One-Cloud Schoolhouse: A Primer on the Application of the Cloud Computing Model to K-12 Education

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One-Cloud Schoolhouse: A Primer on the Application of the Cloud Computing Model to K-12 Education

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All thoughtful men agree that the present aspect of society is portentous of great changes. The only question is, whether they will be for the better or the worse.... For my part, I hold to the former opinion. ...in the belief that the Golden Age lies before us and not behind us, and is not far away.

Edward Bellamy, Looking Backward, 1888

At the dawn of the twentieth century, many shared nineteenth-century author Edward Bellamy's belief that socialism would usher in a “golden age” (i.e., a utopian society). A century later, many hold a similar belief that we are on the cusp of a new golden age, however this time the landscape is digital and the catalyst is “cloud computing.” The belief in the potential cloud computing holds for unlocking a new golden age in technology is perhaps most evident in the unprecedented amount of money corporations have invested, and promise to invest, in the coming years. [1] Analysts predict that by 2013, cloud computing will comprise 15 percent of the software market and have an annual global market of $95 billion. [2]

All this begs the question, what is cloud computing? For educators and researchers, however, another question of tremendous import is whether the cloud computing model—which has been embraced by the business community—can be applied to K-12 education. The purpose of this article, however, is to provide a primer on the cloud computing model and then, in a subsequent article, to provide a review of the role cloud computing currently plays in K-12 education and to introduce a model for more fully realizing the potential of cloud computing in K-12 teaching and
learning.

Michael Sheehan has described the transformation cloud computing has experienced in just the past two years as having gone from being a “newfangled movement” to an “established IT and business strategy.” Comparing it to historical periods, Sheehan further defines the progress cloud computing has experienced these past two years as going from being the “New World” in 2007 to a period of “Colonization and Settlement” today. [3]

Another indicator of the amazing growth cloud computing has experienced these past two years is reflected in the graph below, from Google Trends, which charts the growth of “cloud computing” as a search term—from relative obscurity in 2007 to one of the most popular technology search terms today.

**Figure 1 – Cloud Computing as a Google Search Term**

![Graph showing growth of cloud computing as a search term](image)


**The Etymological Pursuit of Cloud Computing**

While there is ample evidence to support the prediction that cloud computing will continue to enjoy exponential growth over the next few years, there is still confusion/disagreement over what constitutes cloud computing. What makes this somewhat ironic is that, in a recent study by the Pew Research Center, 69 percent of Internet users have already engaged in cloud computing – even though many of them have never even heard of the term. [4] The table below identifies the results of a survey conducted by Pew researchers in the Pew Internet and American Life Project.

**Figure 2 – Pew Research Center Survey, 2008**

![Table showing survey results](image)
With respect to the definition of cloud computing there appears to be only one area of agreement, that being there is no one universally accepted definition of cloud computing. What follows are but a few examples of some of the more colorful descriptions of the seemingly enigmatic nature of cloud computing, which makes it an elusive etymological target:

In the hubbub, the term cloud computing is an ever expanding buzzword. There are private clouds and public clouds and hybrid clouds. Some people use ‘clouds’ as a synonym for virtualization – while others clearly disagree with this use. [5]

Cloud computing is all the rage…. The problem is that (as with Web 2.0) everyone seems to have a different definition. As a metaphor for the Internet, ‘the cloud’ is a familiar cliche, but when combined with ‘computing,’ the meaning gets bigger and fuzzier. [6]

Is there anyone not in the cloud? Cloud computing is the buzzword du jour and everyone–Google, Salesforce.com, Microsoft and Amazon–is trying to get into the act. The problem: It will be another year–2009–before companies use cloud computing services extensively. In the meantime, folks will have to define and sort out a lot of mumbo jumbo about the cloud. [7]

Cartoonists have gotten plenty of mileage out of the information superhighway, it’s true. But when it comes to drawing the Internet, the icon of choice...is a cloud.... For one thing, clouds are easy to draw. There’s no doubt about this. If you’ve ever tried mapping cyberspace in a hurry...you know the cloud’s advantage. Plus, there’s another, subtle advantage to the cloud: You can use it to obscure what you don’t know. [8]

Many of those daring enough to enter the abyss and attempt to define cloud computing conjure up the spirit of Charles Darwin. Often the result is either too narrowly defining cloud computing as simply “the next step in the evolution of software-as-a-service (SaaS)“[9] or overstating its “evolutionary effect” on business and IT. [10] Perhaps the most eloquent invocation of Darwinian theory in describing the seminal historical context in which cloud computing has entered the digital arena was put forth by Andy Cooley in the Afterword of Richard Katz’s book The Tower and the Cloud: Higher Education in the Age of Cloud Computing, as follows:

Charles Darwin observed that it’s not the strongest of the species that survive, nor the most intelligent, but those most adaptive to change. For humankind, the pace of change has been
accelerating, and never as rapidly as in the past century. One hundred years ago, our body of knowledge doubled only once every century. Today, our body of knowledge doubles every few years. In our digitized, microchipped world there is virtually no subject that cannot be Googled, downloaded, and consumed. In higher education the challenge is clear. How can we analyze and apply that information in ways that will help our learning institutions thrive? How do we turn that ubiquitous cloud of information into real knowledge. [11]

Within this context, however, the task of defining cloud computing has been made considerably easier recently by the publication of definitions by two well-known and widely-respected organizations: the University of California at Berkeley and The New Media Consortium.

The first definition, often referred to as the “Berkeley definition,” appeared in the University of California at Berkeley technical report Above the Clouds: A Berkeley View of Cloud Computing, published in February 2009. In the report, members of the Department of Electrical Engineering and Computer Sciences define cloud computing as follows:

Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS). The datacenter hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds. People can be users or providers of SaaS, or users or providers of Utility Computing. [12]

The second definition appeared earlier this year in The 2009 Horizon Report, which is published by The New Media Consortium in collaboration with EDUCAUSE. In the report, cloud computing is defined as follows:

The emergence of very large “data farms” — specialized data centers that host thousands of servers — has created a surplus of computing resources that has come to be called the cloud. Growing out of research in grid computing, cloud computing transforms once-expensive resources like disk storage and processing cycles into a readily available, cheap commodity. Development platforms layered onto the cloud infrastructure enable thin-client, web-based applications for image editing, word processing, social networking, and media creation. Many of us use the cloud, or cloud-based applications, without even being aware of it. [13]

**From Mainframe Computing to Cloud Computing**

As one can glean from the definitions above, computing has come a long way since mainframe computing entered the stage in the 1940s, with the introduction of Mark I, ENIAC, and Manchester’s Baby. [14] Fast-forward six decades and we find ourselves again in the midst of another sea change in computing with the emergence of cloud computing. [15] In fact, the term
cloud computing can even trace its origins back to the late twentieth century. The figure below is reported to be one of the earliest examples of the use of the term or metaphor cloud computing in a public forum; in this case, by two researchers from the Massachusetts Institute of Technology at a 1996 workshop sponsored by the Kennedy School of Government at Harvard University—later included in a book published the next year, edited by Brian Kahin and James Keller, entitled *Coordination of the Internet*. [16]

![Early Introduction of the Term/Metaphor Cloud Computing, 1996](http://ccs.mit.edu/papers/CCSWP197/CCSWP197.html)


**The Cloud Computing Model**

The economic potential of cloud computing is only beginning to be realized by business and industry, while in education, cloud computing is still in an embryonic stage of development and utilization. In the K-12 education community, this is further complicated by the fact that many overtures by business and/or industry to education are made to colleges and universities, perhaps in a belief that the trickle-down theory can be applied to cloud computing in K-16 education. [17]

To more fully understand the economic impact and potential of cloud computing, it is important to fully understand the components of the cloud computing model. The chart below, for example, illustrates not only the growing economic importance of cloud computing—which is forecasted to be a $42 billion dollar business in just a few short years—but also the multifaceted nature of the cloud computing model.

![Worldwide Cloud Computing Spending by Type, 2012 Forecast](http://ccs.mit.edu/papers/CCSWP197/CCSWP197.html)
As the pie chart above illustrates, there are myriad forms of cloud computing, most of which can be placed in three broadly defined categories, as follows:

1. **Cloud Application or Cloud Software as a Service (SaaS)** – the most restrictive category of cloud computing in which applications, which typically serve a single function (e.g., Gmail, Quicken), are made accessible to users through a Web browser.

2. **Cloud Platform or Cloud Platform as a Service (PaaS)** – there is increased control and flexibility with this category of cloud computing in which the user can build and deploy applications (e.g., Google App Engine) that are supported by the cloud.

3. **Cloud Infrastructure or Cloud Infrastructure as a Service (IaaS)** – even greater control is allowed for with this category of cloud computing in which users are provided sheer computing resources (e.g., Amazon EC2), and can deploy and operate arbitrary software, including operating systems. [18]

A visual heuristic for this cloud computing model was developed by Michael Sheehan in 2008 to help differentiate the three major categories of cloud offerings, as he defines them, as well as illustrate their hierarchical relationship (see figure below). [19]

Figure 5 – Michael Sheehan’s Cloud Pyramid, 2008
Cloud Computing in K-12 Education

While cloud computing is already having a significant impact on society, business, and industry, it has not reached nearly the same level of potential in K-12 education. This is not to say examples of cloud computing can’t be found in elementary and secondary schools. On the contrary, in the last year we have seen more and more schools take advantage of the array of services available in cloud computing, however the bulk of these are from one category: cloud application (e.g., email, word processing, media editing). [20] Examples of the integration of cloud platform and cloud infrastructure into K-12 education are just beginning to emerge, as noted in this year’s Horizon Report. These are the categories of cloud computing that appear to hold the most potential for truly enhancing K-12 teaching and learning in the future.

Experience has shown that after school districts make the leap to cloud computing, it opens the door to even greater innovation, such as adopting netbooks or virtual computers, which are more cost-effective and have a much smaller footprint. [21] A recent example of this is the partnership formed between SIMtone Corporation and Frank Porter Graham Elementary School in Chapel Hill, North Carolina. The resulting benefits from this partnership go far beyond the cloud-based educational content and virtual desktop computers, as the press release last fall announcing the partnership reveals:

Durham, NC (October 6, 2008) – SIMtone Corporation, a privately held company delivering the next cloud computing paradigm, today announced that a North Carolina school is piloting its cloud computing platform to deliver low-cost, virtual desktops to hundreds of students and faculty. The pilot is part of the SIMtone Education Thunder Program which aims to help close the digital divide and provide access to full PCs in the cloud to the estimated five billion people who cannot afford it, without requiring them to own a computer. The program educational content is provided by the U.S. Fund for UNICEF (USF), and is open to technology and connectivity sponsors worldwide.

Frank Porter Graham Elementary School in Chapel Hill, North Carolina will use SIMtone’s Universal Cloud Computing products to provide approximately 600 students and faculty with “PCs in the Cloud” usable everywhere without a computer....

“Our school wants to equip each student with the most advanced computing environment necessary today to effectively study, learn and access all the digital courseware and teaching tools available. Asking each student to purchase and maintain their own PC is impossible, just as it is impossible for the school to ensure each student’s PC is up to date and has all the latest courseware. SIMtone eliminates all these complexities and costs, and allows our school to deliver to each student a real ‘PC in the Cloud,’ fully maintained by the school itself, that is always available to our students on-demand and on-the-fly, in class, in the library and at
home, without requiring them to purchase yet another PC,” said Shelia Burnette, Principal of the Frank Porter Graham School.

“Through TeachUNICEF, we are empowering students to be active global citizens in learning about UNICEF’s mission to do whatever it takes to save and improves children’s lives worldwide. Therefore, we are quite excited about this opportunity to take the lead in accelerating the closure of the digital divide,” said Caryl Stern, President and CEO of the U.S. Fund for UNICEF. “The low-cost and ubiquitous access to real PCs enabled by SIMtone allows us to reach students with our education material on an unprecedented scale and offer them programs that grow with them and stay with them throughout their entire curricula. It’s their PC for life, always on, always available, everywhere they are.”[22]

This partnership represents one of many ways in which cloud computing can enhance the K-12 teaching and learning process. Even in the absence of grant- or corporate-funded initiatives, school district superintendents are turning to cloud computing, particularly during tough economic times, for more efficacious ways in which to integrate technology not only into the teaching and learning process, but also into the day-to-day operations of the school. Stephen White, Solutions Manager for Cloud Computing at Hewlett Packard, has identified five such areas in which school administrators are beginning to realize the economic benefits of cloud computing:

1. Data Backup – storing student records, financial data, etc., in cloud-based locations.
2. Mass Notification – adopting systems (e.g., SchoolMessenger) for emergency notification.
3. Netbooks and Desktops – purchasing “cloud computing laptops” for students.
4. Surveillance – connecting surveillance cameras to the Internet for remote viewing.
5. Digital File Storage, Email, and Web Sites – fully hosted in cloud-based locations. [23]

**Conclusion**

There is no denying that the swing of the technology pendulum from mainframe computing to cloud computing has changed not only the way in which we conduct business, but also how students learn in elementary and secondary schools. Billions of dollars have already been invested in cloud computing and even more is being planned for the future. The cloud computing model is one that serves to guide and shape the strategic plan and IT budget of many corporations. Cloud computing also holds tremendous promise for K-12 education, if modified and fully adopted. For this to occur, however, school administrators and teachers—as well as educational researchers and teacher educators—need to develop a better understanding of the cloud computing model and learn how to adapt it to their school environment. Only then, can elementary and secondary schools begin to truly realize the benefits of cloud computing.

**Endnotes**


[8] Although this was not directly in reference to cloud computing, the authors’ evaluation of the cloud metaphor makes it both timeless and germane to the discussion. Jessie Holliday Scanton and Brad Wieners, “Behind the Myths of Cloud Computing,” Seeking Alpha, July 9, 1999. Available at http://www.thestandard.com/article/0,1902,5466,00.html.


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17 THOUGHTS ON "ONE-CLOUD SCHOOLHOUSE: A PRIMER ON THE APPLICATION OF THE CLOUD COMPUTING MODEL TO K-12 EDUCATION"

best skateboard wheels 
on February 2, 2014 at 3:16 AM said:

Thanks to my father who told me about this webpage, this weblog is truly remarkable.

table saw reviews 
on February 3, 2014 at 8:36 PM said:

Hello! This is kind of off topic but I need some help from an established blog.
Is it very difficult to set up your own blog?
I’m not very technical but I can figure things out pretty quick.
I’m thinking about creating my own but I’m not sure where to begin.
Do you have any points or suggestions? Thank you

best shoes for crossfit 
on February 3, 2014 at 10:55 PM said:

I visited various web pages but the audio quality for audio songs current at this web page is truly wonderful.

best humidifier 
on February 4, 2014 at 1:54 AM said:

I think this is one of the most important info for me.
And i am glad reading your article. But wanna remark on some general things, The site style is perfect, the articles is really nice : D. Good job, cheers

http://bcis.pacificu.edu/interface/?p=3673
band saw reviews
on February 4, 2014 at 2:09 AM said:

If you want to grow your experience simply keep visiting this web site and be updated with the latest news posted here.

rifle scope reviews
on February 4, 2014 at 2:23 AM said:

This website was… how do I say it? Relevant!!

Finally I’ve found something that helped me. Appreciate it!

pressure washer reviews
on February 4, 2014 at 2:37 AM said:

Just want to say your article is as surprising. The clearness in your publish is just cool and that i could suppose you’re an expert in this subject.

Well along with your permission let me to take hold of your feed to keep updated with drawing close post.

Thanks 1,000,000 and please carry on the gratifying work.

garment steamer reviews
on February 4, 2014 at 5:29 AM said:

Hi there! This is my 1st comment here so I just wanted to give a quick shout out and tell you I genuinely enjoy reading through
your blog posts. Can you suggest any other blogs/websitesforums that go over the same subjects? Thanks for your time!

saint peter guest house new orleans

on February 4, 2014 at 9:41 AM said:

Very hortly this website will be famokus amid all blogging viewers, duee to it's nice articles oor reviews

induction cooktop reviews

on February 4, 2014 at 11:32 PM said:

Spot on with this write-up, I honestly believe that this web site needs a great deal more attention. I’ll probably be back again to read through more, thanks for the info!

recumbent bike reviews

on February 5, 2014 at 3:29 AM said:

Fine way of telling, and good paragraph to get information on the topic of my presentation focus, which i am going to present in school.

church of christ beliefs

on February 5, 2014 at 7:19 AM said:

Magnificent website. Lots of useful information here. I’m sending it to a few pals ans also sharing in delicious. And obviously, tanks in your sweat!
catholic church north phoenix az
on February 5, 2014 at 11:30 AM said:

Everything is very open with a really clear clarification of the challenges.
It was definitely informative. Your site is very helpful.
Many thanks for sharing!

Christian Church Homes
on February 5, 2014 at 12:30 PM said:

I read this article completely regarding the comparison of hottest and preceding technologies, it’s remarkable article.

christian ministry for mentally ill
on February 5, 2014 at 5:43 PM said:

I really like your blog. very nice colors & theme.
Did you create this website yourself or did you hire someone to do it for you?
Please answer back as I’m looking to create my own blog and would like to know where you got this from. appreciate it

Wade Milkovich
on February 5, 2014 at 6:52 PM said:

Dit is het beste advies over dit onderwerp en je het hebt aangepakt in een noele wijze

christian ministry hickory nc
on February 6, 2014 at 11:43 AM said:
If some one needs expert view about blogging and site-building then i advise him/her to visit this webpage, Keep up the good work.