centuries, on back to the age of Socrates. Yes, we had new technologies, but these were not my focus.

Now, I've reconsidered.

Daily, I receive news briefs, e-mails, notes about blogs, and so forth announcing how new technologies are transforming our classrooms. Students are using devices never imagined just a few years ago:

iPhones, Androids, and other smart devices;

iPads;

BlackBerry smartphones;

iTunes University;

Skype with one/multiple settings;

Google Docs;

Wikis;

Moodle;

Wordle (try it!);

Facebook;

LinkedIn;

Twitter;

Cloud computing (some schools and businesses use extensively); and

many more that haven't yet been invented.

What do we do with all of these means of communication? How should they affect the old models of teaching and learning? What will be their long-term effects for various kinds of students?

The National Association of Secondary School Principals recently (2011) noted, "As mobile devices become more powerful and more affordable, their potential for enhancing student learning has come into clearer focus. Social networking sites provide platforms for student creativity by

enabling them to design projects using words, music, photos, and videos. In recent years, there has been explosive growth in students creating, manipulating, and sharing content online (National School Boards Association, 2007). Recognizing the educational value of encouraging such behaviors, many school leaders have shifted their energies from limiting the use of these technologies to limiting their abuse" (http://www.nassp.org/Content .aspx?topic=Using_Mobile_and_Social_Technologies_in_Schools).

Initially, there may have been abuses with these new ways of communicating. Now, leaders are realizing we must learn how to deal with access to infinite amounts of information and the responsibility to think critically about whatever we find there.

Indeed, we must ensure that from a very early age—some teachers say as early as kindergarten—our students begin to become aware that anything is permitted on the Internet. "Nobody is in charge!" as Tom Friedman (2008) has often noted.

This is what is so different and exciting about educating students for the 21st century—the access to unlimited amounts of information and being open to worldwide resources. I've had the pleasure this year of engaging in Skype conversations with teachers in a Pittsburgh Science, Technology, Engineering, Art, and Math project as well as with educators in Austin, in Syracuse, and in Edmonton, Alberta, while sitting at my desk here in New York City. Obviously, students can do the same. (Witness the commercial with Ellen Page, who enters an elementary school whose students are about to take a field trip to China. And then there they are on the screen!)

"AN EXPANSIVE CANVAS"

Schools are using Skype technologies to connect with one another in different states to learn about "Web 2.0 skills, digital citizenship, personal network building and social media responsibility and practice." Here is the "virtual classroom" (see http://www.edutopia.org/blog/web-20-21st-century-skills-collaboration-digital-citizenship). One teacher, Mrs. Miller, noted, "My students cannot stop talking about our connected classroom. They have made so many new connections and realize that their classroom is not simply limited to a room, but is an expansive canvas." Imagine the prospect of learning about different peoples, their varying points of view, and how that might positively affect your view of a subject, of yourself, of the world. And now we're on to Web 3.0 skills and concerns, such as working more with cloud computing.

So my nephew Benjamin and I have had interesting conversations about his forthcoming studies and about how this technology might affect

how we learn, how we think, how we process information, what we think about old and new knowledge, and how we acquire it. Certainly kindergartners this year will graduate from high school thirteen years from now with vastly different ideas of what it means to learn, where we learn best, and how to become good thinkers and be responsible citizens.

> How will current technology affect how we learn, how we think, how we process information, what we think about old and new knowledge, and how we acquire it? How will our graduating seniors think differently from you and me? What do we need to do to ensure they use all these technologies responsibly and to their own and society's benefit? Most significantly, what effects will these newer technologies have on students' achievement over time? And do we even have means to assess their impact on student learning at present?

This project has set me on a fascinating journey, one that has taken me into schools I've never set foot in physically and back to ones that I've written about in the past (see Barell, 2007).

Even though at present I do not own an iPad2, I know that some districts in the neighboring state of New Jersey are about to field-test a new algebra curriculum using this device and a publisher's curriculum. Apple reports that there are 600 districts across the country that are introducing new curricula in other subjects, sometimes designed by the textbook publishers themselves. The benefits are numerous. In addition to being sleek, lightweight, and able to access more current information, "They include interactive programs to demonstrate problem-solving in math, scratchpad features for note-taking and book marking, the ability to immediately send quizzes and homework to teachers, and the chance to view videos or tutorials on everything from important historical events to learning foreign languages. They're especially popular in special education services, for children with autism spectrum disorders and learning disabilities, and for those who learn best when something is explained with visual images, not just through talking" (Reitz, 2011).

So the means of delivering content have changed, but will our ways of learning change with them? And even more importantly, will the content delivered on these miraculous devices be any different from what we currently find in our weighty textbooks?

We're moving away from a reliance on overweight textbooks to having access to information that may be far more current, but will that change how we educate our students to think about this content?

And what, in the long run, will be the effects of all this technology on student achievement as we currently assess it? Do we have the means to determine how use of, for example, iPads affects our learning of content?

> One teacher, Kelly Taylor from Catalina Foothills School District, near Tucson, Arizona, introduced me to another technology, YouTube, as an assessment tool. She videotaped an evaluative discussion with one of her students, a reflection on a science project, and sent me a link to it on YouTube. Then I became intrigued and finally figured out how to post my own videos on YouTube (see www.morecuriousminds.com/videos.htm).[1]

The teachers I have had the pleasure of working with have not yet, by and large, introduced most of these communication devices into their classrooms. They might not have students Twittering among themselves about school subjects in class, but in one Vancouver third-grade classroom, Shauna Ullman has her students sharing questions and responses using Google Docs, and this is a change. It's a way of including all students, some of whom would rather not raise their hands to contribute. She also, as we'll see in Chapter 6, has had students experimenting with iPads and how they can provide access to even more resources. Shauna is opening her classroom so students can explore myriad possibilities within our globalized world.

21ST CENTURY CAPACITIES

What has made my own journey so rewarding is, of course, meeting many extraordinary teachers who have found ways to identify and monitor their students' thinking. The 21st century skills or capacities we have focused on during this adventure include the following:

inquiry,

problem solving,

critical thinking,

creative thinking,

reflection,

collaboration/teamwork, and

uses of information technology.

Lists of 21st century skills also include dispositions:

self-direction,[2]

leadership,

adaptability/resourcefulness,

responsibility, and

global awareness.[3]

These are, for me, the core intellectual processes we have required in the past, and we surely will require them in the connected, interactive classrooms of the globalized world where we learn from an infinite variety of sources.

RATIONALE FOR THIS BOOK

So why do we need this book? Why focus on these 21st century learning skills, or capacities, as I prefer to call them? *Skills* seems quite technical and limiting. Having a capacity to identify and resolve problems through inquiry is more far-reaching, more demanding of in-depth thinking than the skills of changing a tire, adding a column of numbers, or posting your videos on YouTube.

Even though many of us are not yet where educational leaders see us being in the near future, it seems to me that we are educating our students to grow and thrive within a world that is changing with "an ever increasing acceleration," as Admiral Richard E. Byrd wrote me many years ago about exploring the continent of Antarctica.

GLOBAL COMPETITION

Our students will have to deal with unlimited sources and kinds of information, some of that at lightning speed within a world where there is "increased global inter-connectivity" that puts "diversity and adaptability at the center of organizational operations."[4]

In other words, our students are going to have to compete with people all over the world. They will have to innovate, be critical problem posers and solvers, reflect, and be able to use all of the technologies and social media we've mentioned above. They already far surpass many of us more mature folks in using these technologies!

Recent research on innovation by Dyer, Gregersen, and Christensen (2011) suggests that the 21st century capacities we've identified are part of their DNA:

> questioning,
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> observing,
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> networking, and
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> experimenting.

"Innovators," Dyer et al. (2011) write, "are consummate questioners who show a passion for inquiry. Their queries frequently challenge the status quo, just as [Steve] Jobs did when he asked, 'Why does a computer need a fan?' They love to ask, 'If we tried this, what would happen?' Innovators, like Jobs, ask questions to understand how things really are today, why they are that way, and how they might be changed or disrupted" (p. 23).

Innovators and 21st century citizens are people who are continually raising questions and seeking answers. They are very entrepreneurial, ready and willing to set off on different pathways, take risks, and explore new territories.

The DNA of innovators consists of the capacity to

> question,
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> observe,
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> network, and
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> experiment.

When we engage in these behaviors as well as in what Einstein called "combinatorial play with ideas" (i.e., "Associating"), we foster innovation.

Source: Dyer, Gregersen, and Christensen (2011, p. 23).

We must ensure that we challenge all our students with "authentic" problem situations so they become better at thinking through complex, multifaceted issues such as climate change, pollution control, feeding the hungry, preventing disease, electing the most qualified candidates to

office, preserving our democracy, fashioning the artworks that will inspire us all, and probing nature to ferret out its secrets.

With such challenges as they will face in the interconnected world of today and tomorrow, a curriculum full of pablum-like rote memorization exercises will never suffice. Our students need to think through problematic situations similar to those we confront outside of school every day.

Even if they do not apply for and receive patents for new creations, they will have to become innovators of how to do business, how to succeed, and how to prosper in this new century.

21ST CENTURY CITIZENSHIP

Looking at the political landscape at this writing (September 2011), it seems that our country is mired in public wrangling about so many issues—for example, the role of the federal government in our lives and how to solve problems of employment, health care, clean air, and national security.

Regardless of anybody's leanings or persuasions on these issues, it goes without saying that what America needs to survive as a democracy are people who are intelligent, who keep themselves well informed, and who raise questions about situations that are perplexing and intriguing. These citizens will, then, seek answers as well as pursue remedies for their own as well as the common good.

Benjamin Franklin is reputed to have told a questioner who asked, "Well, Doctor, what have we got—a Republic or a Monarchy?" upon leaving the Constitutional Convention in Philadelphia in 1787, "A Republic, if you can keep it."

That is the responsibility of all of us.

PERSONAL GROWTH

It's not just to enhance our competitive edge that we advocate for 21st century capacities. No, those of us who work daily within schools to enhance, say, students' curiosity, do so because we see how enriching such experiences are for all concerned. The teacher derives benefit from so many students' being engaged with artifacts or stories that are intriguing, interesting, and perplexing. And of course, our students become emotionally and intellectually engaged when they are posing their own questions and can see them become part of what we are investigating for the unit:

"My inquiry skills shot through the roof!" (see Chapter 8).

"STEM changed my life" (see Chapter 9).

Speaking from personal experience, my own questions about Antarctica (Barell, 2011) led to meeting Admiral Byrd; sailing south on his flagship; exploring the highest, driest, and windiest continent on the planet; and thence finding this profession, working with educators like you to foster the same kinds of inquiry and investigation. It is immensely enriching and satisfying!

For these tasks we need all the teachers you will meet here. We will need my nephew Benjamin Gleason as well as parents and principals who will help guide our journeys.

WHY NOT HIGH-STAKES STANDARDIZED TESTS?

But why attempt to observe, measure, and monitor progress, growth, and development?

I once asked educators, "How do we know students are getting better?" at critical thinking and was told we needn't be "reductionist about it." This meant to me that this principal was thinking of reducing growth to numbers.

Most assessments from the federal No Child Left Behind law, as well as state assessments in various subjects, are based on standardized tests. These "bubble tests" record what students are able to do within one subject at that moment. They do not, most of them, come close to reflecting the authentic learning challenges leading educators have been advocating for many years (see, e.g., Bransford, Brown, & Cocking, 2000; Newmann & Associates, 1996). To become a good inquirer, problem solver, and critical/creative thinker, one needs to encounter tests that are complex, intriguing, ill structured, and not given to any one right answer and that reflect what people do in the world to live and make a living. These kinds of authentic problems will not be found in standardized tests (except, perhaps, for assessments such as the College and Work Readiness Assessments that do challenge students with ill-structured problems to consider; see www.cae.org/content/pro_collegework.htm).

And we need to be able to assess students' progress over long periods of time, not in a one-shot test given within an hour or perhaps longer. The 21st century capacities and their associated dispositions grow over long periods of time as the result of maturation, environment, and encounters with authentic problems. Teachers here have disclosed to us ways of capturing this growth and development.

So you won't find numbers within these pages so much as various ways, from kindergarten through eighth grade, that teachers have observed their students' becoming better questioners, better thinkers, and more self-directed over time—during the year and within the span of five years.

But why even seek to observe growth?

Because if we assert that these 21st century capacities are so vital to our nation's survival (and I do believe they are), we should be able to say whether our students are improving beyond merely learning the content of various subjects.

> What I have attempted to share with you in this book is a disclosure model—a model that discloses various possibilities for observing growth over time and within a wide range of different settings.

Can they think about this content productively and creatively?

Are they learning how to adapt to changing conditions and forge adventures toward new horizons of learning and discovery?

What I have attempted to share with you in this book is a disclosure model—a model that discloses various possibilities for observing growth over time and within a wide range of different settings. I do hope that the possibilities described here launch your own inquiries about sharing with students, teachers, and parents how our students are growing and becoming better.

OUTLINE OF THE BOOK

We haven't been able to delve specifically into every K–8 classroom to find the rich textures of students' learning that came from four gifted teachers, Lorraine Radford, Kerry Faber, Pat Burrows, and the teams of Grade 6 through 8 teachers led by Mary Darr. However, I do hope we have sufficient examples from all grade levels to provide every reader with some valuable ways of observing and assessing students' growth in their development of 21st century capacities.

Here's an outline of what you will read:

Chapter 1: This chapter provides an overview of what teachers are doing.

Chapter 2: We address teacher self-assessment, a topic too seldom open for discussion. How do we ourselves think, inquire, and grow intellectually? "We were the blind leading the blind," said one Ohio teacher about her participation in a science, technology, engineering, and math (STEM) project. This may be the most important chapter in the book!

Chapter 3: The topic is designing the invitational environment. How do we ensure that our students are willing to take the risks to ask good questions, to break out of traditional ways of thinking?

Chapter 4: This chapter addresses basic principles of planning for excellence that affect our consideration of assessment. Planning backwards (planning with the ends in mind) has been with us for over a half century, and it continues to dominate our thinking

Chapter 5: I consider preassessment. How do we get an idea very early on of how good our students are at asking questions? Lorraine in kindergarten reports that her students mostly told stories. Pat in eighth grade tells us that early in the year her students were mainly "cookie-cutter A students," not asking questions and not giving good reasons for conclusions.

Chapter 6: Formative assessments, now seen as perhaps the most vital element of assessing how well students are progressing toward desired goals, are the topic of this chapter. Teachers' experiments as well as question-monitoring frameworks help monitor students' progress.

Chapter 7: I consider assessment of inquiry from a kindergarten class in West Vancouver, British Columbia. Lorraine Radford has an easily transferable system of tracking her students' growth in inquiry from telling stories to asking questions such as "If a game is designed for two, what do you do if three or more want to play?"

Chapter 8: This chapter explores assessment of inquiry as well as problem solving and critical/creative thinking based on Kerry Faber's fifth- and sixth-grade classrooms in Edmonton, Alberta. "My inquiry skills shot through the roof!" exclaimed Sydney.

Chapter 9: This chapter assesses problem-based learning within a STEM project for Grades 6, 7, and 8 in Sandusky, Ohio. "STEM changed my life," claimed one eighth-grade girl.

Chapter 10: We explore the process of students' becoming better critical thinkers. Pat Burrows has challenged her students to think deeply about issues in media, politics, and art. Here we describe how she helped Rachel grow from a "cookie-cutter A student" to one who is self-directed.

Chapter 11: This chapter deals with communicating with parents. I relate the story of Isidore I. Rabi, noted Nobel Prize in Physics winner, and his mother's influence on contemporary parents who took up the challenge to observe their son's growth during the early years.

Chapter 12: I review all curricular elements within these case studies to apply to Grades K through 8 in all subjects for all students. What do we do with all the assessment data we might collect from preassessments, formative assessments, and summative assessments?

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ENDNOTES

1. Jose Vilson is a middle school math teacher, and he recently noted Lady Gaga's phenomenal popularity and her use of social media networking, YouTube, and Twitter.

> Some might say she's a product of social engineering, but if anything, she's the engineer. In the same way we already have come to the conclusion that learning can't just happen in class. Much of the mantra these days is still centered on teacher-direct instruction. While I do believe there's room for that, there has to be a sense that learning comes 24/7. It happens even when our students least expect it. . . . I wonder how often students find a context where they used the math they had just learned in class, drop it as a picture on a teacher's fan page, and had the teacher reply back to ask them another question on it? (http://future.teacherleaders.org/2011/05/lady-gaga-and-the-future-implications-of-connectivity/comment-page-1/#comment-293)

2. Ken Kay (2010), former president of the Partnership for 21st Century Skills, noted that one manager at Apple told him that "any employee who needs to be managed is no longer employable" (p. xxi).

3. For a more complete list, see "Framework for 21st Century Learning" at Partnership for 21st Century Skills: www.p21.org/index.php?option=com_content&task=view&id=254&Itemid=120.

4. Advertisement for the University of Phoenix in *The Atlantic,* July/August 2011, "Promotion" pages following page 84.

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