Personalized System of Instruction and Mobile-Learning Models 2014 and Beyond

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ABSTRACT

The purpose of this study is to analyze the delivery method used in Personalize System of Instruction (PSI). Asynchronous in nature, the PSI model may provide viable alternatives m-learning platforms, while at the same time fulfilling some of the theories of social science research. Learning style types are also presented in this study. A strategic alignment model is measured against the learning style types in efforts to map the feasibility of m-learning in social sciences versus other educational research.

In the case of m-learning, stakeholders include but are not limited to curriculum creators, ISPs and those who host mobile sites, streaming content providers, mobile phone users, instructors, educational institutions and mobile phone carriers. Verifying the mobile authenticity of students receiving instruction, and the burden of proof is also presented in this study as it relates to models used in the banking industry.

Adobe, ComF5 and AXMEDIS [2] are a few companies that provide full multi-platform support for multiple mobile based distribution channels. Mobile protocol and the development of mobile applications must minimize frustrations experienced by users. Issues and concerns in this area range from screen size and resolution of content, and the balance of reading text versus seeing live streaming video, all the way to screen scrolling and mobile keyboard functionality. The conceptual framework for Platform as a Service and Infrastructure as a Service are presented to access, capture and share pedagogies toward distribution.

Keywords: Mobile-Learning, Personalized System of Instruction, AXMEDIS, ComF5, MSAM Model, Learning Analytics, Cloud-based Infrastructure, Disaster Recovery Planning, Contextual Framework, Systematic, Systemic, Virtual Systems, Global Economy, Information Security Management, Education-in-the-cloud, mLearning, Conceptual Framework, Contextual Framework

INTRODUCTION

PSI, developed by Skinner and Keller (1970) leaves the student in control of the frequency and speed at which they learn. In the case of the educational study on PSI, it was important for the researcher to test the validity of the PSI theory in various environments over a period of time. The initial quantitative analysis involved the results of test scores. Analysis of Variance (ANOVA) was used to assess and compare test scores.

With PSI comes the assessment of human behavior as they access, capture and share information across platforms. Educational models of the past focused on sharing information face to face and at set scheduled times. The fusion of PSI and information access alters, and in some cases alleviates the need for scheduling information access. Here, customers/students who have the technology, access course content at their leisure and at the availability of their media platform. While there have been noted challenges associated with information access (including server down times, and weak Wi-Fi signals), this has not limited or discouraged the delivery of education. These and other factors enabled the researchers to arrive at the following research question: In what ways do the interview data reporting on the needs for stakeholders in education help to explain the technological preparedness in the delivery of PSI using mobile learning models.

REVIEW OF LITERATURE

Challenges exist with educational models ranging from content to varying delivery systems. Thompson indicates that the fixed and traditional models can come together to create strategic alignment [25]. Educational models like e-Learning are distributed using technology across multiple channels. The traditional classroom is restrictive according to Boyinbode, Bagula, & Ngambi, [4] in that a person has to be in a physical location.

A historical perspective of the United States shows the distribution of education as one that resided with state and local authorities through 1965. With the passage of the Elementary and Secondary School act of 1965, federal government authorities became more involved in the decisions and support of local public schools [8]. It goes without saying that the implementation of any improvements in K-12 education would be distributed and monitored by the federal government. It is the researcher's opinion that K-12 educational models are relevant as society moves toward globalized mobile-learning.

Most of what has been called curriculum today is designed around a proven methodology of hours spent in instruction, lab and outside of the classroom. Because of the constraints/ratio associated with instructional to lab hours, post secondary educational institutions are also challenged with the availability of instruction and more over, the availability of the student to learn. To resolve issues with student availability, many for profit schools developed scheduling to facilitate learning around the student's extracurricular activities, family responsibilities and work.

According to Johnson [15] minimal change was reported in writing effectiveness, based on pre and post test during the first two years of college. Further, the study implied that personal study time was one of three attributing factors that could lead to personal growth and development in collegiate studies. This study came in light of a crisis that was declared among American colleges back in 2005 due to the lack or workforce preparedness of students.

The argument that education must change in order to adapt to the needs of the 21st century has been trumpeted by academics around the globe. Educational constructs created in response to industrialization and urbanization in Europe and the United States in the 19th are clearly not meeting the need of a globalized society. Particularly in developing countries that require low-cost, high-quality forms of learning and must reach families in rural underdeveloped areas; traditional schools are cumbersome, and often ineffective way to meet this need [17].

Digital technology has ushered in a new era exerting pressure for change and providing opportunities for transforming pedagogy. The digital trend has moved the educational experience away from focusing on engagement in school, to engagement in learning. Learning engagement will require a re-examination of the type of environments most conducive to learning in the 21st century.

The opportunities from these challenges have created a world of e-learning systems, which have been devoted to the development of client server based platforms. Examples of these systems include Blackboard ™, eCollege™, Desire 2 Learn™, as well as several popular open sources platforms (e.g. Moodle, a-Tutor, and Sakai, etc…). Another distributive form of education comes from Massive Open On-line Courses or MOOC. Here portals for open on-line education have been created at what's considered Application as a Service, and housed within a Contextual Framework. This affords people with global educational access, to what's considered, some of the best courses taught by prestigious instructors. MOOC based courses do not offer any form of certification or diploma like traditional educational models.

Around the world, innovators such as the Lumiar Institute in Brazil, charter schools in the U.S., and independent schools in Sweden are reinventing school by using technology more creatively and providing more personalized, collaborative, creative, and problem-solving learning, in schools that have many informal spaces for learning as well as classrooms [17]. Identification of the ideal learning environment is beyond the scope of this study. Here we focus on the delivery, the medium, and the underlying infrastructure that will support future learning environments. The proposed model extends beyond Friere's concept of creating schools under mango trees to that of any device anywhere [10].

The proliferation of the Internet and access via mobile devices now enables more people than ever to access information, knowledge, and instruction from skilled teachers and educators, to participate in discussion, and to learn in their own environment through personal discovery. Recent developments by major Internet institutions make the prospect for accessing educational material with mobile devices even more relevant. Google recently enabled 1 trillion free searches of titles and excerpts of scholarly material. Wikipedia provides access to over 13 million free articles. Add to it 20 hours of video content being added to YouTube, and it becomes pretty clear that mobile education shows promise. There is clearly a hungry student base for such material as demonstrated by the BBC service to teach English in Bangladesh through mini-lessons on mobile phones, which attracted 300,000 plus calls in a month [13].

From an IT perspective, mobile-learning environments bear close resemblance to traditional business organizations, with data centers located in a secure room within the confines of a central head quarters, or distributed amongst one or more of its networked satellite facilities. The common thread here is that access and maintenance of the computing environment is tangible and controlled by the organizations' information systems staff and contractors. The computing infrastructure model required to implementing personalized system of instruction requires a radical departure from the traditional instructor lead classroom institution.

While there are advocates who propose the implementation of technology in learning environments, the truth is that there is no empirical evidence that supports a significant increase in educational penetration [4]. And yet, in the future of educational models, students will be required to remember less because of technology access [22]. Students will however have to devote more time to critical thinking and analytical skills [23]. In a study with students taking both the traditional and PSI sections of a humanities course, results showed that students test scores were higher than those who take traditional courses [23]. Over the years, personalized system of instruction or module based instruction has been used as an assessment tool by a variety of industries such as information technology, human resources training certification, to name a few. However, upon completion of such assessment, there is no guarantee of the critical thinking and analytical skills required to perform a job.

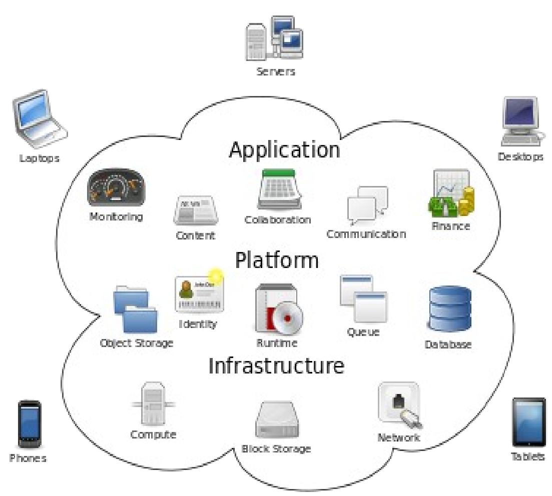
The advent of mobile technology further challenges the current paradigms that provide instruction and educational training. The issue of mobile-Learning becomes even more complex when applied to Personalized System of Instruction, or module based instruction. While the dissemination of education can be transported and captured via mobile technology, we recommend the integration of mobile based assessments to evaluate PSI. At this point it is essential to discuss the components and usage of mobile-Learning platforms and features that are conducive to personalized system of instruction.

To begin the discussion, an exploratory study on the use of mobile technologies in medical education is presented to show the strong distinctions between clinical and educational supervision [26]. Of the two distinctions, clinical supervision provided more support to the use of mobile technology than educational supervision. By definition, educational supervision is the monitoring of educators. Most if not all of the educators in the study were medical practitioners, who indicated that their overall usage of mobile technology was minimal. Use is a very important factor, since a mobile device has to be incorporated by the educator. In the proposed medical study, the extent of use was based on access to the technology, the type of device (iOS, Android, Html5, iPad), and the educator's knowledge of how the device is used. Wi-Fi signals and phone coverage by location were also contributing factors to technological access [26].

Based on the study's results, clinical supervision deemed to be the best suited for mobile-Learning. Students used mobile technologies "as an information resource tool," to access instructional media, for the delivery of module based competency assessments, and to support clinical decision making [26]. The overall use of mobile technologies enabled students to develop clinical logs, communicate with instructors and peers, and create a "personal information management" system. The challenges the students experienced with the mobile technologies included "data security, network connectivity, maintenance and interoperability, use of tool, electromagnetic interference, and social acceptability" [19]. According to Crompton, there are four constructs that comprise m-Learning. They are pedagogy, context, technological devices, and social interaction [7]. These constructs are the driver that supports current efforts toward student centered learning. Through this, we derive that student centered learning emerges through social interaction, as educational pedagogy is captured in a contextual framework, enabling access through technological devices.

The proposed mobile-Learning model for education must interface with cloud computing, according to Rao, Kamar and Sasidhar [23]. The authors indicate that cloud model infrastructure will require users to register for credentialing and authentication.

Cloud computing is uniquely suited to meet the educational requirements of the 21st century. "The same way cloud-based infrastructure offerings allow IT to focus more resources on institutional needs, ... cloud-based educational content enable faculty to focus on what differentiates their institution from others …." [14]. The term cloud in this article is defined as a "computing infrastructure model that facilitates convenient, scalable, on demand access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) universally accessible via the Internet, and mobile devices that can be rapidly deployed and provisioned." The typical cloud consists of three three structural components which can be provisioned independently or collectively based on the scope of the required solution. The components include application (software) as a service, platform as a service, and infrastructure as a service.



Cloud Computing

Application as a service – Refers to one or more applications delivered through the browser to thousands of users in a multi tenant architecture. As the customer it means no upfront investment in servers or software licensing.

Platform as a service – Refers to renting hardware, operating systems, storage and network capacity over the Internet. The service delivery model allows the customer to rent virtualized servers and associated services for running existing applications or developing and testing new ones.

Infrastructure as a service – Refers to outsourcing equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis. The Cloud Computing diagram, represents a generic cloud infrastructure with no customization for any particular industry. However, by design, this conceptual framework will accommodate the access, the capture and the sharing of data within a contextual framework on a wide variety of devices.

An example of application as a service is presented here through mobile banking. Banking institutions, for example enable customers to access their account records by utilizing an application that can be downloaded to their mobile device. This procedure is typically carried out with account set up requirements for mobile devices [21]. Whereas the ability to access user phones or devices through push notification requires that the mobile application is downloaded/installed on the device. This usually requires that the phone/mobile device is GPRS/Wi-Fi enabled; a typical feature with G4/4G based mobile appliances [23]. Educational content provider and developers of curriculum should also consider the types of data to be accessed. Examples of this include text, video and audio files [23].

Disaster recovery requirements, increased mobility, strained educational capital expenditure, and reduced IT budgets are driving educational instructions to look at the viability of implementing their respective learning content in more cost effective ways. They are also challenged with establishing innovative delivery programs that work around the schedule and geographic locations of current and perspective students. Students are also demanding a number of services that cannot be accommodated by traditional IT infrastructure [14]. The learning institution's IT staff are struggling to accommodate the proliferation of personal devices like tablets, smartphones, and laptops belonging to those who desire to access educational resources and material. Balancing these demands is by far one of the greatest challenges facing education administrators. These dilemmas are a part of the weekly/monthly operations of organizations and/or departments that support Platform as a Service/ Infrastructure as a Service. They also present opportunities for educational institutions to strive towards technological preparedness in the delivery of PSI.

METHODOLOGY

To answer the research question, a sequential explanatory mixed method design was employed. In this study, the quantitative data helped identify the potential technological preparedness of stakeholders to access, share and capture digital content across media. Five main qualitative interview questions were developed and sent via email to explain what stakeholders need to facilitate personalized system of instruction via mobile-Learning platforms. Because of its robust nature, and varying formats (size, audio, video, text), music was identified as the distributed media. A link to the web based survey was disseminated via email to the facilitators of three main on-line groups. Facilitators then sent the survey link to their groups via Facebook. For the qualitative data analysis, three group facilitators were purposely selected from these groups. Each facilitator, (classified as a stakeholder) participated in the initial 2006 study.

Quantitative Phase

The strategies used to validate the relationships in marketing science include cross-sectional studies, which are described as the process of collecting information once from any given sample of population elements [20]. An initial cross sectional study was administered to determine the technological preparedness of 7 purposely selected stakeholders. The factors used to measure preparedness came from Malhotra's study on information access, information capture, and information sharing [20]. A scatter plot of the survey results provided a correlation of technological preparedness by general demographic factors like age and the technology access/sharing type available.

The researcher created a radial map of the cross sectional scatter plot to adequately capture the system process of technological preparedness through information access, sharing and capture. The derived model represented the interrelationships of the real system process. According to Malhotra, et al, [20] a graphical model may be best suited in this instance, due to the fact that they are visual. Further, graphical models are used to isolate variables and to suggest directions of relationships but are not designed to provide numerical results [20]. The components from this study provided the validity needed to expand the research towards an exploratory study that focused on two additional factors from Goldsmith [11] – behavior and motivation, respectively.

A survey was administered on-line via a URL. The survey URL was sent in an email to 3 of the 7 purposely selected stakeholders in an email with directions on participation. The stakeholders posted and emailed the survey link with the general email within their social networking groups. From the 1000 potential participants, 132 responded to the survey within the allotted two week window. Of the 132 participants, approximately 42% were under 20 yrs, 30% were 20 – 25 yrs, 11.4% were between 26 – 30 yrs, 3% were 26 - 30, and approximately 9.1% were 31 – 40 yrs. For the purposes of this study, the researcher extracted data relating to mobile information access, information capture, and information sharing.

Qualitative Phase

The results of the qualitative study are seen below. Five questions were provided for the participants via email. A follow up date and time were determined for the virtual interview. One of the interviews was conducted via Skype due to the location of the participant.

The participants ranged in age from 41 to 45 years. All were male. Two of the participants have doctorate degrees and teach in college environments. The third participant is a church pastor. Two of the males were black and one was white. Two of the participants live in states in the southeastern United States. One lives in the United Kingdom. All of the participants are musicians and have the ability to create music. Further all of the participants own at least one Apple OS mobile device. The results of the quantitative survey are included.

Table 1: Qualitative Survey Questions and Responses 2013

QUESTION	QUALITATIVE RESPONSES
1. How do we use mobile technology to enhance human involvement?	Nigel I use it as a means to get quick response to inquiries. When we capture data via a web form and the person submits their mobile phone number there, we never respond via email. We respond to the mobile phone. That's because of the speed. If someone has filled in a form and put their phone number down, they'll respond quicker than the email. Because of that speed of response, we already know that 99.9999% of our competition will not respond in that manner. So we've beaten the odds. Kennith discusses the ability to access material from around the world via mobile technology. He uses the iPad to access musicnote.com or praisecharts.com. Once he purchased it, he could use the iPad to disseminate to the music team prior to rehearsal. The charts get sent in advance, which decreases rehearsal time. It enhances the interaction because it gets the material to them earlier and gives them more practice time. It raises the level of expectation across the board. Raising the level expectation... ---What I think happened is with the initial appearance of this technology and getting access to all this information immediately, teachers felt that students could teach themselves. And the element of teaching got lost. The art of the interpersonal teaching is becoming more prevalent with technology as a supplement. Richard Mobile phones are limited unless you have a larger screen (there is a visual challenge). Used to access resources, threaded discussion, audio book, email exchange, video production.
2. How can mobile technology foster group interaction?	Nigel The best way that I could say that it has groups come together is by choice of social media. With mobile phones as the vehicle to social media, social media is the marketplace. Kenneth Consider a traditional classroom...there is a survey/website where you can launch questions and students can text their answers and the responses occurs on the screen in the classroom. It tells where the deficiencies are with instruction..... Richard Threaded discussions, mobile conference calling work groups and surveys are ways to foster group

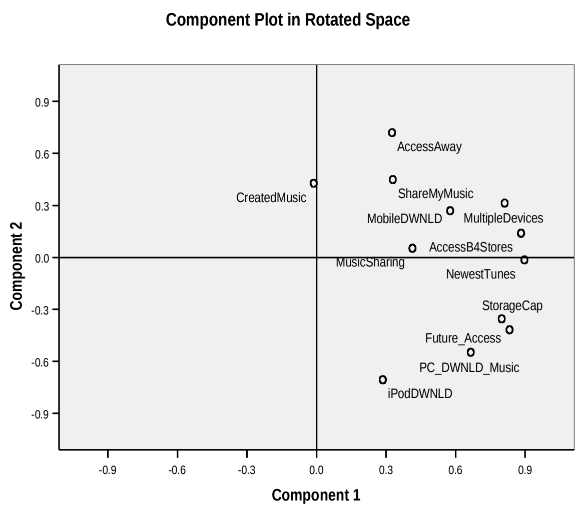
QUESTION	QUALITATIVE RESPONSES
	interaction.
3. What is the best way mobile technology can be used to enhance the educational experience?	Nigel, I would say the increased ability for apps and phones to be able to house content without streaming. It means making the phones with bigger capacity. Kennith Tends to only use it to disseminate materials. "I can be more impactful with students one on one face to face. For example, there are piano teachers (for students that moved away) that do Skype lessons. The problem is based on the delay, bandwidth to support the technology." Richard For the instructor and content developer…I haven't considered the phone as a means to distribute education. It's another medium to gain access to curriculum. Audio and Video Lectures can be available. Instructors can facilitate discussion threads and monitor user access/student activity. Being accessible real time is probably one of the better features (depending on how the mobile phone is set up.
4. What are the threats (if any) to mobile technology as an extension to learning/mentoring environments?	Nigel For me the biggest threat or the limiter (As I see it) is reliance on an Internet connection. I have a hard drive that is about the size of my phone. Storage in the form of terabytes. Kennith It depends/falls on the shoulders of the mentors themselves. If the mentors attempt to use the technology as a replacement for instruction. We'll have a generation of students who get faulty information. If it's used as a supplement to what has already been explained then its a tool immense proportion. Richard An interface has to be built. Brick and Mortar professors are more used to standing and doing lectures. A company called Skills Soft has a competency based module training….this works in the corporate environment. Module based instruction is used by universities to help people (like IT folks) obtain certification. In one such school, certification testing is part of the school's Bachelor of Science program. SAT pre-testing modules also fall under this category.
5. List other Mobile-Learning uses and concerns	Nigel My phone sweats because of the apps. At any given moment on any given day...I only have 3 pgs of apps....60 apps total. Pg. 1 is everyday ongoing use. Apps have made the use/need of people more specific. Kennith (1) Auto flip – designed for pianist; multi page piece in the iPad. Record yourself playing it and turning the page. The computer memorizes the way you play (2) Air Touch – a new foot pedal that turns pages automatic (3) Virtual Choirs – Eric Whittaker...he writes a new piece, puts it on-line via Twitter – people choose the section they want to sing and they record and send their recording back to Eric, who puts the voices together to make the virtual choir. (4) Youtube.com symphony –Use it as auditions are used to screen members Richard Virtual classrooms will foster collaboration. Challenges come from collaboration which is the dynamic exchange between 2 or more people interacting or being present with 'alternative negotiation' – agreeing to disagree. Here we learn how to take some ones ideas over your own. Through scenarios, we can ask questions and derive if people can solve problems (or not).

RESULTS

The quantitative results of the study explain several things. First, the relative frequency of mobile purchase behavior is much lower at 3.7% compared to 65% of users, who still use debit and credit cards for the similar transactions. It was also interesting to note that 34% of the participants either never use iPod for downloading, while at the same time, 44% of participants always use their iPods. The same is true when it comes to mobile phone use. In this study, 31% of participants never download files (e.g. music) to their phones, while approximately 35% always follow this practice. Approximately 60% of participants indicated that it was very important to have access on multiple devices. This need is in support of the premise behind student-centered learning. Only 12% of participants ascribed little or no importance to having access to content on multiple devices. This could be related to either the lack of ownership of technological devices or little experience using the technology or the technological device. Meanwhile, 93% of participants indicated it was important to have access to content outside of a connected network. The results seen on the component scatter plot in Figure 1 below are explained.

Access to content away from a network keeps the consumers/students mobile and not fixed to a location. Further, the AccessAway (component 2) is a higher predictor of learning that “assists us in combining work, study, and leisure time meaningful ways” [16]. According to the authors [16], most education learning models are somewhat confined to a network (also known as n-learning), where time on the network is captured and logged for attendance and/or accreditation purposes.

Figure 1: Component Scatter Plot [25]



Misaligned network collaboration (component 1) occurs when people are disconnected from a network for any reason, yet still collaborate. This is typically discouraged in n-learning environments, simply because it's difficult to track access to resources and penetration when a person is not 'logged in'. However, according to Boyinbode, et al [4], there is still no evidence that guarantees educational penetration with increasing technological access. Proponents of Learning Analytics are best suited to confer the appropriate educational assessments, student learning, and other scholastic goals for mobile-learning.

CONCLUSIONS

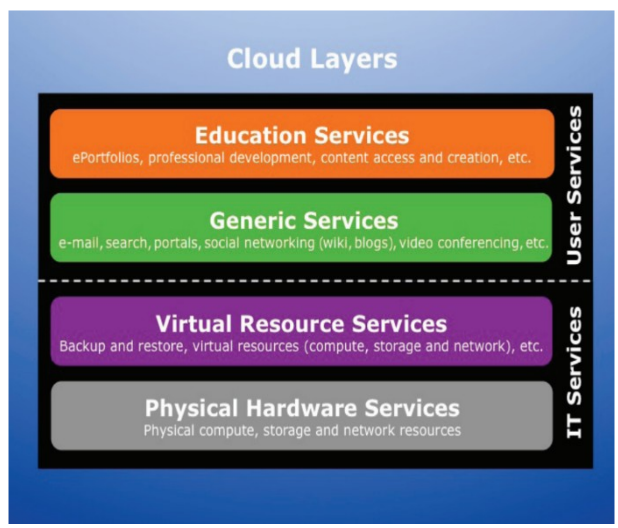
We derive from this study that Personalized System of Instruction/module based instruction has many benefits as an instructional mechanism. Further, mobile technologies (in general) can accommodate this mode of instruction, but not without the continual involvement of the Internet as the main distribution house for content. Un-interrupted mobile-learning will be dependent on consistednt Wi-Fi access and little interference. The decision to forge forward with mobile learning has support from the United Nations Millennium Goals initive for global learning. As a result, the hesitancy of both educational providers and mobile users (in general) to embrace the technology will eventually become minimal as people adjust with the times.

While it is expected that students will have an easier time searching and finding material via web based platforms (that include mobile portals for access), their ability to think critically could be compromised as a result [22]. For mobile-learning to really work, one could also expect increased responsibility on behalf of educational stakeholders to learn the technology like an expert, which may include knowledge of instructional delivery and methodology.

The education cloud framework described herein is designed from a mobile perspective and provides the foundation to support PSI and 21st century educational initiatives. From the user’s perspective the education cloud makes resources available in such a way that the student need not be concerned with where the resource or service originates. The services are available real time via a variety of Internet access points from literally any mobile or WIFI enabled device.

Educational and instructional systems are viewed as services from a cloud perspective. As such, the education cloud framework described here is based on the SAsS (software as service) sub-area of the cloud computing model. The layers in an education cloud framework differs from that the traditional cloud. Education cloud includes layers for education services, generic services, virtual resources services, and physical hardware services as shown in Figure 2. The services can be grouped in one of two categories, 1) user services or 2) IT services.

Figure 2: Cloud Layers Source: Fogel, R. [9] Intel Corporation



User services are typically education specific including student academic records, financial aid and content access. Generic services on the other hand are supplemental services like wiki’s blogs, video conferencing, portals and email, which the education community can access from devices such as laptops and PDAs.

IT services (e.g. backup and restore, security and access control, (as well as virtual and physical resources like servers, and networking) define the infrastructure of the education cloud. Specifically, the Virtual Resource Service offering in this model is synonymous to 'Platform as a Service.' The Physical Hardware Services could be seen as 'Infrastructure as a Service. ' From this premise, it is important to note tha global infrastructure will vary from country to country. Further, a wide variety of factors could impact the Physical Hardware layer of this model. From this foundation, customized applications and user interfaces can be developed. Typical services offered in an education cloud framework include:

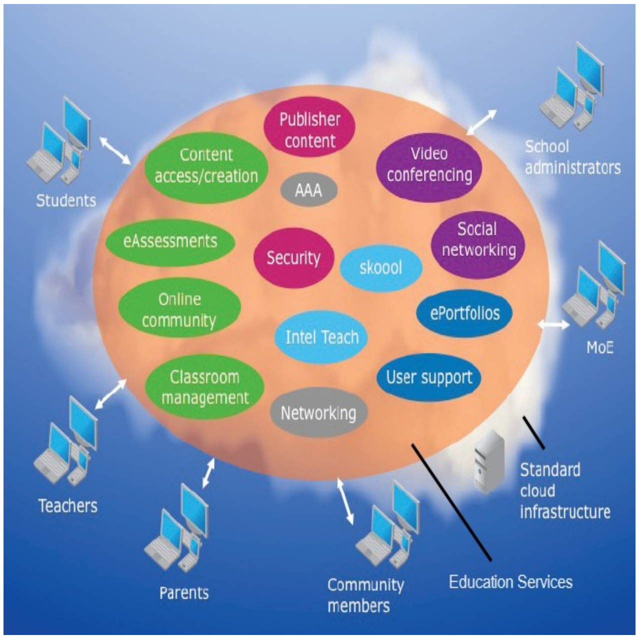
- ePortfolio service – Designed as an electronic record of a student's academic life including assessments, evaluations, assignments
- eBursar service – Designed to handle student billing, tuition grants and financial aide
- eAssessment service – Designed for managing student assessments
- eGrade Book – Designed as a roster, lesson plan, and course records for students and teachers
- Content management – Designed to assign, access, and store curriculum and student submissions.
- An on-line community used by students and teachers – Designed to interact with peers and share lesson plans

Specific education services vary and depending on the needs of a given learning institution as specified in a contractor RFP.

Each service (with the exception of the on-line community) can run as a standalone service (i.e. on a laptop), without connectivity. The service can also run from local school servers, from centralized data center or from a third-party services provider accessible from the Internet.

These services and others become a catalog of sorts sitting on top of the traditional cloud infrastructure as shown by in Figure 3. The actual services will depend on the design scope document provided by the subscribing education institution.

Figure 3: Cloud Educational Infrastructure Source: Fogel, R. [9] Intel Corporation



A combination of specialized web based applications and relational databases both provide the user interface and store data.

Note: Clouds are different than hosted computing services. A hosting computing provider will load software and perform backups and other typical IT functions as specified in the contract. Clouds on the other hand are virtual computing environments that are managed by the customer and or its designated representatives. The policies procedures for backup, virus scan, data retention, data loss protection analysis and monitoring would fall in line with the IT policy of the purchasing organization.

The disaster recovery policy of each respective cloud implementation would resemble that of the organization purchasing cloud services. A financial intuition with sensitive data is likely to have a more elaborated disaster recovery than a corner bakery with CRM application in the cloud. The advantage of the cloud is in how it facilitates mobility, rapid provisioning, and lower costs associated with owning and operating a data center. The nature of the cloud enables organizations to create disaster recovery solutions much more cost effectively. Recover time can be as much or as little as your customer base is willing to tolerate. With that being said, here is a narrative that looks at "cost".

Determining cloud costs is nearly impossible without a detailed design of server resource requirements and the level of operational support. Services like virus scan, backup frequency and monitoring also play a role along with desired level of performance. Private clouds tend to me more expensive than public clouds because one hundred percent of the cost is being absorbed by a single agency or organization.

Many innovative cloud providers allow organizations to pay for only the resources that they use. For instance, some providers start a clock from the time you create a server until the time it's decommissioned. Monthly bills reflect the actual cost of time provisioned vs. a flat fee. Yet other providers have pre-packaged resources that can be purchased based on Input/Output Operations Per Second and other factors (IOPS). Entry level packages suited for web servers, batch processing, network appliances, small databases, and most general-purpose computing workloads typically includes:

1. Low to medium RAM (4 – 8 GB)
2. High-performance, RAID 5-protected SSD storage
3. Redundant 1-Gigabit networking*
4. From 1–8 vCPUs*
5. Disk I/O up to ~35,000 4K random read IOPS and ~35,000 4K random write IOPS.

A package designed for increased performance best suited for applications demanding higher RAM, more disk I/O, and more consistent performance, including medium to large relational databases, NoSQL data stores, and distributed caches typically include:

- Medium to high RAM (15 – 120 GB)
- High-performance, RAID 10-protected SSD storage
- Redundant 10-Gigabit networking*
- From 4–32 vCPUs*
- Disk I/O scales with the number of data disks up to ~80,000 4K random read IOPS and ~70,000 4K random write IOPS.

The challenge for most organizations will be predicting pay-as-you-go costs based on changing use patterns.

As curriculum developers and book publishers create educational content, current e-Educational platforms will need a face-lift to accommodate mobile access. This includes the development of screens that are transferable to ".mobi" format. The importance of the mobile transformation is paramount as mobile Internet usage is expected to overtake desktop usage by

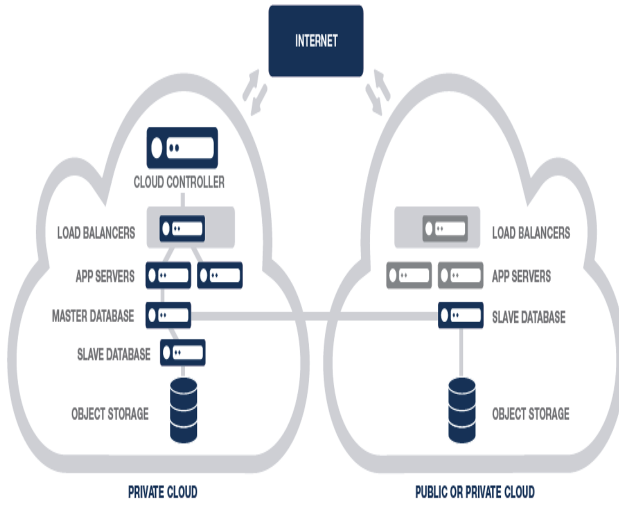
2014 (FairSearch.org).

Three platforms best accommodate the needs of PSI/module based instruction. They are Adobe Creative Suite, AXMEDIS [2] and COMF5. All of the platforms offer extensive space to house video interaction, live chat and directed social networking, will foster educational growth and development. The issue of security will be one that is mobile device dependent. BlackBerry™ RIM technology is a leader in the mobile security market, offering firewall protection to its users. Of the phone brands, Android would be considered the least secure, leaving Apple's iOS brands in the middle.

While there is an abundance of discussions about mobile platforms, nothing has been said so far about the departure from the Internet or Wi-Fi use, which is embedded in mobile usage. Further, mobile storage on the device is still inadequate for the potential continual and educational usage at this time. Several vendors last year broached the discussion and probability of the terabyte phone, that could accommodate the recommended storage capacity. Storage capacity in this area would diminish the constant need for web access and cloud storage.

Ideally the infrastructure would reside in linked clouds with data replication between them providing for fault tolerance and simplified disaster recovery. Figure 4 illustrates the architectural design of cloud components.

Figure 4 : Cloud Architectural Design



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