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The International Journal of Instructional Technology and Distance Learning is refereed, global in scope, and focused on research and innovation in teaching and learning.

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Donald G. Perrin
Executive Editor

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Editorial

3pLearning, vLearning and eLearning [+++]

Donald G. Perrin

In the beginning was the word.

It was used for tutoring by Socrates, and lecturing by men of religion. And the word was good. Men inscribed words in stone and on papyrus, and replicated it using wooden blocks and ink. Now words were cheap, and could be transmitted to millions of people.

Distance learning was invented using a principle called correspondence. It used Print, Paper and the Postal service (3pLearning). The word was good. It was circulated widely and the people became educated. They took jobs in the cities and enjoyed libraries and museums and theatres. And some became lawyers and politicians.

3pLearning was challenged by video (vLearning). Video enabled instant communication to thousands of learners at the same time. Now it was possible for one teacher to teach to a thousand classrooms and save 999 teacher salaries, but the result was not good. The Ford Foundation (Hagerstown, Maryland and Anaheim, California) tried to make it work, but students needed supervision, discipline, control, punishment, and on occasion feedback, tutoring, and nurturing. So the best teachers taught on television so others could sit in the back of the room and rest for a short while during the long teaching day. And sometimes the word was OK.

But academicians could not set the clocks on their VCRs and they lost all sense of time. Then came computers, networks, and interactive technology that extended the works of great teachers to the masses above the digital divide. And inequity grew so that the rich learned more and earned more, and those less fortunate became slaves of ignorance.

And the government intervened with eRate and other ways of collecting money without calling it taxes, and the result was better. Many learners were lost in cyberspace, and many teachers failed the technology test, because technology was advancing at the speed of light. And the word was corrupted because teachers and scholars did not use their spell checkers because they did not know how.

Information technologies stored all knowledge in computers and only librarians knew how to access it. Knowledge became intellectual property, a commodity to be traded by the wealthy and plagiarized by the masses. The explosion of knowledge reduced it's half-life so that learning to access knowledge was more important than knowledge itself.

A great ignorance spread across the land. People needed machines to do simple addition and computers to find information. Many students failed because their computer locked up in exams. And Microsoft was punished by the Courts. And the new tools fell into the hands of wizards and game makers and purveyors of evil. The towers crumbled, viruses corrupted the word, and the world returned to ignorance from which it had come.

And learning was reborn in virtual universities and blended programs because there were still persons who valued learning for self-improvement and economic growth. And universities of old rose *virtually* from the ashes like a new dawn with hope and assurance for the future.

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(First published in USDLA Journal: http://www.usdla.org/html/journal/JUN02_Issue/editor.html)

Editor's Note: This is an especially significant article for its teaching value and application. It addresses philosophical and practical issues of special interest to everyone, especially IT and network security, administrators of online learning programs, financial institutions, and government.

This paper defines and relates authentication and identification and provides a secure means to protect computer communications. This technique can be implemented now using scripts linked to this article. Google lists hundreds of blogs and comments in response to its original publication of this concept in OLDaily.

Authentication and Identification

Stephen Downes

Part 1. The Problem of Identity

Each of us has an identity. We are composed of a single physical entity - the human body - to which, typically, a name or sign is attached: 'Stephen Downes', 'The King of England', 'Jennifer 8. Lee', 'Prince'. Identity is important. It is - in a literal sense - who we are. Through identity we distinguish ourselves from each other, and through this distinction a host of cultural and social artifacts flow: attribution of authorship, ownership of houses, permission to drive, residency, citizenship, the right to vote, and more.

The problem of identity has traditionally been posed as an ontological problem. What is it, philosophers have asked, that makes an individual person an individual person? Today we generally approach this with a materialist response: a person is the body that contains the person. The problems posed by philosophers - problems such as the potential migration of souls, of brain or body transplants, of possession and transubstantiation, we leave to the philosophers. Produce the body and you have the person. *Habeas corpus*.

The problem of identity is today an epistemological problem. How do you know that this person is who this person claims to be? It is described, not from the point of view of the *cogito*, not from the point of the view of the person wondering who they are, but from the point of view of a third person, the one who seeks to know, "Who goes there?" and to be able to be satisfied with the response. The problem of knowledge, when it is connected to questions of personal identity, is tied into the fabric of society. Without the capacity to *know*, most of our customs and institutions would founder. The ritual of marriage, the assignment of criminal responsibility, the right to access a home: none of these would be possible without a third party being able to state an informed opinion about your or my identity.

In the virtual world, this problem is magnified. The virtual presence is corpus-free. There is no body to present to a third party as evidence that we are indeed who we say we are. The traditional connection between signification (the use of a sign to attribute identity) and instantiation (the actual instance of a human body) has been lost. The question, "Who goes there?" attains a new significance when there is no means to follow up with the demand, "Step forward and be recognized." And without this, the second part, it seems, the fabric of society so well known in the physical world cannot be migrated to the virtual world.

Definitions

The title of this paper suggests that the answer to the problem consists of two parts: authentication and identification. This is partially true. It would be more accurate, I think, to say that it consists of two approaches. On the one hand, we have the *assertion* that I am a certain person. That is 'identification'. It is the specific process of attaching an identity of a presence - either a physical presence, or in the context of our current enquiry, a virtual presence. And on the other hand we have the *verification* - the means of proof that what I say is true, that there is sufficient evidence for my claim.

This is not as easy a distinction as it may seem. In every instance of identification there is a flavour of authentication, and in every instance of authentication there is a flavour of identification. In my own self-identification as 'Stephen Downes', for example, there needs to be some means by which I know that this is true. Typically, when I self-identify, I consult my own memory (a process so easy and habitual I do not even notice having done it) to find the specific string of characters or sounds that correspond, more or less uniquely, to me. Without memory, self-identification is impossible; the first utterance of amnesiacs (at least in the movies) is, "Who am I? I don't know who I am?" And not, say, "I can't remember the name of the capital of France."

Because of the complexity of contemporary society, a name is seldom sufficient to uniquely identity an individual. Search Google and you will find references to numerous other instances of people named 'Stephen Downes'. Consequently, I use supplementary strings in order to distinguish myself: I have a Canadian Social Insurance Number. I have a unique email address. And over the years I have accumulated a clutter of other identification marks: bank account numbers, drivers' licenses, passport numbers, and more. And I have established a unique set of relations with other entities: a marriage certificate, a property deed and address, a telephone number, a birth date.

Of course, I cannot remember all of these things (usually I'm good for only two or three of them) and so I carry *tokens* to assist me. Here now I am not relying on my memory (save for the fact that I *have*, say, an account at a bank or an Air Canada frequent flyer number). My knowledge of the particular identification mark consists entirely in my having of the token containing that number. Ask me to repeat my credit card number without looking at my card and I am lost. Telephone number? I am always looking at my telephone to remember what it is. Though these numbers may constitute a part of my identity (where we think of 'identity' precisely and only as the means of establishing my unique personhood) my knowledge of my own identity requires verification via these external tokens. It requires, even for me, authentication.

Conversely, authentication is impossible without identification. There must be, at some point, a mechanism whereby I say, "This is who I am," in order for that claim to be verified. True, such claims are often more or less implicit. The license plate on my car, for example, functions as an ongoing self-identification statement (or would, if I had a car). Placing a bank card into an ATM is an act of self-identification. Presenting my body in front of the members of the parole board, or in front of a prospective employer, or in front of a college registrar, is also a means of self-identification. In each of these instances, identification is a necessary first step occurring prior to authentication. The proof will follow, but it *must* follow, the claim.

Even though the distinction is therefore somewhat ambiguous, it is nonetheless possible to draw the distinction in a rough and ready fashion. A lot will ride on this distinction, so it is worth being as clear as possible at the outset.

- *Identification* is the act of claiming an identity, where an identity is a set of one or more signs signifying a distinct entity.
- *Authentication* is the act of verifying that identity, where verification consists in establishing, to the satisfaction of the verifier, that the sign signifies the entity.

Identity Claims

There are two major types of assertion to be considered:

I claim that I am P, and I am P. Here I am making a true claim. This (it should be emphasized) is the normal case. I make a claim about myself, and the claim is true. Most of us (even criminals) most of the time want our identity claims to be successful.

I claim that I am P, and I am not P. Here I am making a false claim; I am stating that am someone other than who I actually am. Identity theft is the making of such a claim on a consistent basis for the purpose of monetary gain (usually money belonging to the person who I am claiming to be). But in fact false claims of identity are common: forging a cheque, presenting false ID at a bar or tavern, falsely representing oneself as an architect or a marine biologist, using Bugmenot - these are all instances of this second case.

Aside from the presentation of a physical body (and sometimes accompanied by the presentation of a physical body) identity claims may take only one of two forms; these are, in fact, the same forms we use to remind ourselves of our *own* identity:

First, we may make an *assertion.* That is, we produce, through an utterance, an act of writing, or a keyboard entry, an appropriate sign that signifies our own identity. For example, I may say, "I am Stephen Downes." Or I may sign my name to a document. Or I may key my PIN number into an ATM. Each of these is the assertion that "I am so-and-so."

Second, we may present a *token.* That is, we produce a physical object on which an appropriate sign signifying our identity has been embedded. In some cases, tokens may contain more than one sign - for example, a driver's license will contain a name, a signature, and a photograph. In other cases, tokens may contain a reference only to *the bearer* - the presentation of money, for example, is a token that somebody (nominally, the government) owes the bearer a certain value of goods; presentation of the token is in essence the claim "I am the person to whom the government owes this amount of goods."

It is common at this juncture to confuse an identity claim with authentication. For example, the presentation of a bank card (a token) to a bank machine, combined with an assertion (the keying of a PIN), is often taken to constitute a type of authentication. However, it is not; it is nothing more than the *claim* to be a certain person.

Importantly, *nothing inherently in the bank card and PIN prevents the possibility that 'I claim to be P, and I am not P'.* In fact, this happens all the time. I give my card to my wife, tell her the PIN number, and say, "Take out an extra $40 for me too." In a similar manner, there is nothing *inherent* in a passport, driver's license, assertion that "I am Stephen Downes," claim that "I am an architect," etc., that precludes the possibility of it being a false assertion. Thus we have fake ID, fake passports, counterfeit money, and sleazy ladies men at a pick-up bar.

To put it in slogan form: when you present your driver's license to the police officer, that's an identity claim. When the police officer compares the photo on the license with your face, that's authentication.

Nothing in the *claim* prevents it from being a false claim. This is true notwithstanding a long history of efforts to make claims self-authenticating. But the only sure evidence of identity is the presentation of the thing itself - and in the case of people, of the person him or herself. Any entity distinct from the person may be forged, faked, stolen, loaned, lost or otherwise disassociated with the person. That this is a *logical* possibility is tautologically true; and when the stakes are sufficiently high, the logically possible becomes probable.

In the virtual world, moreover, the body is never present. Hence, the *only* thing a person or service ever sees is the *claim*. Hence, it is always a logical possibility that the identity claim may misrepresent the person being identified. On the internet, no identity claim can *ever* be self-verifying. In order to *know* that a person's claim that "I am P" is in fact true, there must be a reliance on some process of authentication. Or so, at least, it would seem.

Authentication

As mentioned above, authentication is the process of verifying an identity claim. A billion words (more or less) have been written on the subject of authentication, but for brevity's sake we will skip most of them here.

The idea of authentication is to present the person or service with evidence that attests to the truth of a statement of the form "I am P." And while numerous techniques are employed in the process of authentication, they break down into two major categories:

First, the testimony of some third party who can attest to the truth of the statement that *I am P*, or

Second, the presentation of an artifact that is in some way knowably unique to the person *and which also* attests to the truth of the statement that "I am P."

Below we will look at some authentication systems intended for use on the internet. But it is important first to observe and to argue that, with some few (and generally unacceptable) alternatives, *no system of authentication succeeds*.

This is a strong claim. It needs clarification. It is important to recognize that by 'succeeds' we mean here 'proving beyond reasonable doubt that "I am P" is true.' But what would constitute reasonable doubt? This depends on the circumstances. If you want to give an advertising flyer to 'Stephen Downes', then your standards of proof are pretty low. But if you want to give a million dollars to 'Stephen Downes' then (I would hope) your standards are higher.

Authentication is, indeed, a classic epistemological problem. Absolute certainty is impossible to obtain, therefore, the standards of proof are adjusted to meet the circumstances.

It is easy to see how any sort of authentication could fail.

First, consider the testimony of some third party. This is a very common form of authentication. It typically takes the form, "X asserts that 'I am P' is true" where X is the identity of a trusted third party. In systems relying on identity brokers, authentication servers, and the like, authentication takes this form.

However, now where you had one problem, you now have two.

First, how do you know that the statement 'I am X' is true? After all, in order to trust statements from an authentication service, it is necessary to know that it is in fact the authentication service making the statement. But what is to prevent someone from asserting "I am X" in cases where it is not true?

Second, how does X know that the statement 'I am P' is true? X is faced with the same problem you are: in order for X to authenticate the statement that 'I am P' X must be able to prove that the statement is true. But how is X to do this? X has at his or her disposal only the same tools that you have at your disposal. X must either rely on some trusted third party (in which case we go through the cycle again), or X must rely on some artifact that is knowably unique to the person in question.

For the purposes of this argument, we can ignore the first problem (though in practice the designers of authentication systems cannot).

The second problem, meanwhile, is merely an instance of the original problem. After all, if an authentication broker could establish that 'I am P' is true, then so (in principle) could you. Conversely, if there is no way for you to establish that 'I am P' is true, there is no way for a third party to establish that 'I am P' is true.

The problem of authentication thus resolves to this: the presentation of an artifact that is in some way knowably unique to the person *and which also* attests to the truth of the statement that "I am P."

And here is why authentication ultimately fails: there is no such artifact. The only entity that is necessarily unique to a person is, necessarily, the person him or her self. Any other entity may, at one time or another, be associated with another person. A key, a card, a telephone, a computer, a specially marked deck of playing cards - any of these may change hands at any given time, any of these may be altered to record false information, and any of these may be forged or duplicated. Even the body itself, in some circumstances, fails this test: a person may be coerced, a person's fingers may be cut off - the writers of *Law and order* and *Crime Scene Investigation* have contrived no end to the number of ways even a person's body can offer misleading evidence.

Proxies

Is this the end of authentication? Of course not. But here we get to the heart of how authentication *really* works. At its core, authentication depends on some sort of proxy *standing in* for the person being authenticated. In other words, it depends not on *person* uttering "I am P" but on some sort of stand-in uttering "I am P", and then leaves the question of the relation between the proxy and the person up to the person.

In a sense, it's like the police identifying a car, and then holding the owner responsible for the actions of the car. If a radar camera captures a photograph of a car running a red light, no attempt is made to identify the driver of the car; rather, the *car* is deemed to be the offender, and therefore, the *owner* of the car is liable for fines or suspensions. The car, in this case, is a proxy for the person, and while it may not be possible to establish beyond a doubt whether the car signifies the person, it is possible to establish that the car is the car.

Online, while we may not be able to identify the person using the computer, we can establish the identity of the *computer* (within certain bounds). Thus liberated, we now have a legion of authentication schemes. For example:

IP-based authentication - a computer is deemed authenticated if and only if it accesses the internet through a limited range of IP addresses. Since IP addresses are owned, and since it is difficult to spoof an IP address, a computer reporting to be connected through the appropriate IP address is deemed to be authenticated.

Processor-based authentication - a computer (or an Ethernet card, using a MAC address) is deemed to be authenticated if and only if it provides an authorized hardware address to the authentication service.

Trusted computing - a computer is deemed to be authenticated if and only if it provides credentials obtained from a 'trusted' programming space within the computer, that is, a part of the computer's program that is inaccessible to the computer user.

The process of authentication, therefore, involves the establishment of a unique identity for the computer (or some essential part of the computer, such as its Ethernet card), and the transmission of that identity to the authentication service, whether that authentication service is the original service provider or some trusted third party that will provide testimony to the service provider.

It ties access, in other words, to a specific device, rather than to a specific person.

There is no doubt that this is the direction in which the authentication industry as a whole is moving. Machine identification is already the norm in the mobile phone industry, where the vendor has control over the hardware and programming of the phone. Microsoft's trusted computing initiative seeks to "create secure compartmentalization of data and applications" that cannot be accessed by the computer owner. My laptop uses a secure wireless networking card. To access journal subscriptions through CISTI my IP must be authenticated either directly or through a VPN.

But there is also no doubt that these developments are not being met with open arms. There is a large community devoted to hacking mobile phones. Microsoft's Longhorn has met with widespread criticism. Critics have charged, reasonably, that using the computer as a proxy for authentication locks the user into a hardware dependence; his or her content is tied to a specific machine, a specific hardware configuration, a specific vendor. As I once commented, only half-jokingly, "Trusted computing will bring to Microsoft Word the reliability and stability of Outlook and Exchange."

Beneath that, though, is a sentiment probably more accurately captured by opposition to things like red light cameras. Such mechanisms usurp my ownership of my own identity. If my assertion that "I am P" has little credibility before, it has *no* credibility in an era when authentication is based on machine ID and license plate number. It strips away my control over the use of my identity, as I now have no ability to allow or deny the release of that identity to third parties. And it impacts my autonomy, as now I may use what was once thought of as *mine* under strictly controlled circumstances.

Motivation

In my opinion, the unhappy situation brought about proxy authentication is based on a misunderstanding of the concepts of identity and authentication generally. The general distaste for proxy solutions (of which there will be increasing empirical evidence as such solutions become more widespread) illustrates a gulf between our underlying values regarding identity and the manner in which it has manifest itself online.

It was once the case (or so legend tells us) that a man's word was his bond. What that meant was that it would be such a loss to a person to be caught, say, misrepresenting his own identity, that it was almost inconceivable that he would do such a thing. This cost was reflected not in prison sentences (though if you were caught by the authorities the penalties were severe) but by the person's greatly diminished standing in the community. A man who could not be trusted would not be able to take advantage of the many small favours essential in medieval life, or in later days, would not be able to pay for goods at the hardware store merely by signing a cheque.

Above I mentioned what may have been passed over on first reading something as startling as it is true: Automatic Teller Machines (ATMs) do not depend on authentication at all, they depend solely on identification. This may seem counter-intuitive to most people; after all, what more secure system is there than the ATM network? Yet, when the card is presented to the machine and a PIN typed into the keypad, the machine takes it on faith that the presenter of the card is, in fact, the person authorized to do so. It does not use biometrics to scan the user, it does not validate the user's thumbprint against a third party authentication service. The mere possession of the card and the mere typing of the PIN number is sufficient to withdraw all the cash from a person's account, no questions asked. Anybody could do it, even smart animals.

What makes the ATM network so secure? As in the case of a man's word, the cost of allowing the misrepresentation of one's own identity is much greater than any benefit that could be obtained. Were I to allow open access to my bank card and to publish my PIN on the internet, it is a virtual certainty that my bank account would be drained of money by other people. So it is in my best interest to remain in possession of my card and to keep my PIN to myself, or at the very least, to restrict their distribution to people I know well and trust completely.

If we examine existing systems of identification, it is easy to observe that the vast majority of them operate in exactly the same way. I do not loan my driver's license to another person, for example, because I would then be responsible for the actions of that person, which could get me in legal or financial trouble. I do not give out the password to my computer because then somebody could get into the system and delete files, rewrite web pages, and engage generally in the practice now called 'hacking'. I do not make copies of my house keys and distribute them to everyone I know because I would then feel much less secure in the continued ownership of my possessions.

Moreover, there is a whole range of similar incentives that convince me not to adopt someone *else's* identity (and not merely legal incentives). When I write an exam at the university, for example, I make sure to write my own name on the paper, in order to receive a grade. When I publish an article, I place my own name in the byline, in order to receive credit. When I sign a cheque, I sign my own name, in order to receive the cash. I give my employers accurate information regarding my name and address to ensure that I am paid for the work that I do.

The point here is, *self-identification can be trusted if it is in the interest of the self to self-identify accurately*. Indeed, I can be trusted not only to correctly assert that 'I am P' but to do so in such a way that *I*, at least, can know that the information provided *could be known by no other person* or that the token provided could possessed by no other person. When sufficiently motivated, *I can prove my own identity to my own satisfaction*.

Indeed, on reflection, we can see that exactly the same principle applies even to proxy authentication systems. Suppose, for example, that access to a video game is authenticated by a hardware serial number. Well, what prevents me from simply giving my computer to my friend and letting him play the game for a week? Nothing - except that I would then be without my computer. What prevents me from sharing my Cisco wireless card with people in the neighbourhood? Nothing, again, except that I would now be without wireless access. Similarly, I could share ring-tones with my friends by circulating my mobile phone, enable neighbours to read online journals by letting them use the computer in my office.

Logically, no authentication system is more secure than self-identification. It is not more secure because, in the end, no authentication system consists of anything over and above self-identification. Without self-identification, authentication would not work at all. And no more rigorous standard of identification can be applied over and above self-authentication. Even if we had computers that sampled out DNA and would not function unless this input were verified at a national DNA registry, the system would be able to prevent my spitting into the DNA reader and letting my friend have a free-for-all.

What authentication actually *does* is two-fold: first, and most of all, it increases the *cost* of my incorrectly self-identifying, by attaching self-identification to devices I would not want to part with, such as my computer or my phone. And second, it increases the *difficulty* of falsely self-identifying by requiring specific hardware, software or network properties. But it should be evident that when the benefit obtained by falsely self-identifying exceeds the cost, then there will be significant motivation to do so. And with the cost of computer components dropping all the time, it would seem, therefore, unwise to tie identification to the computer.

Privacy and Control

As mentioned above, one of the advantages of self-identification, as opposed to authentication, is that I can control who I reveal my identity to. The control of my identity is, in other words, in my own hands. If a person or a site requires that I reveal my email address to them, it remains my choice whether or not to reveal it. If, on the other hand, my identity is authenticated by means of, say, hardware address, then I am unable to control the release of my identification information; every site gets it. And if every site gets it, then it follows that, if I release *any* additional information to any site, every site could get it as well, because the site has a 'trusted' association between a hardware address and an email address. Revealing one - which I cannot help but to do - reveals all.

The question of control raises the issue of privacy, and the question of privacy is a common concern with respect to authentication systems. In my opinion, privacy isn't so much a question of legislation (because people will break the law) and it isn't so much a question of technology (because technology can be circumvented) as it is a question of trust: can the user trust the service provider to respect the user's rights with respect to personal data?

And the answer, of course, is "no." There is no shortage of evidence that shows that if corporations and government entities *can* share personal information, they *will*. From the long reach of Carnivore to the carnivorous reach of Equifax, it is evident that personal data will be distributed well beyond the user's original intent. Even if the intentions of the company or the government agency are benign, there is no shortage of people willing to try to steal that personal information. Moreover, it is likely the case that companies will treat authentication information in the same manner as users; so long as the cost of sharing this information with others is greater than the cost of keeping it, the information will not be shared; but once the cost of keeping it exceeds the cost of sharing it (as is the case in virtually every corporate takeover, potential lawsuit or government action) the information will be shared.

At the heart of this issue, though, is the question of who has the right to answer the question, "Who am I?" And there are two possible approaches here, approaches coinciding (not coincidentally) with the initial distinction drawn between identification and authentication. In the case of identification, the mantra is, "You are who you say you are," where the guarantee lies in the user's interest to correctly self-identify. While in the case of authentication, it is, "You are who *we* say you are," where the guarantee lies in the authenticator's interest to correctly identify others. And since it is clear that the authenticator's interests will, at least from time to time, conflict with the user's interests, it seems likely that users would prefer self-identification over authentication.

For after all, the *objectives* of the two systems are also different. In the case of identification, the objective of a correct self-identification (and the protection of that identification) is to protect and promote the *user's* interests. A person will self-identify, as described above, in order to get something or to keep something. In the case of authentication, however, the objective is to promote the *service provider's* interests. It is to keep unauthorized people out, to protect assets; it is to enable the reliable collection of user information and user data.

Who holds the right to answer the question, "Who am I?" It is, it should be, a fundamental principle of a democratic society that each person holds the right to control their own identity, to say who they are, to have exclusive rights over the sentence that begins, "I am..." And this is the case because, without this fundamental right, no rights exist whatsoever. When the right to assert who you are is controlled by someone else, your identity is *owned* by someone else, and a person whose identity is owned does not own any of the attributes commonly associated with identity: attribution of authorship, ownership of houses, permission to drive, residency, citizenship, the right to vote, and more.

I think that people understand this, and I think that this is why there is an often unstated but often perceived undercurrent of dissent as one's right to one's own identity is eroded. I think that this assertion of one's individuality is what lies behind acts of creativity, acts of vandalism, and most everything in between. It is our desire to recognize individuality that leads to teams placing names and numbers on team uniforms, the personalization of news articles, the elevation of obviously talentless individuals to stardom. It is not that any of these actions is intrinsically valuable, it's that each one is a means of our enabling the expression of *who we are* - we look at Paris Hilton and we say, "That could be me, if I was a different person." And we either shudder or breathe a sigh of relief, depending on who in fact we are.

Self-Identification

Though the development of authentication systems will no doubt continue to be a source of considerable churn and considerable investment in the near future, it should be evident from these considerations that authentication is (a) not necessary, (b) won't work, and (c) is not desired.

It is not necessary because, given sufficient incentive, people will correctly and honestly self-identify. And this barrier is much lower than may be supposed. Even given today's prevailing system of authentication (user registration and login with a password), and even in cases where there is no intrinsic benefit to the user, the majority of users supply accurate information, even where there is no email confirmation (I can't find the reference to this off the top of my head, however, if you dig through the Online News mailing list archives, it is there). For the benefit of obtaining access to a community or of reading some free (advertising supported) content, people will self-register accurately.

It won't work because, as argued in this article, no system of authentication provides any more security than a system of self-identification. Authentication will not work at all unless it is tied to a proxy, the identity of which can be established online, which means that the security of the authentication is no greater than the value of the proxy to the user. With cheap computation, computers on a USB (reference is out there somewhere), disposable telephones, e-paper, and more just beyond the horizon, it seems clear than the value of the physical asset to which authentication is being tied will continue to decline, at which point authentication will provide no disincentive against misrepresentation of identity whatsoever. Authentication is useless if not tied to the person, and can be tied to the person only with the compliance of the person, which in effect reduces it to self-identification.

And it is not desired because authentication essentially involves the transfer of control over one's own identity from oneself to a service provider or identity broker, and as a consequence, enables the breach of the user's security and privacy whenever it is in the interests of that service provider or broker to do so. It moreover undermines the individual's fundamental right to determine and express who they are.

So where to now?

As I mentioned earlier in this paper, the creation of authentication systems is a major industry. The creation of self-identification systems, by contrast, has remained virtually unchanged since the days of the first login prompt. On website after website, users are asked to supply their login credentials, a process as predictable as the typing of a PIN number into a keypad.

Indeed, on the wider internet, service providers face in general not a choice between authentication and identification, but rather, a choice between identification and nothing at all. This choice exists because there is a significant *disincentive* for users to login. Leaving aside the problem of spam email and user tracking, logging in to website after website is a tedious process for which the reward is minimal. Many users propagate toward sites that do not require registration, partially because of security concerns, but mostly because they're easier to access. Websites linking to other websites (most especially blogs) link almost exclusively to open access websites (check Blogdex for evidence of this).

Moreover, on the internet at large, there is no capability for a person to have *an identity* (beyond an email address). Rather, each new registration at each new website creates a new identity. What gets credited to 'datamouse2001' on Yahoo! is not related in any way to what gets created by 'StephenDownes' on NewsTrolls, even though they are the same person (and the same person who, moreover, has dozens of accounts - usually 'Downes' - on dozens of websites). Worse, these accounts are not in any important way *mine* -- something Netscape Netcenter users discovered to their dismay when the company was taken over by AOL.

We need a mechanism for self-identification. We need a mechanism where clear and unambiguous control is placed in the user's hands, a mechanism that enables the user to declare to every site (or none, if that's their choice), "I am me!" And a way to do this automatically, unambiguously, with as little effort as possible.

It is my belief, and my contention, that were such a system to become widely available, much of the apparent pressure for authentication would disappear, and we could rely on self-identification to carry the same load online it has always done offline.

Authentication and Identification

Stephen Downes

Part 2. mIDm - Self-Identification and the World Wide Web

My thanks to Scott Wilson, James Farmer, Scott Leslie, Luc Belliveau,
Rod Savoie, and Seb Schmoller for contributing to this article.

The Concept

The idea behind mIDm - pronounced "My - Dee - Me" - is that people using the web can log in once, on their own website, and then forget about logging in anywhere else. It is, in essence, single sign-on for the people.

Billions of words have been written about user identity on the web. Numerous solutions have been proposed: to name a few, Passport, Liberty Alliance, LID, SxIP, PKI, CoSign and more...

Equally obviously, however, is the fact that no identity management solution has taken hold in any large measure on the World Wide Web. While it would be premature and in a certain sense outright wrong to call any of these initiatives a failure, it nonetheless remains true that for the vast majority of people, on the vast majority of websites, identity continues to be managed via a simple login with a username and a password.

The bulk of the initiatives listed above - if not all of them - are attempting to build something *more*. Sure, all of them offer some form of single sign-on - that is, a system whereby you enter your username and password once, and then access resources from a number of sites. But in addition, they are also attempting to provide some mechanism for *authenticating* these logins, that is, some way of asserting that the information supplied in these web forms is *true*.

And in order to ensure that the assertion is true, these systems employ some sort of central registry or authentication service. Part of this is driven out of pure practicality: how could a website know where to look for information about the user unless the user is registered somewhere? And part of this is driven by the desire for verification: while the website may not implicitly trust the user, it *does* trust the authentication service.

The purpose of this proposal is to eliminate the need for any central registry or authentication service. That does not mean that it decrees that they *must not* exist; certainly, there will always be a need for some sort of guarantor, some sort of third party opinion about the person in question. Rather, it means that such registries and authentication services *need not* exist, that everything the website needs to know about users can come from the users themselves.

The key differences, therefore, between what I propose and other systems, is:

a) You can self-declare the location of your identity server

b) You can self-identify, that is, you can *state for yourself* who you are and (say) how you can be reached

Which leads to the point of yesterday's paper, and the reason why I wrote it:

c) And self-authentication is good enough (and more to the point, any 'stronger' form of authentication doesn't buy you any greater security than self-authentication does)

What this does, in effect, is to establish a regime where a person's own declaration is the *primary* source of their identity, their own identity server; they do not need to depend on a proxy (such as a university registration, employment in a corporation, subscription to an internet service provider, or whatever). Sure, they may at a later time refer to some external agency to provide a reference or recommendation, but even this referral is at the user's discretion.

Moreover, since people choose their own identification server, the level of security they require may be as weak or as strict as they desire. If a simple login with cookie support is enough (as it is for the vast majority of people on the vast majority of websites) then this is all they use; if they want secure sockets layer with IP verification, then they may opt for this as well.

Moreover, by creating a mechanism by which anyone may self-identify, it also creates a mechanism whereby *any web service may request identification*. A website does not need to belong to a federation, be some part of a trusted network, or some such other secret society. The self-identification network is *open*: anybody can play.

Caveats

In the sections below I will provide some computer code, written in a programming language called Perl. The code provided is not *the* self-identification service I am proposing. Eventually, I would hope that it will be an instance of it. But not yet.

What I have provided is merely a proof of concept. That is, I have written the minimal amount of code necessary to show that what I am proposing will work. Based on input that I have already received, I can say that this code will *definitely* change over the next few days and weeks.

Moreover, it is important to emphasise at this point that the code is not the proposal. The code is merely an *instance* of the proposal. It is my expectation (already fulfilled to a degree) that versions of the same proposal will be written in other languages, such as Python or PHP. It is moreover my expectation that application-specific code, such as Drupal or WordPress modules, will also be created.

Finally - it is necessary to stress again - what mIDm is not is an authentication service. That is, websites have to take the user's word that they are who they say they are. But what it does do is to provide any user who wants it with a unique identity. Also, it is not by itself a solution to other problems, such as comment spam. Though such solutions will rely on a system such as mIDm, they will require a second part (which, yes, I will illustrate in a subsequent work).

What I am trying to prove here is that we can get a free, open and distributed system of single sign-on self-identification off the ground using nothing more than Notepad, some common understandings, and a little ingenuity. And what I believe we will prove, in the long run, is that this is all we ever needed.

The Proposal

The proposal is dead simple.

You - a web user - create a website on which you create a program you can log in to (you don't have to do this yourself - you could use a program someone else created to do the same job - but the point is, you *could* do it yourself.

You then *place the address of that program* - its URL - *into your browser*.

Then, any time you go to a website, if that website wants to know who you are, it gets the URL from your browser and sends a request to the program. "Who is this?" the website will ask. "This is me!" the program will reply.

How does the website know that you've sent it to *your* program, and not someone else's? The same way Feedster or Technorati or Blogshares allows you to 'claim' a blog. It gives you a little bit of code which you then *place* into your program. Because you have to log into the program, *only you* could have placed the information there. So once the website gets the little bit of code *back* from the program, it is satisfied that you, indeed, are the person described by this program.

In a sense, it's no more and no less secure that having you type your personal information into a form. Sure, you could lie - but that's not the point here. The point is that this is a mechanism by which you, the web user, can *make a declaration* about who you are.

Now, in the code provided at http://www.downes.ca/idme.htm, the messages sent back and forth are very simple - too simple, actually. The 'little bit of code' is nothing more than the current time. The response back is nothing more than the little bit of code.

In the final version, these messages will be a little more complex (but not a lot more complex). They will be, in particular, valid instances of the Security Assertion Markup Language (SAML) V2.0. This means that statements made by mIDm will be predictable - everybody will know how to make a request, everybody will know how to read a response. And it means that your own little self-identification server will speak the same language as the centralized identity servers - just in the same way your home-grown web site speaks the same HTML that Yahoo! or Google speak, just the way your own little cut-and-paste RSS feeds speak the same language as those produced by LiveJournal.

How Does It Work?

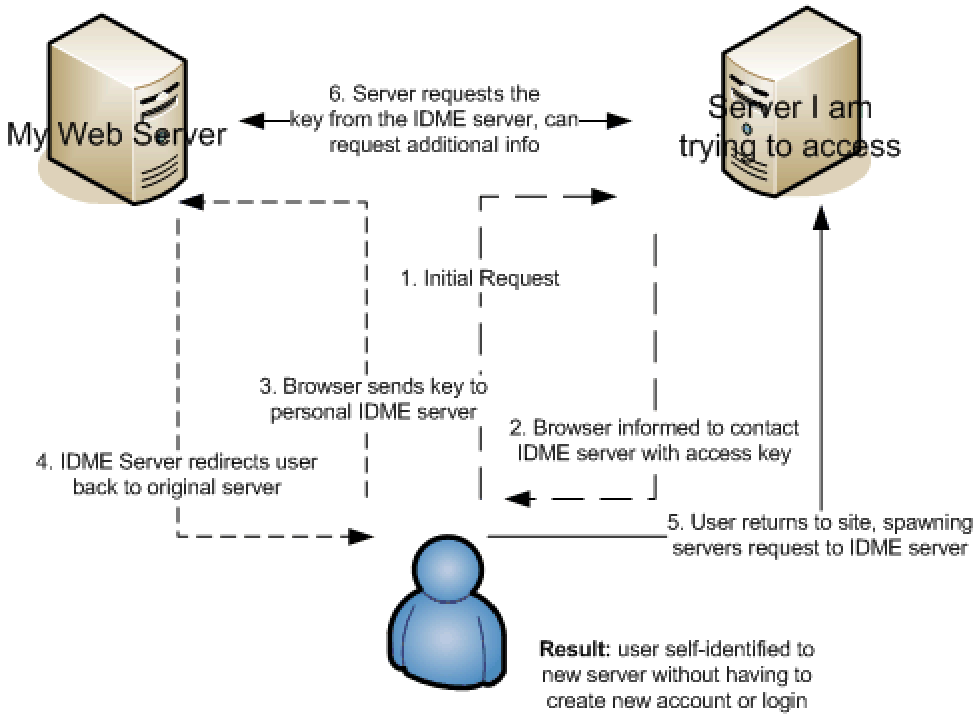
In a nutshell:

- A user declares the name of his or her private website - the location of an mIDm script on their own server (or a server provided by a host, such as an online community of their choosing)
- When the user attempts to access a remote website, the remote website redirects their browser to that mIDm server with an access key (sometimes called a 'handle', though I don't like that name).
- The mIDm server accepts and stores the key. The idea here is that only a person with access to the mIDm server can store that particular key.
- The mIDm server redirects the user back to the remote website.
- Upon the user's return, the remote website independently requests the key from the mIDm server.

- If the key is returned, then the server accepts that the mIDm address provided by the user is valid, and hence, may request additional information (such as, say, FOAF data) from the mIDm server.

Now it should be clear from the outset that this system does not prevent the user from adopting an alternative identity. Nor does it prevent several people from sharing a single identity. This is not the purpose of the mIDm system. The sole purpose is to guarantee that the information being provided by the mIDm server is in fact being provided by the user requesting access. In essence, it is as secure as (and no more secure than) requiring a UserID and a password to access a website.

Scott Leslie provides this image of the process:



More precisely, what is proposed is an instance of 'SP Initiated: Redirect->Artifact binding. See Figure 18, pg. 25, of the SAML 2.0 Technical Overview (PDF).

Set-Up - User End

Step One - Install the mIDm script

The mIDm script is a CGI script that runs on the user's web server (or is provided by a website host). This script checks the user's browser cookies for a valid USERID (the code provided uses two cookies, named 'person_title' and 'person_id', but can be altered to accept any cookie values already set by the server). If the cookies are not present the script exits (the code provides redirects the user to a login screen).

To install the script, copy the code listing immediately below (Listing 1) and save it as a file on your web server. Edit the cookie values if necessary. On Linux / Apache systems, chmod the script to 755 (in other words, run-enable the script). Test the script by typing the script address in a browser. You should see the message 'mIDm script installed OK'.

Note: you can't just install this script out of the box and expect it to work. It needs to be tied to a login system. The example provided below is tied to the downes.ca login system. I will, at a future point, provide a script that handles login as well as identification. But this isn't that script.

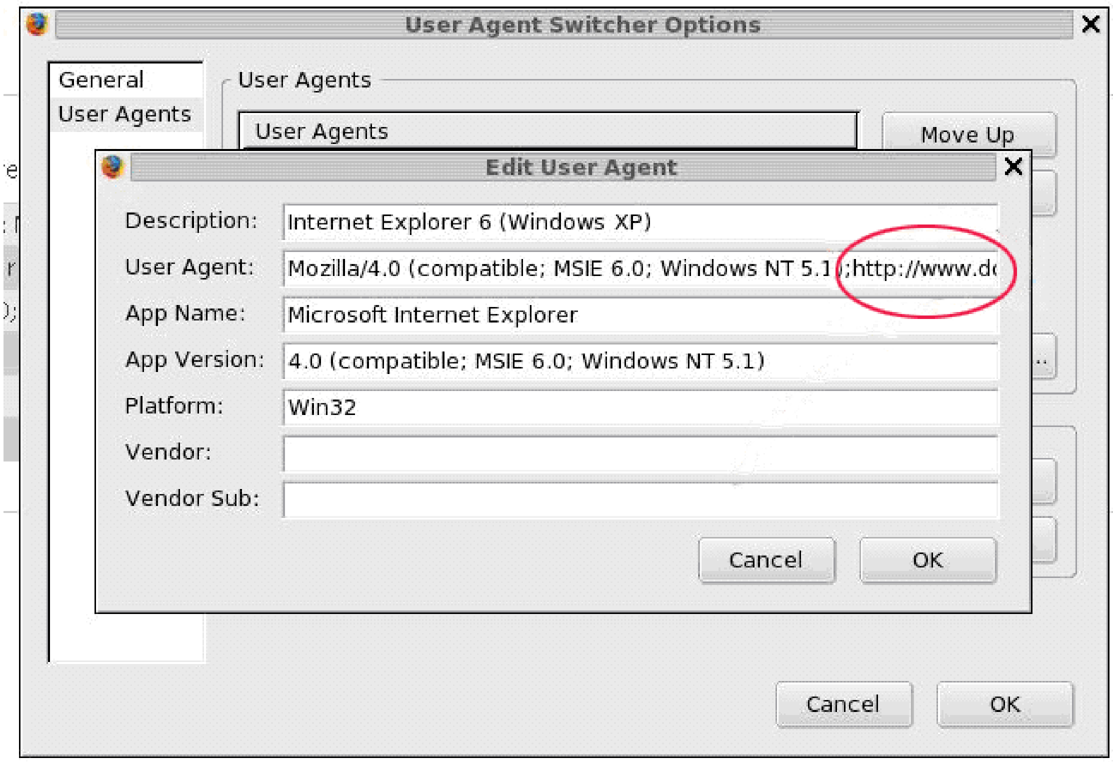
Note: for most users, access to this script will simply be something provided by their web community of choice and no installation will be required.

Step Two - Declare your mIDm Location

Using a Firefox browser go to the User Agent Switcher Extension website and install the user agent switcher.

Once the extension is installed and the browser restarted, select 'Tools' from the menu bar, then select 'User Agent Switcher', then 'Options', then 'Options'. In the box that pops up, select 'User Agents' from the left-hand menu. A list of user agent names will be displayed; select one of those or add a new one (I simply selected 'Internet Explorer'). Click 'Edit'. In the 'Edit User Agent' box that pops up, in the second line (where it says 'User Agent'), add a semi-colon and then the address of your mIDm script.

The following image shows (part of) the URL of an mIDm script added to the 'User Agent' line (circled in red):



Clock 'OK', then 'OK' again to close the popup boxes. Then select 'Tools > 'User Agent Switcher' again and select the user agent that you just altered from the list.

Luc Belliveau also reports that the User Agent can be changed in Internet Explorer by amending the IE registry entry: "In key [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Internet

Settings\5.0\User Agent], the "Version" string can be added to change it, you can even change the platform."

> **Note**: this slightly cumbersome process relies on an existing extension to amend the user agent. Presumably, someone will write a simple extension and/or plugin that will simply allow you to input the location of your mIDm script, and will automatically append it to the end of your existing user agent.
>
> **Warning**: Messing around with your User Agent may cause some websites to react in an odd way. I am testing this now and have found no ill effects so far. But you've been warned.

Set-Up - Server End

If you have a web server and would like to enable single sign-on, do the following:

Copy the script below (Listing 2) to your website and chmod it to 775. Edit the URL for your script.

Note: the script supplied does nothing more than say whether the user has been verified or not. OK, so I have no imagination. In a fuller version, once the user has been verified information would be obtained about the user and this information used by the website to provide personalized services.

Try It Before You Install

I have installed a test case of the two scripts on my website.

First, install the User Agent Switcher as instructed above and set the following as your mIDm URL: http://www.downes.ca/cgi-bin/idme.cgi

> To try it out, try to access the single_signon script: here. You will notice that you are bounced to the login script.
>
> Now try to access the single_signon on a different server (newstrolls.com): here. You will notice that you are bounced to the same login script on the downes.ca.
>
> So go to the login script: here and log in as UserID: tester password: tester
>
> Now go back to the single_signon script: here. You will notice that you are now verified.
>
> Finally, go back to the single_signon script on newstrolls.com: here. You will notice that you are now verified on the NewsTrolls site as well.

The Road Ahead

So what needs to happen before we can start implementing this system?

Nothing.

It can be done now, with the tools we have now. For after all, we already have the two major components we need: the place to store the location of our own authentication severs, and the language (SAML) websites and identity services can use to talk to each other.

Don't like the code I provide here? Write your own in Python, PHP or whatever. Think my login system is way too loose? Embed your code in Drupal, Plone or whatever - write it as a module, write it as base code.

Nothing new needs to be invented. We don't need to wait for some major authentication project to come along and manage it all for us. We can do it ourselves. We should do it ourselves.

Of course - if you do want to wait, the code provided here will be cleaned up and written more rigorously. You will be able to simply copy the code to your website, make minor modifications, and be up and running. After all, it's not rocket science.

Or, at least, it shouldn't be.

Yes, there will be a part three: Applications of mIDm. Moreover, I will be updating the code listings at http://www.downes.ca/idme.htm. Stay tuned.

Scripts

It is recommended that you go to website - http://www.downes.ca/idme.htm to receive the latest version of this script. Bookmark this site and go there for updates in the future.

Editor's Note: Instructional designers need data to validate their strategic decisions. This multivariate study provides useful guidelines on significance and priorities that may be applicable in other contexts and courses. It stimulates interest in research to further test and validate these findings for different learner populations, subject matter, and pedagogy.

The Editors thank **The College Quarterly,** A Journal of Research and Discussion for College Educators Across Canada, for permission to republish this article. The original article - *Communication Technology, Student Learning, and Diffusion of Innovation* - is available on the following site: http://www.collegequarterly.ca/2005-vol08-num02-spring/liao.html.

Adoption of a Course Management System at a College Campus: The Implication of Diffusion of Innovation

Hsiang-Ann Liao

Abstract

Rogers' diffusion of innovation model was used to examine adoption and contribution of a web-based course management system at a college campus. This study surveyed 196 students. It was found that Rogers' model successfully explained adoption of the innovation. Adoption of the course management system led to increased interaction between students, instructors, and course materials. The increased interaction, in turn, significantly contributed to student learning. A path model was developed to examine direct and indirect effects among variables. Contextual factors, such as student motivation, student learning styles, and computer skills, were also examined.

Key Words: e-learning, web-based learning, information technology, course management system, diffusion of innovation, student learning, college education, interaction and learning

Introduction

Diffusion of innovation as a mass communication theory has been used to examine how an innovation is adopted in a particular social system. Since the pioneer of diffusion study, which is Ryan and Gross' study on the adoption of hybrid seed corn (1943), the diffusion of innovation model has been used to examine the diffusion of new products, ideas, and practices around the world. Diffusion of innovation, with its practical implication on the adoption of technological innovations, can be used as a theoretical framework to understand how students adopt a web-based course management system and integrate this system into their learning environment.

The Iowa study of the adoption of hybrid seed corn by Iowa farmers revealed how social change could be examined via the analysis of the adoption of innovation. The Iowa study researched the overall pattern of adoption by focusing on background factors that contribute to the adoption of the new seeds, the role of the mass media and interpersonal communication in the adoption process, and the time lag between awareness and adoption (Ryan & Gross, 1943). It was found that while the mass media contributed to the awareness of the innovation, interpersonal communication among farmers was the determining factor for the adoption of the new seeds.

Another landmark in the diffusion study is Rogers' model of diffusion of innovation (Rogers, 1995). In this model, Rogers specified four elements in the diffusion process: the innovation, communication channels, time, and the social system. With regard to the innovation, Rogers identified the five characteristics of an innovation: relative advantage, compatibility, complexity, trialability, and observability. An innovation has to be relatively advantageous, compatible with the existing values or needs of potential adopters, and simple to use. An innovation that can be experimented with on a limited basis and is visible to others will be more likely to be adopted.

Rogers (1995) states that no other field of behavior science research has generated "more effort by more scholars in more disciplines in more nations" (p. xv.). Diffusion research has been conducted in a variety of fields ranging from medical, agricultural, business, educational, national development, and information technology. I will review diffusion research conducted in the fields of education and information technology to lay a foundation for the examination of the diffusion of a web-based course management system on a college campus.

Studies have shown the benefits of web-based technologies in enhancing student learning. For example, information technologies supported learning by providing course information, study material, and assignments conveniently, timely, and in usable formats (Parikh & Verma, 2002; Silva, 2003; Riffell & Sibley, 2003). Web-based information technologies made interaction between student with course material, faculty, and other students possible and facilitated students' critical thinking and writing skills (Caruso, 2004; Meyer, 2003). In an Educause Center for Applied Research (ECAR) study of 4,374 respondents at 13 college campuses, it was found that the use of information technology in classes helped students better communicate with the instructor and classmates, resulted in prompt feedback from the instructor, allowed students to take greater control of their class activities, and facilitated student engagement in class (Caruso, 2004). Web-based information technologies also made active learning feasible where students could design their own course content and post the course content on the web, in contrast to the traditional learning method where the instructor was the main source of course information (Lim et. al., 2003; Stocks & Freddolino, 2000).

Given that a web-based course management system is a computer-related innovation, previous research in this direction is helpful in understanding the diffusion of this education technology. In assessing the diffusion of online research in newsrooms, Garrison (2000) found that journalists had increasingly relied on the web for information gathering and e-mail. Herling (1996) found three factors that explained resistance to the adoption of Lexis/Nexis, an online news database. The first factor was functional benefits factor, which explained non-adoption from perspectives of necessity and benefits of the innovation. When an individual perceived little necessity and few benefits in adopting the innovation, resistance occurred. The second factor was innovation amenability factor, which examined how willing an individual was to change to allow adoption to occur. If an innovation required some adjustments in an individual's routine, and the individual was not willing to make the adjustment, adoption was less likely to occur. The third factor was innovation adaptability, which examined the need for the innovation to adapt to the individual. Although Herling (1996) conducted his study to address the pro-innovation bias in Rogers' model by assessing non-adoption, the results showed that relative advantage, compatibility, complexity, and trialability from Rogers' model were relevant to explain the non-adoption process.

The preceding literature suggests the following hypotheses concerning the adoption a web-based course management system by college students:

H1: Based on Rogers' model, advantageous innovation characteristics, such as relative advantage, complexity, trialability, and compatibility, will predict the adoption of a web-based course management system by college students. The four factors will also contribute to the interaction between instructors, students, and course materials. The four factors will contribute to student learning. Observability does not apply here so it will not be tested.

H2: Meyer (2003) called for the examination of how individual student differences in terms of learning style, motivation to learn, computer skills, and ability to self-regulate affect the use of information technologies. The second hypothesis of this study examines how student characteristics affect the adoption of this course management system. Three variables will be assessed: student motivation, student learning styles, and instructors' requirement.

H2a: Students who are more motivated tend to use the technology more.

H2b: This course management system benefits aural, dependent, and visual learners equally well.

H2c: Frequency of use of this technology is predicted by instructors requiring participants to do so.

H3: Previous research (Beveridge and Rudell, 1988) indicated that the assessment of the use of a particular technology should take technological knowledge and attentiveness into consideration. As a result, it is hypothesized that computer skills, whether participants were informed about and interested in technological inventions, and whether participants initiated technological discussions moderately correlate with the use of the information technology. The hypothesized moderate effect is because the course management system under study is a user-friendly software hence does not require much technological expertise to use it.

H4: The use of the course management system contributes to the interaction between students, instructors, and course materials.

H5: The increased interaction contributes to student learning.

Method

Participants

Participants in this study were 196 undergraduate and graduate communication students at a college in Western New York. The survey was administered to students enrolled in communication courses in Spring 2004. 54% of the students surveyed were females, 36% were males, and 11% were unknown. 18% of the participants were 18 or 19 years old, 51% were between 20 to 22 years old, 11% were between 25 to 30 years old, 10% were between 23 to 25 years old, and 4% were over 30 years of age. In terms of year in school, 8% were freshmen, 24% sophomores, 28% juniors, 26% seniors, 4% graduate students, and 11% unknown. The majority of the participants (66%) did not have prior experience with a web-based course management system, while 26% did have prior experience with a similar system.

Procedure

Student were told before the questionnaires were distributed that they would be asked questions concerning their experience with ANGEL, the web-based course management system used by the College where the survey took place. All of the questionnaires were completed in class.

Measures

The survey asked questions based on Rogers' model of the characteristics of innovation: relative advantages, compatibility, complexity, and trialability. Observability does not pertain to the use of a web-based learning system so it was not included in the study. Learning related questions, interaction questions, and technology related questions were asked to assess the impact and the context of the adoption of a web-based learning system by students. All of the questions were answered on 5-point Likert scales. A list of questions pertaining to each variable examined in this study is in Table 1, mean scores and standard deviations are included.

Relative Advantage. According to Rogers (1995), relative advantage is the degree to which an innovation is perceived as better than the option it supersedes. Important factors include economic advantage, social prestige, convenience, and satisfaction. An innovation perceived to be advantageous would have more rapid rate of adoption. The advantages of using this web-based learning system were measured by asking participants how the technology benefited them in their learning. Participants were asked whether they "strongly agree," "agree," "neutral," "disagree," or "strongly disagree" with the following statements: "ANGEL contributes to the quality of teaching," "Using ANGEL saves time," "ANGEL is a positive innovation," and "ANGEL makes it more convenient to communicate with my professors."

Table 1A

Measures: Independent Variables

Relative Advantage
A1: "ANGEL contributes to the quality of teaching." (M = 2.51, SD = .88)
A2: "Using ANGEL saves time." (M = 2.47, SD = .93)
A3: "ANGEL is a positive innovation." (M = 2.96, SD = .73)
A4: "ANGEL makes it more convenient to communicate with my professors." (M = 2.83, SD = 1.01)

Compatibility
P1: "ANGEL is compatible with the way I like to work." (M = 2.54, SD = .94)
P2: "Using ANGEL would require me to change my work habits." (M = 2.48, SD = 1.00)
P3: "ANGEL is compatible with the computer system I use at home/in my dorm room." (M = 1.81, SD = .90)

Simplicity
X1: "ANGEL is easy to use." (M = 3.22, SD = .72)
X2: "I am confident in my ability to use ANGEL." (M = 3.46, SD = .60)
X3: "ANGEL is too complex for me." (M = 3.43, SD = .72)
X4: "ANGEL is user-friendly." (M = 3.07, SD = .78)

Trialability
T1: "I can practice using ANGEL at a comfortable pace." (M = 2.73, SD = .82)
T2: "ANGEL can be easily tried out." (M = 2.86, SD = .81)
T3: "I am not worried about making mistakes, i.e. clicking on the wrong item, when I use ANGEL." (M = 2.92, SD = 1.06)

Motivation
M1: "I hand in my assignment on time most of the time." (M = 3.45, SD = .81)
M2: "I do not miss classes without a good reason." (M = 2.53, SD = 1.29)
M3: "I am a self-motivated learner." (M = 2.64, SD = .95)

Learning Style
Y1: "I can comprehend course material better after I listen to the instructor's lecture." (M = 3.40, SD = .83)
Y2: "I rely on the instructor's guidance in mastering the course material." (M = 2.72, SD = .94)
Y3: "I learn better with step-by-step demonstration." (M = 2.55, SD = .95)

Instructor's Requirement
R1: "I use ANGEL because my professors post course materials on ANGEL." (M = 3.34, SD = .84)
R2: "I use ANGEL because my professors require me to do so." (M = 2.90, SD = .96)

Informed about technology
F1: "How informed do you think you are about new scientific discoveries?" (M = 2.75, SD = .96)
F2: "How informed do you think you are about the use of new technological inventions?" (M = 2.71, SD = .89)
F3: "How often do you use the media for information on new technological inventions?" (M = 2.07, SD = .94)
F4: "How often do you use the Internet to gain information on new technological inventions?" (M = 2.04, SD = 1.04)

Interest in technology
N1: "How interested are you in new scientific discoveries?" (M = 2.43, SD = .95)
N2: "How interested are you in the use of new inventions and technologies?" (M = 2.44, SD = .88)

Computer Skills
S1: "I am pretty good with the computer." (M = 3.17, SD = .79)
S2: "I am knowledgeable about computer hardware." (M = 2.59, SD = 1.01)
S3: "I am knowledgeable about computer software." (M = 2.75, SD = .89)

Initiate discussion on technology
D1: "How often do you initiate a discussion on new technological inventions?" (M = 3.49, SD = 1.12)

Compatibility. Compatibility is the degree to which an innovation is perceived as being consistent with the existing values, past experiences and practices, and needs of adopters (Rogers, 1995). This second component of Rogers' model was assessed by whether the adoption of the course management system would require the participants to change their work habits and whether the course management system was compatible with their computer system at home or in their dorm room.

Simplicity. According to Rogers (1995), complexity is the degree to which an innovation is perceived as difficult to understand and use. Innovation that is easy to use will more likely to be adopted and will be adopted faster. The term "complexity" in Rogers' model actually pertains to whether it is simple to use the innovation. As a result, simplicity will be measured in this study. Items included, "ANGEL is easy to use," "ANGEL is user-friendly," "ANGEL is too complex for me," and "I am confident in my ability to use ANGEL."

Trialability. Trialability pertains to the degree to which an innovation may be experimented with on a limited basis (Rogers, 1995). Trialability was assessed by the degree to which the course management system could be easily tried out by participants. Items included, "I can practice using ANGEL at a comfortable pace," "ANGEL can be easily tried out," and "I am not worried about making mistakes, i.e. clicking on the wrong item, when I use ANGEL."

There are three learning related variables investigated in this study: student motivation, student learning style, and adoption out of requirement from the instructors.

Student motivation. Whether participants were motivated learners was assessed by questions pertaining to whether they handed in their assignment on time, kept good attendance, and whether they thought they were self-motivated learners.

Learning style. Three learning styles were investigated: visual, aural, and dependent, to examine how the information technology benefited different types of learners. Items included, respectively, "I learn better with step-by-step demonstration," "I can comprehend course material better after I listen to the instructor's lecture," and "I rely on the instructor's guidance in mastering the course material."

Instructors' requirement. The frequency of the use of the information technology was also hypothesized to be affected by whether the instructors required students to go online to get assignments, take quizzes, or submit homework. Questions that assessed the reasons for the use of the technology were asked, "I use ANGEL because my professors post course materials on ANGEL," and "I use ANGEL because my professors require me to do so."

Four technology related questions were also administered. The four variables examined were: computer skills, informed about technology, interested in technology, and whether participants initiated discussion on technology.

Computer skills. In order to assess whether students who were less competent on the use of computer hardware and software would benefit less from the technology, self-report questions on computer skills were included, "I am pretty good with the computer," "I am knowledgeable about computer hardware," and "I am knowledgeable about computer software."

Informed about technology. To assess whether participants were informed about technology, participants were asked whether they thought they were informed about new scientific discoveries, and the use of new technological inventions. Questions on participants' information seeking behaviors regarding new technological inventions were also included.

Interest in technology. To investigate whether participants' interest in technology would affect the adoption and the use of the learning technology, questions on whether participants were interested in new scientific discoveries and in the use of new inventions and technologies were administered.

Technological discussion initiation. One question was administered to assess this variable: "How often do you initiate a discussion on new technological inventions?" This question was answered on a 5-point Likert scale.

Table 1B

Measures: Dependent Variables

Frequency of Usage
F1: "How often do you use ANGEL?" (M = 2.98, SD = 1.02)
Interaction
C1: "ANGEL increases my interaction with my instructors." (M = 2.31, SD = 1.02)
C2: "ANGEL increases my interaction with course material." (M = 2.50, SD = .96)
C3: "ANGEL increases my interaction with my fellow students." (M = 1.82, SD = 1.12
Learning
L1: "I believe I learn the course material better because of ANGEL." (M = 1.71, SD = .98)
L2: "Using ANGEL improves my grade." (M = 1.86, SD = 1.01)

Note: All questions were coded on 5-point Likert scales with 5 coded as "Strongly agree" and 1 as "Strongly disagree."

Trialability. Trialability pertains to the degree to which an innovation may be experimented with on a limited basis (Rogers, 1995). Trialability was assessed by the degree to which the course management system could be easily tried out by participants. Items included, "I can practice using ANGEL at a comfortable pace," "ANGEL can be easily tried out," and "I am not worried about making mistakes, i.e. clicking on the wrong item, when I use ANGEL."

There are three learning related variables investigated in this study: student motivation, student learning style, and adoption out of requirement from the instructors.

Student motivation. Whether participants were motivated learners was assessed by questions pertaining to whether they handed in their assignment on time, kept good attendance, and whether they thought they were self-motivated learners.

Learning style. Three learning styles were investigated: visual, aural, and dependent, to examine how the information technology benefited different types of learners. Items included, respectively, "I learn better with step-by-step demonstration," "I can comprehend course material better after I listen to the instructor's lecture," and "I rely on the instructor's guidance in mastering the course material."

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Technological discussion initiation. One question was administered to assess this variable: “How often do you initiate a discussion on new technological inventions?” This question was answered on a 5-point Likert scale.

Explanatory Factor Analysis

Two explanatory factor analyses were conducted to assess the reliability and validity of this investigation. For the first factor analysis, all innovation variables and learning related variables were entered with Direct Oblimin rotation. Results are shown in Table 2. This factor analysis indicates that among the four components in Rogers’ model, relative advantage and compatibility emerged as one factor. In addition, two of the three compatibility measures (P1 and P3 in Table 1) did not cluster with the rest of the relative advantage measures and were dropped, the one compatibility measure that clustered with the advantage measures (P2) was moved to the advantage factor. Visual learning style (Y3 in Table 1) did not cluster with the rest of the learning style variables and was dropped. The rest of the two learning style measures were labeled as dependent learning styles in future analysis because both questions pertain to the dependence the participants had on the instructors to learn the materials.

Table 2

Factor Analysis of Innovation Predictors and Learning-Related Predictors

Variable	Factor Loading					
	1	2	3	4	5	6
Trialability						
T1	.824	.049	.110	-.172	-.096	.332
T2	.790	.040	.119	-.345	.052	.412
T3	.484	-.016	-.044	-.324	.073	.363
Instructor Requirement						
R1	.097	.810	-.028	-.245	.071	.174
R2	-.036	.796	.021	.033	.299	-.064
Motivation						
M1	.168	.213	.766	.058	-.047	.145
M2	.113	-.060	.716	-.089	.217	-.019
M3	-.176	-.207	.679	-.290	-.079	.172

Relative Advantage/Compatibility						
A1	.151	.023	.050	-.786	.131	.242
A2	.040	.063	.021	-.766	-.077	.351
A3	.493	.108	.131	-.733	-.067	.396
A4	.292	.312	.068	-.710	.001	.370
P1	.420	.016	.267	-.678	-.128	.305
Dependent Learning Style						
Y1	.003	.109	.038	.033	.810	.003
Y2	.023	.223	.057	-.033	.763	-.053
Simplicity						
X1	.420	.110	.241	-.358	-.090	.807
X2	.362	-.012	.161	-.341	.024	.787
X3	.136	.038	-.090	-.241	-.031	.770
X4	.473	.135	.215	-.328	-.096	.750

Total Variance Explained: 63.1%

The second factor analysis pertains to the technology related variables. Three factors emerged from the data: informed, computer skills, and interest. Discussion variable clustered with all the informed about technology variables and was moved to the informed factor. Results of this factor analysis are shown in Table 3.

Table 3

Factor Analysis of Technology Related Predictors

Variable	**Factor Loading** 1	2	3
Informed about Technology			
F2	.851	.090	.185
F4	.791	-.105	.068
F1	.753	.141	.339
D1	.722	-.006	.002
F3	.647	-.070	.303
Computer Skills			
S3	-.002	.898	-.007
S2	-.021	.874	-.063
S1	.018	.843	-.055
Interest in Technology			
N2	.166	-.114	.905
N1	.214	.010	.897

Total Variance Explained: 62%

Results

Preliminary Demographic Analyses

A series of demographic analyses were conducted to explore the effects of gender, age, and year in school on the three dependent variables. For the frequency of the use of the learning technology, the higher the grade of the respondents, the more often was the use of the technology, $F(173) = 2.44$, $p \leq .05$. Gender and age did not affect how often the respondents used the technology.

None of the three demographic variables made a difference in the interaction dependent variable. In other words, in terms of respondents' experiences on whether the course management system facilitated interaction among students, instructors, and course materials, the differences across different gender, age, and year in school groups were not significant.

For student learning, year in school was the significant factor in determining whether students thought the course management system contributed to their learning and good grades. The higher the grade of the respondents, the more likely the participant would think that the technology helped them learn the course material better and contributed to their good grades. Gender and age did not make a difference in terms of student learning.

H1: Advantageous innovation characteristics, the adoption of the innovation, interaction, and student learning

To assess the relationship between advantageous innovation characteristics and the adoption of innovation, one correlation analysis and one multiple regression analysis were conducted. Results are presented in Table 4 and Table 5.

Table 4

Inter-Correlations among Variables

	1	2	3	4	5	6	7	8	9	10	11	12
Advantage/ Compatibility	__											
Simplicity	.468***	__										
Trialability	.436***	.537***	__									
Motivation	.158*	.160*	.086	__								
Requirement	.136	.137	.051	.013	__							
Dependent Learning Style	.001	.008	.004	.077	.242***	__						
Informed on Technology	.029	.081	.063	.052	.062	.106	__					
Computer Skills	.130	.194**	.172*	.009	.123	.008	.003	__				
Interested in Technology	-.044	.089	.047	.112	.001	.011	.232**	.069	__			
Frequency of Usage	.349***	.338***	.232***	.248***	.026	.087	.099	.02	.004	__		
Interaction	.630***	.341***	.277***	.041	.109	.007	.026	.008	.038	.303***	__	
Learning	.552***	.243***	.191**	-.006	.060	.048	.019	.054	.017	.205**	.639***	__

*≤.05, **≤.01, ***≤.001

According to Table 4, all three factors significantly correlate with the frequency of the use of the course management system (Advantage/ compatibility: $r = .349$, $p < .000$; Simplicity: $r = .338$,

$p < .000$; Trialability: $r = .232$, $p < .000$). To assess which one of the three factors predicted frequency better than the other factors, a multiple regression analysis was performed.

Results in Table 5 show that when all three factors were entered simultaneously, simplicity was the best predictor of the frequency of usage ($\beta = .28$, $p < .000$), followed by advantages/compatibility ($\beta = .22$, $p < .000$). Trialibility failed to explain the variance in the dependent variable when all three factors were present. This multiple regression model explains 18% of the variance in the frequency of the use of this information technology.

Table 5

Innovation Predictors on Frequency of Usage, Interaction, and Learning

Predictor Variable	Frequency of Usage		Interaction		Learning	
	β	R^2	β	R^2	β	R^2
Advantage/ Compatibility	.22***	.18***	.58***	.40***	.57***	.30***
Simplicity	.28***		.14		.01	
Trialability	-.02		-.06		-.07	

*≤.05, **≤.01, ***≤.001

The relationship between advantageous innovation characteristics and interaction was assessed by data presented in Table 4 and Table 5. According to Table 4, all three factors significantly correlate with interaction measures, with advantage/compatibility measures stand out (Advantage/compatibility: $r = .630$, $p < .000$; Simplicity: $r = .341$, $p < .000$; Trialability: $r = .277$, $p < .000$). In other words, relative advantages and compatibility, such as saving time, convenience, and compatibility with preferred work habits, contributed the most to the increased interaction among students, instructors, and course materials. Results from multiple regression analysis in Table 5 also confirm this result. When all three factors were entered together, advantage/compatibility measures are the most robust predictors of the interaction between students, instructors, and course materials ($\beta = .58$, $p < .000$). Simplicity is also a significant predictor ($\beta = .14$, $p < .05$). Trialability failed to predict interaction when all three factors were present. The multiple regression model explains 40% of the variance in interaction measures.

Do the advantageous innovation characteristics contribute to student learning? Correlation coefficients in Table 4 indicate that all three factors contribute to student learning (Advantage/compatibility: $r = .552$, $p < .000$; Simplicity: $r = .243$, $p < .000$; Trialability: $r = .191$, $p < .01$). Advantage/compatibility is the strongest predictor of student learning. Table 5 confirms this finding. When all three factors were entered into the multiple regression equation, only advantage/compatibility measures predict student learning ($\beta = .57$, $p < .000$), while simplicity and trialability fail to do so. The multiple regression model explains 30% of the variance in student learning.

H2: Student characteristics and the adoption of the innovation

Two of the three hypotheses for H2 are sustained. Student motivation predicted the adoption of the innovation ($r = .248$, $p < .000$). In other words, students who were more motivated tended to use the course management system more often.

Visual, aural, and dependent learners benefit equally well from the course management system. A series of ANOVA analyses on the three learning styles generate insignificant differences in both frequency of usage and learning measures. In other words, learning styles did not make statistically significant differences in terms of how often respondents used the technology and whether they thought the technology contributed to their learning:

for visual on frequency: $F(191) = .38, p > .05$;

for aural on frequency: $F(194) = 1.32, p > .05$;

for dependent on frequency: $F(191) = 1.15, p > .05$;

for visual on learning: $F(190) = .81, p > .05$;

for aural on learning: $F(193) = 1.53, p > .05$;

for dependent on learning: $F(190) = .86, p > .05$).

Instructors' requirements for students to go online for homework and course materials did not predict the frequency of usage ($r = .048, p > .05$), while student motivation did ($r = .248, p < .001$).

H3: Technology related attributes and the adoption of the innovation

The hypothesized moderate correlation between technology related attributes and the adoption of innovation was not found. Results of the correlation analyses are presented in Table 4. In fact, none of the technology related measures, such as informed, interested, or computer skills, significantly correlate with the frequency of the use of the course management system. This finding actually leads to an interesting conclusion. That is, the technology is so user friendly that people who do not have moderate to high level of knowledge and attentiveness to technology can use the information technology. In other words, similar to the finding that the technology benefits respondents with different learning styles equally well, this technology also benefits respondents with different levels of technological know-how equally well.

H4: The adoption of the innovation and interaction

It is hypothesized that the adoption of the information technology will facilitate interaction among students, instructors, and course materials.
This hypothesis is sustained ($r = .303, p < .000$).

H5: Interaction and student learning

It is further hypothesized that the increased interaction between students, instructors, and course materials will contribute to student learning. This hypothesis is sustained ($r = .639, p \leq .000$). In fact, the correlation is quite high between interaction and student learning.

A Path Model

Based on the above sustained hypotheses, a path model was constructed to assess the direct and indirect effects among variables. The path model is based on data from Table 4. Independent variables that consistently generate significant correlation coefficients across the three dependent variables were entered into the path model as exogenous variables, which include advantage/compatibility, simplicity, trialability, and student motivation. Two of the dependent variables were conceptualized as mediators in the model: frequency of usage and interaction. Student learning is the final variable that the model is intended to explain. The path model is constructed using LISREL. The path diagram is depicted in Figure 1.

The goodness of fit of the path model was assessed by considering chi-square value and the root mean square error of approximation (RMSEA). According to Segrin and Nabi (2002) the goodness of a path model's fit to the sample data can be judged using the following two criteria: (1) a χ^2/df ratio of 5 or less (Segrin & Nabi, 2002; Marsh & Hocevar, 1985), and (2) an RMSEA less than or equal to .08 (Segrin & Nabi, 2002; Browne & Cudeck, 1993).

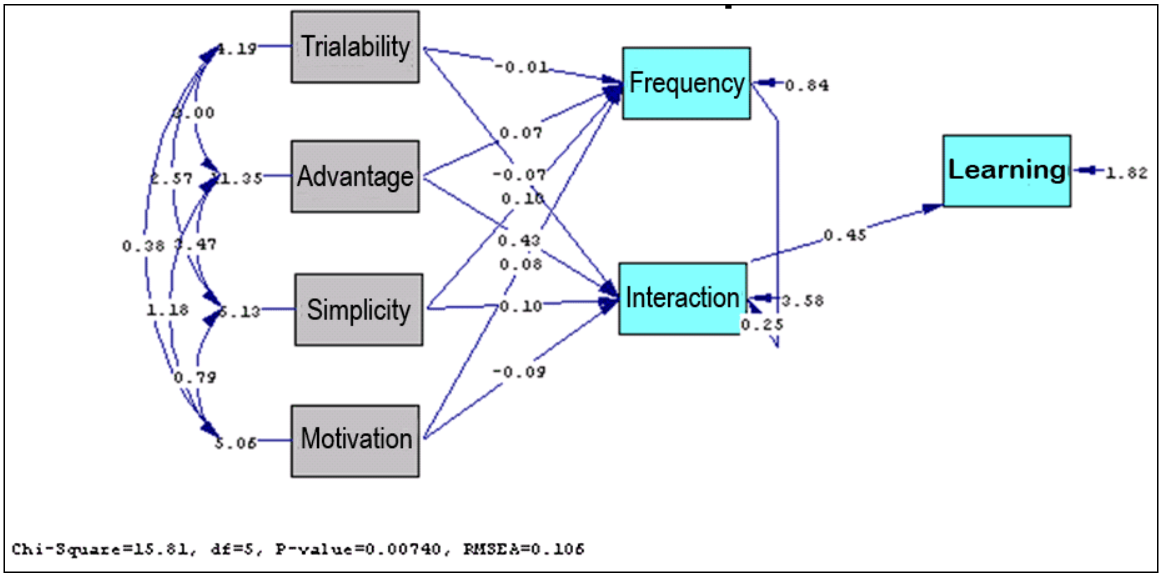

Figure 1: Path analysis of relationships among advantage/compatibility, simplicity, trialability, motivation, frequency of usage, interaction, and learning.

This model has a $\chi^2 = 15.81$, df = 5, $p < .01$. The χ^2/df ratio for this model was 3.16, indicating an acceptable fit to the sample data. The RMSEA = .11 suggests a marginally acceptable fit, indicating that there is some room for improvement in the specification of this model. Individual path coefficients suggest that simplicity predicts the frequency of usage better than other variables. This is consistent with my previous discussion. Advantage/compatibility and student motivation also predict the frequency of usage. In predicting interaction, advantage/compatibility is by far the most robust predictor compared to the other variables ($\beta = .43$). Collectively, the four exogenous variables accounted for 19% of the variance in the frequency of usage, and 41% of the variance in interaction. Finally, the path from interaction to student learning appears to be robust, $\beta = .45$. All variables in this model explain 41% of the variance in student learning.

Discussion

This study sought to explain the adoption of a web-based course management system by college students using Rogers' (1995) model of the diffusion of innovation and to assess the impact of the adoption on interaction between students, instructors, and course materials. The impact of the adoption on student learning was also examined. Results indicate that Rogers' model successfully predicts the adoption of this innovation. All four factors in Rogers' model predict the adoption. When advantage/compatibility, simplicity, and trialability were entered simultaneously into multiple regression analysis and path analysis, simplicity is the most robust predictor of the adoption, which was measured as the frequency of usage. In other words, the user-friendly nature of the course management system encourages respondents to use the technology often. This finding suggests that it is important for an educational technology to have user-friendly designs for it to be used by students. Complex educational technologies will be much less likely to be adopted on college campuses. In addition to simplicity, relative advantage, compatibility, and student motivation are also significant predictors of the adoption.

Rogers' model was also used to assess the impact of technological attributes on interaction between students, instructors, and course materials. It was found that while all of the four factors in the model successfully predict interaction, the combined measure of relative advantage and compatibility is the most robust predictor of interaction. Simplicity is also a robust predictor of interaction. This finding indicates that advantageous features of the technology actually help increase the interaction between students, instructors, and course materials. The increased interaction, in turn, significantly contributes to student learning. In other words, the opportunities provided by the technology did lead to increased interaction, which directly affects student learning.

It is interesting to find out that instructors' requirement of students using the course management system did not predict frequency of usage and learning, while advantageous features of the information technology did. One possible explanation for the lack of correlation between adoption of the technology and instructor requirement is that adoption in this study is defined as the frequency of usage instead of simply the use of the technology. Findings from this study are consistent with the results from the ECAR study (Caruso, 2004). According to the ECAR study, students reported that the biggest benefit of the use of classroom information technology is convenience, followed by class activities management, saving time, and improving learning. One additional factor specified in the ECAR study is that the majority of the students nowadays prefer to take classes that use a moderate amount of technology. In other words, the opportunity to work with information available online has become a significant aspect of a student's college learning experience.

Among the four factors of Rogers' model examined in this study, although trialability alone predicted the frequency of the use of the technology, interaction, and learning, when all factors were simultaneously investigated, trialability appeared to be an insignificant predictor of frequency, interaction, and learning. One possible explanation would be that when all factors were present, the portion of the dependent variable that could be accounted for by trialabililty was explained by other factors. Because adoption was measured as an on-going process and because the adoption has already taken off, when all factors were present, relative advantage, compatibility, and simplicity stand out as more robust predictors than trialability. This finding, however, does not suggest that trialability would be irrelevant in explaining the beginning stage of an adoption process with the other factors present.

Preliminary demographic analyses for this study also show that year in school successfully predicts the frequency of the use of the technology. Moreover, the higher the grade of the participants, the more likely they would think that the technology contributes to learning. In other words, the benefits of using the technology are not immediately noticeable for participants. It takes one or two years for participants to efficiently incorporate the technology into their work habits and to realize the benefits of the technology.

The other interesting and important finding from this study is that participants with different learning styles and different technological background benefit equally well from this technology. This is great news for the manufacturer of the software and a good lesson for future manufacturers of educational technologies.

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Editor's Note: This study compares learning and performance for online and onsite students and defines situations and variables that characterize each group. Even when students on campus have access to the tools of distance learning, their expectations and behavior are different. The authors provide valuable insights into the processes involved as a result of well planned and carefully executed research.

Curriculum Adaptations within the Online Environment

Barbara N. Young, Dorothy Valcarcel Craig, Kathryn Boudreau Patten

Abstract

As the demand for online learning increases, teacher preparation programs must offer a variety of courses utilizing E-learning formats. These formats must model effective teaching practices, curriculum design, and adaptations for the online learning environment. In addition, teacher preparation programs—following the Dewey philosophy as well as the psychological aspects of cognition outlined by Piaget—must integrate collaboration and interaction along with project-based learning. Following a qualitative design, this study examined effective practices and curriculum design in order to provide insight into effective practices within the online learning environment. Data was collected from graduate and undergraduate students enrolled in a variety of teacher preparation courses in order to examine: a) adaptations in curriculum design for the online environment, b) interactions and collaborations, c) depth of application of concepts and skills, and d) preferences and differences with regard to learning styles.

Key Words: online courses, online course delivery, online course design, curriculum adaptations for online environment, effective practices within online learning environment, curriculum design for e-learning

Introduction

Course designers and professors at institutions of higher education instructing via distance learning modalities can no longer view learners as "blank slates" whose minds are waiting to be filled with knowledge. Rather, they must adopt a constructivist point of view as they adapt learning to the online environment and adopt a more collaborative approach to learning that requires interaction with a variety of entities, inquiry, and multiple resources (Brooks & Brooks, 1993). Furthermore, university professors must also address the needs of those students who make up the rapidly growing population of online learners, the non-traditional student—a population that consists of working adults, second-career students, and those students who are unable to attend classes on the traditional on-site campus (Palloff & Pratt, 2001).

The Study: Adaptations, Explorations, and Examinations

This study examined the curriculum design and adaptations made to three university courses—which are part of the professional education requirements for state licensure—that were delivered entirely online utilizing the WebCT course delivery software. In order to conduct a comparison and gather findings that would improve practice, assignments and interactions gathered from online students were compared with the same items gathered from students taking the onsite/campus version of the courses.

Throughout the semester, assignments, interactions, processes and preferences of the students enrolled in the courses in order to determine the degree of course effectiveness with regard to curriculum design. Students enrolled in the courses represented a variety of programs at the undergraduate and graduate levels—the commonality being that all students were seeking professional licensure as part of their individual programs.

Due to the nature of the inquiry, a qualitative approach was employed. Bogdan and Biklen (1998) suggest that qualitative researchers study a specific setting or situation because they are concerned with the context of the environment. According to Patton (1990), the research design should address specific issues of the inquiry—with considerations made to the purpose, focus, data, and approach taken. In addition, triangulation options were explored in order to address validity and confidence in the findings. Considering the notion that research is conducted to describe a particular phenomena, understand what is taking place, and utilize findings to inform practice, a formative research model (Schensul, Schensul, and LeCompte, 1999) was designed (Figure 1).

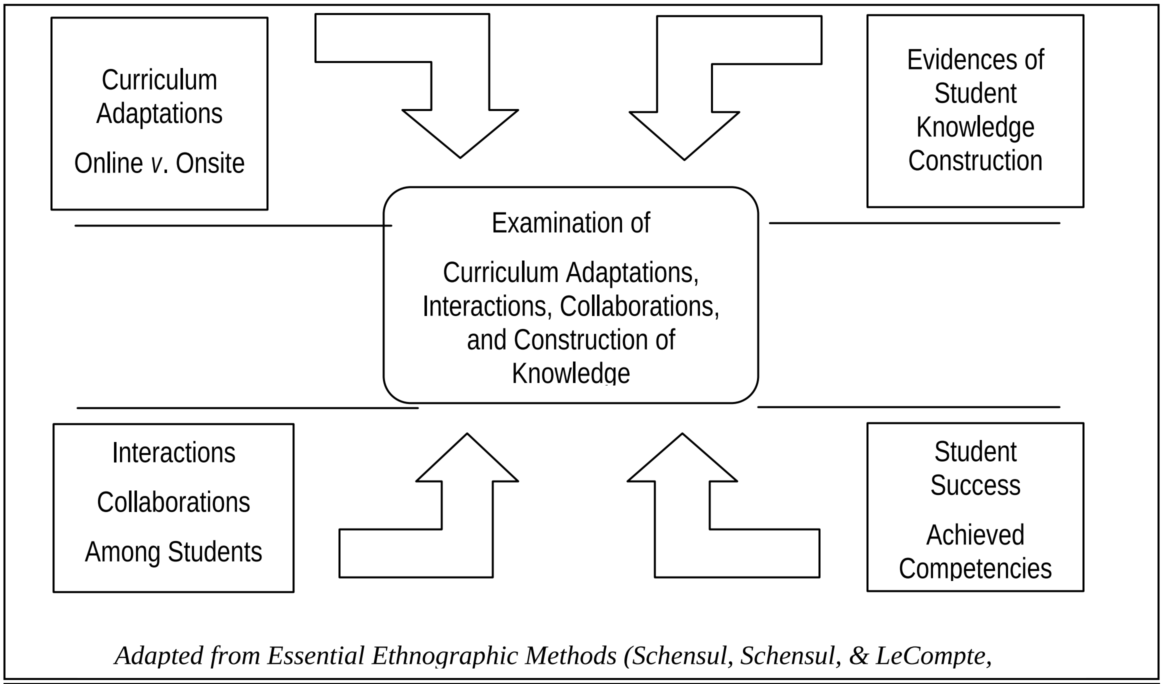

Figure 1. A Formative Research Model.

Three overarching questions framed the study and set the tone and theme of the research. A variety of data sets were gathered in order to examine and analyze multiple sources. Table 1 provides an overview of the data sets with each corresponding overarching question.

Prior to the semester, each course was carefully examined. Following the elaboration theory as outlined by Reigeluth in the 1970s, instruction was organized in increasing order of complexity for optimal learning. Eight basic strategies were followed including:

a) organizing course structure,
b) sequencing tasks and activities in a simple-to-complex manner,
c) designing lessons with "lesson sequencers,"
d) developing summarizers as often as needed,
e) providing synthesizers to help learners integrate and apply content,
f) utilizing analogies as needed,
g) incorporating cognitive activators in the form of graphic organizers, graphics, and diagrams, and
h) making all content and tasks available at the onset of the course in order to enable learner control.

Table 1

Overarching Questions and Data Sets

Overarching Question	Data Set 1	Data Set 2	Data Set 3
What adaptations in curriculum design would be necessary in order for students to effectively construct knowledge and become immersed in the online learning community?	Online Syllabus Onsite Syllabus Field Notes Ex: Adaptations	Online Student Tasks Onsite Student Tasks Student Work/Online Student Work/Onsite	Products and Artifacts Field Notes and Collection of Correspondence
Would interactions and possible collaborations assist or hinder student inquiry, construction of knowledge, and development of competencies and reflective thought processes?	Field Notes Ex: Onsite Dialog Emails Ex: Online Dialog	Field Notes Ex: Onsite Seminars Discussion Forum Postings	Products and Artifacts Student-to-Student Interactions
What processes and preferences would emerge from the study that—when analyzed—would inform and improve practice for future online learning?	Coded Data Sets	Artifacts	Completed Assignments

Note: Data Sets were collected on a weekly basis throughout the semester.

Subjects consisted of both male and female students enrolled in online and onsite sections of the following courses:

1. *FOED 1110—Introduction to the Profession,*
2. *FOED 6850—Cultural Issues in Education, and*
3. *LS 5150—Books and Media for Children.*

In addition to curriculum examination, course designers—following guidelines offered by Palloff and Pratt (1999)—integrated the following components into each course:

- Focused outcomes and shared goals,
- Teamwork and a variety of collaborative learning tasks,
- Assignments to promote and encourage active learning and construction of knowledge,
- Facilitation, interaction, and a system for regular feedback.

Table 2. provides examples of online course components. Tables 3, 4, and 5 illustrate examples of curriculum adaptations made to a selected assignment in each course.

Table 2

Online Course Components

FOED 1110 **Introduction to the Profession**	**FOED 6850** **Cultural Issues in Education**	**LS 5150** **Books and Media for Children**
• Course Content Units (8)	• Discussion Boards:	• Online Lecture Notes/Slide Shows
• Course Handouts/Slide Shows	• General Class Discussion (1)	• Outside Readings/Online Articles
• Textbook Readings	• Special Topics Forums (6)	• Teleresearch as basis for definition of reading skills and strategies to attain skills
• Outside Readings/Online Articles	• Study Groups (5)	• Independent work
• Supplemental Books (2)	• Personal Journal (1/student)	• Collaborative work via discussion board
• Weekly Discussion Forums based on units of study and assessed with Online Forum Rubric	• Self-Portrait Pages (1/student)	• Two field experiences--Students interview a reading teacher and assess a student one-on-one
• Teleresearch Assignments which integrate unit content materials, current issues in education, and topics closely related to public school teaching	• Chat Rooms (5)	• Reading strategy charts
• Collaborative Assignments	• Textbook Readings (2)	• Genre with reading strategies in chart format
• Individual Mini-papers, Meta-Commentaries, and Projects	• Supplemental Autobiographical Lit (3)	• Reading teacher interview
• Onsite Teacher Interview conducted with a practitioner	• Novel (Adult)	• Reading assessment with a child and reflection on findings
• Lesson Plan and Materials	• Essay Collection (Young Adult)	
	• Vignettes Collection (Adolescent)	
	• Online Lecture Notes/Slide Shows	
	• Outside Readings/Online Articles	
	• Online Teleresearch/WebQuests	
	• Online Exhibitions, Museums	
	• Collaborative Group Research Project	
	• Ethnic Study	
	• Group Presentation	
	• Onsite Saturday Seminar	
	• Individual MC Unit Revision Project	
	• Lesson Plan and Materials	
	• Exhibition of Multicultural Units	
	• Individual Essays, Meta-Commentaries	
	• Personal Journal Reflections	

Table 3

Examples of Curriculum Adaptations—FOED 6850

FOED 6850 Interaction / Onsite	FOED 6850 Interaction / Online
• Self-Introduction (no discussion possible) • Personal e-mail person-to-person • Office Phone and Personal Conferencing • In-class Discussion of Topics • In-class Study Groups • Written responses to topics as assigned • Group Project / Common Theme • In-Class Presentation (15 minutes) • Communication between "teacher and SOME individual students" within class discussion • Individual Projects shared by exhibiting/displaying • Assigned Research Topics with written responses including bibliography handout shared in individual small groups within one class session with handouts	• "One Word" Activity/Responses –Discussion • Home Pages: Cultural/Teacher Self-Portraits • Discussion and Interaction via postings & email • WebCT email including electronic student lists • Online "chat" rooms and online office hours • General, Special, & Personal Discussion Bds • Study/Inquiry Group Discussion Boards • Study/Inquiry Research Project completed via Discussion Board and Chat Rooms • Group Project presented at end of semester • Projects "published" via online content module • Communication between "teacher and ALL students" via multiple modes • Individual project "published" and available for viewing by all • WebQuests and Online Exhibitions with individual meta-comment essays shared via Discussion Board Posting (abstract) of essays (attachments) with embedded hyperlinks to various websites, museums, archived information investigated

Table 4
Examples of Curriculum Adaptations—FOED 1110

FOED 1110 **Mini Lesson Assignment / Onsite**	**FOED 1110** **Mini Lesson Assignment / Online**

Assignment Components:
• A strong, attention-getting beginning – such as a video clip, pictures, props, costume
• Presentation of information regarding the selected topic
• Learner-Centered activity (for audience participation)
• Assessment strategy and closing statement
• Preparation: Lesson modeled by instructor as a means of providing an example and examination of online resources and examples.
• Presentation: Completed in Teams of 2
• Time: 7-10 minutes
• Evaluation/Assessment Tools:
  o Team Member Evaluation Rubric
  o Self-Evaluation Rubric
  o Assessed by Instructor using Rubric
• Interaction: Teams interact with instructor in selecting topics, designing lesson and materials. Remainder of class is not involved in planning or dialoging prior to presentation.
	Assignment Components:
	• A strong, attention-getting beginning – such as a video clip, pictures, props, costume
	• Presentation of information regarding the selected topic
	• Learner-Centered activity (for audience participation)
	• Assessment strategy and closing statement
	• Preparation: Examination of online resources. Topics posted to Discussion Forum and explored via dialog and discussion of relevancy to teaching.
	• Presentation: Completed individually – by sending materials to each other on a determined schedule. Viewed via Lesson Exchange
	• Evaluation/Assessment Tools:
	  o Peer and Self Evaluation Rubric
	  o Assessed by Instructor using Rubric
	• Interaction: Whole group interaction (student-to-student) in selecting topics, designing lesson and materials. Instructor-to-student interaction in selecting topics, designing lesson.

Table 5
Examples of Curriculum Adaptations – LS 5150

LS 5150 **Exploring Literacy / Onsite**	**LS 5150** **Exploring Literacy / Online**

• Classroom based oral and written instruction
• Students watch a video, participate in discussion, and do minor research via library resources or the web
• Modeling of Why Reading is Hard segment by instructor
• Students work in a face to face group during class for the post video viewing
• Whole group face to face discussion follows
• Two charts with literacy strategies required
• Answers to questions after video viewing; some are factual, most are reflective
• All parts must be typed and submitted in class
• Assessment is based on video elements and quality of strategies
	• Web based written instruction
	• Students must do intensive research via the web as background
	• Students work independently at first and then participate in discussion through web portal (asynchronous)
	• Two charts with literacy strategies required
	• Two field experiences—
	  o Students interview a reading teacher and
	  o assess a student one-on-one
	• All parts must be typed and submitted through the online course portal
	• Assessment is based on depth of reflection for field experiences and quality of strategies

Findings, Discussion, Reflections

Stevens-Long and Crowell (2002) offer insight into online learning when saying that computer-mediated learning presents one of the greatest opportunities and most important challenges ever faced by university professors. This challenge became quickly apparent by course instructors involved in the study due to several emerging patterns. Egon Guba (1978) describes qualitative research as a “discovery-oriented” process that minimizes investigator manipulation of data and setting and which places no prior constraints on what the outcomes of the research will be. Although the overarching questions were designed to examine how curriculum adaptations would assist and facilitate the process of knowledge construction, the course instructors did not anticipate the differences among students with regard to online v. onsite delivery. Clandinin and Connelly (2000) suggest that stories illustrate the importance of learning and thinking narratively as one frames research puzzles, enters the field of inquiry, and composes field texts. In order to provide a rich and thick description of what took place, the following findings have been organized according to the themes that emerged as the study progressed.

Utilizing the questions as a framework—data was collected, coded, and analyzed. In order to provide an overview of findings, one assignment was selected and compared. Findings gleaned from the data sets include:

<u>Overarching Question #1 – Curriculum Adaptations</u> – After examining both the online and onsite completed student tasks, artifacts, and products, two themes emerged as follows:

1. *Creativity v. Bland* - Online student overall project and lesson designs were more in-depth, creative, and student-centered than the onsite students. This was an interesting finding considering the fact that the online students received oral and written guidelines for each assignment and were given time in class to discuss expectations. In addition, instructors modeled lessons for onsite students—online students just examined text-based assignment guidelines and viewed slide shows. Students enrolled in the online version of the courses submitted assignments that in general were written in a more sophisticated voice, were more creative, and illustrated application of content and skills to a greater degree than the onsite students.

   Online students demonstrate a richer list of sources and use the sources to construct the required information. When asked, online students indicate that they have an expectation of spending 9-12 hours per week on class work. On ground students indicate that they expect to spend only 6 hours per week on the class (3 out of class hours and the 3 hours in class). On ground students use only the provided resources; their bibliographies do not show independent research.

   It seems that the opportunity for and ease with which content could be explored via website links motivated students to delve into activities and writings with greater enthusiasm and more motivation, thus producing exciting, informative, and extremely interesting products.

2. *Orientation to Technology* - Online students utilized technological skills to a greater degree when designing lessons and completing assignments. Although both online and onsite students were required to utilize technology as much as possible, findings indicate that the online students appeared to be more comfortable with technology and were operating at a higher level of technological literacy than the onsite students. On ground students view the web-basis as an optional component and will balk when required to use the course web portal.

   Specifically, as students became more at ease with online course navigation and utilization of WebCT course tools, they “relaxed” within the online learning environment and were able to profit from exposure to the technological aspects of the course in addition to course content. Examples include utilization of graphics, incorporation of web resources, presentation and materials design. In addition, since all communication on line must be communicated in a format other than oral verbalization, students were obligated to express themselves in written format. As a result, the art of writing was engaged in on a daily basis and the writing skills of the online students evidenced a better command of the written word than that of the onsite students. Examples include individual writing assignments, meta-commentaries, self-portraits, and personal journal entries.

3. *The Face-to-Face Dilemma* – As the semester progressed and data was collected, it was clear that the products and assignments submitted by the online students were clearly at a different level academically. With this knowledge, course instructors closely monitored onsite students—encouraging students to discuss assignments for clarity, incorporating group sessions during class time, and providing additional guidance.

   However, with all of the extra assistance, onsite student assignments did not improve to the degree of the online students. An interesting question to explore might be whether or not online students "get to know" classmates and instructors better within the online learning environment than do onsite learners within the "face-to-face" classroom settings. Further examination of a) differences in populations, b) age and gender differences, c) learning preferences, and d) online course adaptations and activities are needed to explore this emerging pattern.

<u>Overarching Question #2 – Interactions and Collaborations</u> – An analysis of field notes, forum postings, products and artifacts as well as email exchanges yielded the following findings:

1. *Collaboration and Dialog* – The exchange of ideas within the online environment was required and encouraged in the form of weekly Discussion Forum and Special Topic Discussion Board postings and emails among students as well as to instructors. The onsite students were required to engage in dedicated, focused Discussion Forums in the same manner as online students. Both were evaluated based on an online forum rubric developed by instructors.

   However, while most of the online students adhered to rubric guidelines (Example: Post initially and respond to peer postings throughout the week; Utilize and incorporate at least two outside sources to support your postings, etc.), onsite student postings were more superficial and "low-level" in terms of application of terms, skills, content, and content processing. On ground students rarely plan or prepare well for a discussion. They were less likely to adhere to the guidelines.

   Online student postings, however, illustrate content processing, application, and construction, elaboration, and explanation of knowledge and ideas. The Discussion Forums provided an avenue for discourse with peers in the online environment. For on ground students, the Forums were just one of many avenues for discourse; therefore, they were not viewed as that important—even though students received a grade for postings.

   Some discussion opportunities are suggested, but not required. The goal is peer support. Several problems emerged in the on ground class. Shallow discussion of topics occurred. An extrovert "talker" can take control direction of discussion and overwhelm others in the group. Students may lurk in the discussion board and not participate actively.

2. *Interaction with Instructor / each other* – Not surprising, the online students interacted individually with the instructor at a higher rate than the onsite students. The interactions in the form of emails and phone conversations took place on a daily basis. Even though

onsite students were given opportunities to interact with instructors, not all students interacted on an individual basis. Findings indicate that the interaction between the instructors and individual students assisted the students with clarification of assignments, formulation of ideas, and elaboration of opinions.

Although onsite students were given ample opportunities to interact with each other, students typically interacted at a "deep learning" level when required to do so. On the other hand, online students engaged in exchange of ideas via email to each other on a regular basis. Study groups were utilized at a high degree within the online environment, however, onsite students rarely sought out each other's assistance and/or advice within the classroom or via online chats and discussions. Fear of failure at having to make public statements of opinions and ideas is also a possible cause for the lack of in depth discussion by an on ground student. In the library science course, the instructor noted that the students who had the weakest postings were the same students who seemed unsure of their abilities to handle the online environment.

On ground students are comfortable with an isolated lecture / note format and do not think that a major portion of the course will consist of group work.

Overarching Question #3 – Processes and Preferences – After coding and organizing data sets, several processes and preferences emerged from the study. The processes and preferences that were gleaned from student assignments, coded data sets, and artifacts include:

1. *Active Involvement v. Stagnant Involvement* – An analysis of all data sets collected indicates that an interesting phenomenon was present and prevalent among the onsite students. With relation to active involvement, the online students were actively engaged to a high degree. The rate of interactions in terms of peer-to-peer interactions and student-to-instructor interactions occurred at a high level. Students enrolled in the online sections of each course engaged in conversations and interactions on a regular basis; silence is possible within an onsite learning environment but definitely not an option in the online learning environment. In many instances, the majority of students enrolled in the onsite sections remained silent and passive during class sessions as opposed to the daily interaction and communication between and among students and teachers within the online course sections. Information gleaned from data sets indicate that the thought processes of onsite students centered on "getting a grade," as the main focus. These thought processes differed greatly from the online students in that most of them engaged on a regular basis and took an active role in their own learning. Examples of evidence of these processes include: a) rate of engagement and interactions, b) working ahead on assignments, c) seeking out additional information, d) unsolicited feedback noting the benefits or more interaction with classmates and teachers, and d) sending inquired to instructors on a regular basis in order to gain additional information.

   On ground classes are bound by time and place constraints and students expect to meet ONLY within the allotted time/space—the "endure-it factor". Field experience assignments generate complaints and usually result in less than high quality work. Because online classes do not have specified time/space limits, field experience assignments are taken in stride. Students apply same standards for performance and are unwilling to submit less than their best work

2. *Work Habits and Preferences* – While most online students engaged actively—working ahead on units and adhering to deadlines, onsite students were less timely with regard to slack completion and submission of assignments. The majority of onsite students—even when given the opportunity to submit assignments early—did not capitalize on early

submissions and time management. Online students, however, regularly worked ahead of schedule allowing themselves time for revision, and they usually submitted assignments ahead of schedule and deadlines.

Conclusion

As university professors and instructors continue to adapt and redesign courses for the online environment, more and more are finding that—even with minor adaptations—online students differ greatly than their onsite counterparts. The broad ranges of learning styles and diversity represented by those students enrolling in online courses present greater challenges to instructors. However, one must not forget that the populations of students who enroll in the onsite versions of classes are becoming more and more diverse also.

In terms of curriculum development, findings gleaned from data sets collected indicate that there is additional inquiry that must be addressed in motivating those students who enroll in the onsite sections of typical university courses. Although onsite students and online students appear to differ in terms of engagement, work habits, preferences, and interactions—it seems that there is much work to be done with curriculum development that would yield better results with onsite students. If the online environment is one that draws a more “serious, professional and dedicated” student, then where does that leave onsite teaching? The process of constructing knowledge requires scaffolding, modeling, and coaching. Although the onsite students were provided opportunities for all of these, findings show that these things alone did not enable the onsite students to truly internalize new knowledge and construct new knowledge in different and new situations.

For those who are about to embark on the journey of online teaching, there are challenges that must be realized. First, the course designer and instructor must acknowledge that curriculum changes and adaptations must be made in order for the online student to acquire and apply new information. Second, multiple opportunities for interaction and multiple configurations for collaboration must be integrated into the course. For those instructors and course developers who continue to teach onsite, traditional courses, much can be learned from the online environment. Onsite students must be encouraged to interact and to become active learners in acquiring and constructing knowledge. Second, onsite students need additional motivation and opportunities to take part in real-world simulation and application of meaningful content acquisition. Last, both onsite and online students must be empowered to take responsibility for their own learning so that they too become the coaches and scaffolds to others. Perhaps the most important information gleaned from this study may be that university professors continue to model effective practices in order to encourage and foster the construction of knowledge and the development of lifelong learners.

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Editor's Note: This is results of a two-year study to investigate the influence of distance learning activities in eighth-grade language arts classrooms on student attitudes. Technology was used to build *unique* learning relationships in an information rich learning environment. The project developed cognitive and affective learning and targeted higher-order thinking skills for *Macbeth* and *A Separate Peace.*

Improving Attitudes of Eighth-Grade Students toward Language Arts Education through Distance Learning Projects

Christopher H. Tienken and Scott Sarraiocco

Abstract

Self-concept plays a role in student attitudes because student expectations and attitudes toward learning are related to self-concept. If a student views himself as a successful learner and believes others see him that way, he is more likely to persevere and attempt to engage in deeper learning and understanding of content. This article presents the results of a two-year study conducted to investigate the influence of distance learning projects on the attitudes of eighth-grade students toward learning in language arts class. A description of the distance learning projects is provided. The aggregate posttest mean score for the students' attitudes toward working with others, learning new language arts content, and using technology in the classroom environment showed statistically significant ($p \leq .008$) improvement by the end of project.

Keywords: Distance learning, distance education, student attitudes, technology infusion, informating, automating, special education, educational technology, student empowerment.

Introduction

Technology and its impact on student achievement are popular issues in the current education environment. In the United States, K-12 spending on technology exceeded seven billion dollars during the 2003-2004 school year. School districts spend thousands of dollars each year purchasing new hardware and software and school boards of education want results. Because few replicable empirical studies exist demonstrating the link between technology use in the classroom and student achievement, district leaders must proceed with a clear plan and model for implementation to ensure effective and efficient use of resources.

This article presents: a) The influence of implementing technology infused projects in a middle school classroom on student attitudes toward learning, b) the underlying concept for the way technology was used in the classroom during the study, and c) explanation of the projects implemented.

Underlying Concept for Technology Utilization

November (2001) wrote that it was unlikely that technology will improve learning without a specific plan for its use and without skilled teachers assisting students to go beyond traditional expectations of achievement. Yet district leaders across the United States continue to invest taxpayer dollars on hardware and software without a strategic plan for their use.

Automating, and informating (Zuboff, 1988; November 2001) are examples of uses for technology in education settings. The aim of using technology to automate is to help teachers and students accomplish their basic tasks more efficiently. Electronic grade-books and attendance systems represent examples of technology used to automate work. Typing a term paper using word-processing software is an example of one way students use technology to automate. Simply stated, automating encompasses using technology as a work tool instead of a learning tool, communication tool, or empowering tool. November (2001) stated, "When an organization automates, the work remains the same, the locus of control remains the same, and the relationships remain the same." (p.xix).

Aims of informating are to impact student achievement and shift the locus of control from teacher-centered to student-centered. Teachers use technology in an infor-mated environment to: (a) Empower students by teaching them how to access high quality, and primary source information, (b) build unique learning relationships with other classes, teachers, and schools around the world, (c) help students become information connoisseurs and learn to manage the large amount of information they encounter everyday, and (d) increase their learning capacity.

Others in the field identified similar uses for technology and computers. Taylor (1980) grouped computer use by schools into three categories: a) Tutor, b) tool, and c) tutee. When used as a tutor, the computer functions like a surrogate teacher. The most common example of this is math computation software. Students solve problem after problem in drill and practice mode. When students use the computer as a tool it executes the tasks assigned by the student. Computer programming is an example of the computer in the tutee role. Means (1994) identified four categories of educational technology use: a) As a tutor, b) to explore, c) as a tool, and d) to communicate. Bruce and Levin (1997) built upon prior research and Dewey's (1943) ideas and created four categories of educational technology use as media for: a) Inquiry, b) communication, c) construction, and d) expression. When compared to Taylor's (1980) ideas, one can see the progression from teacher-centered, passive use of technology to student-centered and active engagement.

During this study, teachers and students used technology in the learning environment in two ways: a) communication for educational relationship building and b) empowering students to take ownership of their learning.

Informating and Student Attitudes

Student attitudes towards school, teachers, peers, and the subject matter have an impact on learning outcomes (Hoy & Forsyth, 1986). In fact, there is a connection between student attitudes toward teachers, peers, and school to learning subject matter. The awareness of these connections is not new. Over 70 years ago it was accepted that attitudes produced from social situations and interactions with peers impact student motivation to learn specific subject matter (Waller, 1932). Positive social interactions in the school setting can produce attitudes toward subject matter that help students personalize learning.

Self-concept plays a role in student attitudes because student expectations and attitudes toward learning are related to self-concept. If a student views himself as a successful learner and believes others see him that way, he is more likely to persevere and attempt to engage in deeper learning and understanding of content. Teachers can foster positive self-concept and attitudes by decreasing negative competition, structuring positive learning relationships, and increasing opportunities for students to excel (Shavelson, et al., 1976).

The ideas embedded in informating promote positive attitudes and improved self-concept. The Information management aspect of informating implies that students can control parts of the learning sequence. They have choices and can exercise independent thought. Building learning relationships creates social situations and fosters communication with peers and teachers in which students investigate and learn subject matter together. The third facet of informating is autonomy. Autonomy as fostered in an informated learning environment is based on empowering students to take responsibility for their learning, shifting the locus of control from teacher to student.

Methodology

The project took place over a two-year period and was conducted to investigate the influence of informating, in a ongoing education environment (the classroom), on regular and special education eighth-grade student attitudes toward: a) Learning unfamiliar language arts content, b) using technology as a learning tool, and c) learning with academically diverse students.

Participants

Participants were students and teachers from intact classes. There was no attempt to randomize selection as this was a study conducted "on the ground" in an ongoing, real-life education setting.

The two-year project included two eighth-grade teachers and 44 students from a middle school in New Jersey, USA. One teacher taught students in the school's Gifted and Talented program and the second teacher taught in the special education program. During the 2001-2002 school-year two teachers and 22 students participated; 15 students from the eighth-grade gifted and talented class and 7 eighth-grade language arts special education students. During the 2002-2003 school year the same teachers and 22 new students participated. There were 15 students from the eighth-grade gifted and talented class and 7 eighth-grade language arts special education students.

Context

The gifted and talented and special education classes learned together, in the same room during the study. The teachers facilitated structured and deliberate interactions among the diverse group of learners to help dispel stereotypes and ignorance caused by labeling. The gifted and talented and special education language arts classes traditionally did not work together in this school. They have different curricula and program goals. For this project the teachers combined the classes for instruction an average of one 45-minute period a day for approximately four weeks to instruct the students and develop a working relationship.

All special education students who participated read at least two years below grade level and met criteria based on standardized test scores and other measures used by the school district's special education child study team. Students in the gifted and talented class met or exceeded district criteria for placement into the class. Criteria included: a) Scores exceeding two standard deviations above the mean on the verbal and non-verbal portions of the commercially prepared Test of Cognitive Abilities, b) superior writing ability as measured by pre and posttest writing assessments, and c) four consecutive marking periods of exemplary grades in all subject areas. Table 1 contains descriptions of each class during the two-year study.

Table 1

Class characteristics during 2001-2002 (A) and 2002-2003 (B) school years

Teacher	*Years*		*# G/T*		*# Spec. Ed.*					
ID	Teaching		in class		in class		Male		Female	
	A	B	A	B	A	B	A	B	A	B
1	7	8	15	15	0	0	7	5	8	10
2	3	4	0	0	7*	7	5	5	2	2
Total							**12**	**10**	**10**	**12**

Note:* One special education student was also limited English proficient as Spanish was the student's primary language. A= 2001-2002 B= 2002-2003

Total Class Size was N = 22 for Each Year's Project

The first project, conducted during the 2001-2002 school-year, was called *Shakespeare on Trial*. Teachers used technology as an informating tool (Zuboff,1988) to facilitate students' access to high quality information and to build critical learning relationships within and outside of the school. The project targeted the needs of learning disabled, emotionally disturbed, limited English proficient, and gifted and talented students. The diverse group of middle-school students worked cooperatively to study the works of Shakespeare. Specifically, they studied Macbeth. The students interacted via distance learning with 10^{th} grade students in an Advanced Placement (AP) class from a neighboring school district. The groups conducted a videoconference trial of Shakespeare's *Lady Macbeth* as a culminating activity.

The students read *Macbeth* and learned about the trial process prior to conducting a three-day videoconference trial. Students assumed the roles of the prosecution team, witnesses, and members of a jury. Students conducted organized Internet searches to gather information. The teachers taught the students how to analyze websites and web addresses to determine fact from fiction and quality information from disinformation.

The class conducted a series four videoconference sessions with Shakespeare's Globe Theater in London, England as one method of learning about Shakespearian literature. The Globe Theater is world renowned for its productions of Shakespeare's works. The education director of the theater provided lessons on interpreting *Macbeth* and other works by Shakespeare. The students, under the direction of the Globe Theater's education director and the classroom teachers, conducted character and plot analyses. The students studied how the characters' traits and actions impacted the plot and outcomes.

The same eighth-grade teachers repeated the project during the 2002-2003 school using the book, *A Separate Peace*, by John Knowles. They followed the same format and time-line.

Data Collection

The teachers created surveys to gather data on students' attitudes in three areas. Students responded to 20 questions using a 5-point Likert scale with 1 indicating a strong negative response and 5 indicating a strong positive response (See Appendix A). A survey was given prior to the teachers telling the students about the project (pre) and again at the conclusion (post). These students never participated in a videoconference session prior to this project and they were unfamiliar with the videoconference process.

Data Analysis

A two-tailed, paired-samples t-test was conducted to compare the means from the pre and post-project survey results. A two-tailed t-test was used because little replicable, empirical research demonstrating positive impacts of technology use on student attitudes is available.

Results

2001-2002 School Year

The means of the total score for the students' attitudes showed statistically significant ($p \leq .008$) improvement in all three areas of the survey by the end of project. The mean for the pre-test survey was 72.55 and the mean for the post-test survey was 92.36. There were 100 points possible for each survey. Table 2 shows the student scores and Table 3 summarizes the results.

Table 2

Individual Student Scores on 2001-2002 (A) & 2002-2003 (B) Pre and Posttest Surveys

ID	*Pre Score*		*Post Score*		*ID*	*Pre Score*		*Post Score*	
	A	B	A	B		A	B	A	B
1	80	63	95	76	12	77	78	94	90
2	63	70	88	79	13	78	77	91	90
3	72	76	90	81	14	77	82	93	92
4	58	88	89	83	15	76	69	93	94
5	88	76	96	84	16	74	73	92	94
6	59	75	79	87	17	68	70	95	94
7	72	71	98	88	18	82	79	90	95
8	73	69	88	88	19	64	75	88	95
9	70	80	89	89	20	73	75	95	95
10	75	81	90	90	21	71	68	83	96
11	76	78	90	90	22	70	82	82	96

Note: 100 points possible. Scale 0-100.

Table 3

Aggregate Results from the 2001-2002 Pre and Post-Project Surveys

Survey	***N***	***Mean***	***SD***	***Sig.***	***Gain***
Pre	22	72.55	7.18		
Post	22	92.36	4.68	.008	+19.81

Note: All three sections are included in the results.
100 possible points from three sections.

Scores for the individual sections of the 2001-2002 survey indicated statistically significant growth ($p \leq .000$). Significance levels were calculated for the mean scores of each section on the pre and post-project surveys. There were 35 points available for the Social section, 40 points for the Content section, and 25 points for the Technology section of the survey. The total points available were 100. Table 4 summarizes the results.

Table 4

Results for the Individual Sections of 2001-2002 Pre And Post-Project Survey

Section	*N*	*Mean*	*Mean per Response*	*SD*	*Sig.*	*Gain*
Social Pre	22	23.82	3.40	4.82		
Social Post	22	31.09	4.44	3.37	.000	+7.27
Content Pre	22	29.91	3.73	3.29		
Content Post	22	36.45	4.55	2.32	.000	+6.54
Technology Pre	22	18.82	3.76	2.79		
Technology Post	22	22.82	4.56	1.82	.000	+4.00

Note: 35 points possible for 7 questions from the Social section
40 points possible for 8 questions from the Content section
25 points possible for 5 questions from Technology section.

2002-2003 School Year

The students' attitudes overall showed statistically significant ($p \leq .000$) improvement. The mean for the pre-test was 75.23 and the mean for the post-test was 89.36. Table 5 shows the individual student scores and Table 6 summarizes the results.

The scores for the individual sections of the 2002-2003 survey indicated statistically significant growth ($p \leq .019$).

Table 5

Aggregate results of pre and posttest surveys for the 2002-2003 project

Survey	*N*	*Mean*	*SD*	*Sig.*	*Gain*
Pre	22	75.23	5.78		
Post	22	89.36	5.74	.000	+14.13

Note: All three sections are included in the results.
100 possible points from three sections.

Table 6

Individual Section Pre- and Post-Project Survey Results for 2002-2003

Section	*N*	*Mean*	*Average per response*	*SD*	*Sig.*	*Gain*
Social Pre	22	23.32	3.31	4.72		
Social Post	22	31.55	4.50	3.51	.000	+8.23
Content Pre	22	30.36	3.79	4.66		
Content Post	22	34.09	4.26	2.88	.019	+3.73
Technology Pre	22	21.55	4.31	2.94		
Technology Post	22	23.73	4.76	1.70	.004	+2.18

Note: 35 points possible for 7 questions from the Social section
40 points possible for 8 questions from the Content section
25 points possible for 5 questions from Technology section.

Conclusions

The multi-faceted project emphasized the development of the cognitive and affective domains. Teachers created technology enriched activities targeted at higher-order thinking skills (Bloom, 1956). They used complex literary works, *Macbeth* and *A Separate Peace*, combined with technology integration via videoconferencing and accessing the Internet to motivate students to analyze texts and apply knowledge.

Just as technology played a meaningful role in the project, combining classes for instruction had a real-life purpose for the students. The diverse group of students learned and worked together toward a common goal. Technology facilitated communication among the middle schools and between the students, high school students, and the Globe Theater.

The technology infused projects had a positive impact on student attitudes toward: a) The subject area of reading and the content of the particular literature class, b) peer relationships with unfamiliar and academically diverse students, and c) working in a technology rich environment. All measures showed statistically significant positive differences ($p \leq .05$) between the pre and post-project surveys. Some measures showed significance at the $p \leq .000$ level. Using technology as an informating tool can improve students' attitudes toward learning, peers, and technology use.

So What?

The ideas embedded in the informating model are congruent to ideas that would improve student attitudes toward learning content and interacting with diverse peers. Students used technology to informate when they strategically searched for, created, shared, and managed knowledge and skills on their own terms. November (2001) stated, "Informating requires thinking about opportunities that could not be achieved without the technology." (p.xxii) In an informated learning environment students can create instead of just imitate. They can become persistent learners. Those who traditionally did not have access or control, the students, were more empowered during this project.

Could student attitudes improved without using technology? Possibly, but what would that project have involved? Would the students have been able to interact rapidly with international experts in the field of Shakespearian literature without the technology? No. Technology was used to build *unique* learning relationships. Would the students been able to conduct autonomous research on Shakespearian characters, plan defense strategies, and prep witnesses without technology? Sure, but they would not have had access to the same amount of information easily without using technology. Would they have been able to access the same quality information easily? No. Would students have the same sense of empowerment without the technology? Considering the scope and reach of the project: No.

Summary

Using technology to informate instead of automate made a positive difference in the learning experiences of the students. The students responded positively and the survey results supported the conclusion. It is important to note the difference between informating and simply placing computers in classrooms and hoping something happens. Schools and teachers must plan comprehensive learning sequences and lessons to create an informated environment. Technology can be an effective tool to inspire students and expand learning horizons. The opportunities are limited only by one's creativity and persistence. The project continues today and was recognized as a Best Practice by the New Jersey Department of Education in 2003.

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APPENDIX A

Survey

Attitude Toward Language Arts/Reading Content

1. I am motivated to read and think in language arts class?
2. I like to read outside of school.
3. I gain valuable information from novels assigned in language arts class?
4. Knowledge of details and characters is critical to successfully understand a story?
5. Guest speakers who speak to our class about literature related topics get me interested in reading.
6. I learn valuable information from guest speakers that help me understand the literature I am reading?
7. It is important to understand the underlying content or subject matter of a story.
8. I possess an understanding of Shakespeare's Macbeth.

Attitudes Toward Students Different from Themselves

1. I work with students who have diverse learning styles and abilities often.
2. I feel comfortable collaborating with students who have different learning styles and abilities?
3. I think working in mixed ability groups is productive.
4. I am not apprehensive about interacting with older or younger students.
5. I enjoy performing/speaking in front of students I do not know.
6. I find it easy to verbally communicate with other students who are not like me.
7. I think conducting collaborative projects will help me better understand students who are different from me.

Attitudes toward technology

1. I am familiar with the distance-learning/videoconferencing lab.
2. I am comfortable working in the distance-learning/videoconferencing lab.
3. I think it is important to incorporate videoconference experiences into language arts and reading lessons.
4. I think it is important to use the internet to conduct research.
5. I frequently use the Internet for research.

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Editor's Note: This theme will be repeated as other aspects of online learning come under scrutiny. We know enough at this point to optimize quality in design and delivery. Quality of course content is more difficult to define and measure.

Key Aspects Affecting Students' Perception Regarding the Instructional Quality of Online and Web Based Courses

Terry Kidd

Abstract

This study assessed the perceptions of college students regarding the instructional quality of online and web based courses via WebCT. The results showed an overall positive perceptions regarding the instructional quality of online courses delivered via WebCT (M = 2.63, SD = 0.87). The mean obtained for students' perceptions regarding the instructional quality items ranged from 2.45 to 2.86. The visual appeal of website material received the highest rating (M = 2.86). Clarity and purpose in introduction to content components earned the lowest ratings (M = 2.45). These results were closely correlated to students' responses regarding the important aspects of instructional quality of online courses. The most important aspect indicated by students was the idea of "clear instruction." The results of the study also indicated other perceived aspects that affect students' views of the instructional quality of an online course, including interaction, design, convenience, feedback, and usability.

Keywords: World Wide Web, Online Courses, Multimedia, Student, Teaching, Learning, Distance Education, Instructional Quality, Content Management Systems, Instructional Design, Technology and Learning, Design, Web Based Learning, Assessment, Course Design

Introduction

Online and web based courses have become popular with both students and educational institutions as the new mediums to deliver educational programs. For universities, they are an excellent way to reach students in diverse and distant locations. Some may also be used to supplement school enrollments since students can take the courses anywhere. Given their popularity and increased use, it is imperative that administrators and professors monitor students' perceptions of courses using these mediums for delivery. This type of feedback can help in modifying and improving the programs, so that course can function as desired by all parties.

Literature Review

A thorough analysis of major research related to students' perception of online courses uncovered important factors that are involved in determining students' satisfaction of online courses (Anderson & Joerg, 1996; Cedefop, 2002; Hara & Kling, 2000; Polloff & Pratt, 2001). The literature indicates that students' perceptions of online vary, but overall are positive (Daugherty & Funke, 1998; Morss, 1999; Polloff & Pratt, 2001). The top reasons for taking online courses were flexibility, convenience, and learning enhancement. Students could "attend" their online courses at any time and from anywhere. Convenient features of online courses include economy of travel, comfort, and family environment. Under learning enhancement, participants ranked technology factors and comprehension as the top reasons (Polloff & Pratt, 2001). The disadvantages of online courses were related to technology and isolation. Technology issues related to poor video quality and complaints about transmission delay over the Internet. As for isolation, students voiced the lacked opportunities for informal socialization with instructors and other students.

With regard to the interaction, participants rated interpersonal contact and self-monitoring of individual progress as the most highly rated indicators, followed by timely responses from instructors. Although indicators existed in each of the interaction areas, self-regulating learning and timely feedback from the instructor were reported as most valued by participants. Polloff and Pratt (2001) found that students are most satisfied with courses in which the instructors facilitate frequent contact between themselves and students, use active learning techniques, convey high expectations, emphasize of time spent on specific tasks, and provide prompt feedback.

According to Anderson and Joerg (1996), students perceived online courses as a valuable delivery tool, and they reported that online courses changed the dynamics of access to class materials toany time from different locations. Students perceived online courses as a valuable educational improvement, according to one study (Anderson & Joerg, 1996). However, students hesitated to enroll in online courses due to problems associated with Internet access and ongoing questions related to the advantage of the technology. Students were also concerned about spending time on external Web sites. According to Cedefop (2002), online instructors tended to rely on external sources for materials or content that did not necessarily reflect the instructional standards of the course.

Web design issues are of concerned to students as Polloff and Pratt's study (2001) indicated that students were moderately satisfied with the Web design of online courses. If students are not satisfied with the design of the course website, they may have negative perceptions of the effectiveness their online courses (Brush, 2001). As reviewed in the literature, Khan (1997) defined and explained Web Based Instructional (WBI) environments by providing two distinct classifications - components and features. According to Khan (1997), components are integral parts of the Web, such as instructional design, multimedia, graphics, text, video, audio streaming, and asynchronous/synchronous communication modes. The findings indicated that these components of Web Based Instruction (WBI) contribute to the students' perceptions for online courses. Multimedia elements, if designed properly, could have a positive impact on student achievement and the learning process (Ryan & Kasturi, 2002).

Chickering and Ehrmann's (1996) proposed several principles of good learning and practices for online courses. The first principle of good practice encourages interaction between students and faculty. The students perceived the interactive course environment and frequent discussion as conducive to learning in online courses (Jiang, 1998). In fact, students identified more opportunities to interact with their instructors and peers as one of the main benefits of the online courses (Holmes, 2000). However, if interaction was not available, students became frustrated and unsatisfied with the course. According to Hara and Kling (2000), students' frustrations with online courses originated from two sources: technological problems and pedagogical issues. Technological problems included students' difficulty in obtaining technical support. Access to technical support was crucial to students' perceptions of their online course. The second principle of good practice encourages cooperation among students. Working together with other students increases involvement in learning and deepens understanding (Chickering & Ehrmann, 1996). A third principle or good practice is prompt feedback. Although many aspects contribute to effective online instruction, prompt feedback consistently emerges as a powerful tool to promote student learning (Holmes's 2000 and Polloff and Pratt's 2001).

Although studies have investigated student's perceptions of online courses, none have assessed the instructional quality of online courses. All online courses are not necessarily equal in terms of efficacy in delivery the course content. While most faculty assume that their online courses are good, this may not be the same assumption from the students' view. Little research has identified the factors that students use to form quality perceptions. Yet this is important due to the fact that, perception could have long term implications to school programs given that online and web based delivery programs will continue to grow in the future.

The purpose of this study is to identify the factors that affect students' perception of the instructional quality of online and web based courses. This will lead to the development and implementation of innovative strategies to promote quality teaching and student learning via the online and web based mediums.

Design Methodology & Approach

For this study, a web-based course was developed where students were taught to use specific instructional technology tools to solve education-related problems in local schools districts. The mode of learning was geared towards a student-centered, constructivist learning perspective where students were active learners, worked in a group environment and constructed knowledge and understanding in their learning process. At the end of the course, a survey was given to the students to assess their perceptions towards this learning environment along with the factors that affect the instructional quality of the online courses. A total of 291 students were enrolled in the classes and 89% completed the survey instrument. Students were encouraged to be truthful in completing the survey and were assured that their grades would not be affected based on their responses.

Findings

Students Perceptions of Online Learning

Overall perceptions: The results from this study indicated an overall positive response regarding the instructional quality of online courses delivered via WebCT (M = 2.63). The visual appeal of online courses received the highest perception ratings of instructional quality (M = 2.86), followed by the tasteful use of colors for online courses (M = 2.79). The results indicated that students had high ranking of visual design of the website for the instructional quality of online courses, and they perceived that the visual display of content was an important factor that affected their view of online courses. Visual appeal of online courses may not seem to be critical to students' learning of the content of the course (Brush, 2001), but this study shows that it this factor affects the students' level of interest and desire to use the site to obtain information. For the important aspects of instructional quality of online courses, several students identified the use of color in their online courses. They indicated that "the colors on the website were not chosen in a professional and easily readable manner." Instructors are thus faced with the challenge of creating a functional and aesthetically pleasing website and they are responsible for the presentation of their online courses.

Perception of Web Design: Although respondents were satisfied with the web design of this course, many are not satisfied with the web design of most web based courses in general. Fifty-two percent of students answered they were satisfied with the Web design of online courses. However, nearly half of students (46%) were not satisfied with the Web design of online courses in general. It is possible that instructors who use WebCT for their courses may not incorporate good design aspects for their online courses.

Factors Related to Instructional Quality: Approximately 15% of the students indicated that good web design of their online courses was important. This was the third-highest-ranking aspect of instructional quality. The results of this study confirmed that instructors need to take into consideration the architecture and user interface of an online course's site (Brush, 2001). The site architecture determines the ease with which students can locate desired information. Brush (2001) emphasized that the site architecture establishes the sequence of the course, the organization of the information, the order of procedures that should be followed, and supplementary resources for students. From the study conducted by the research team, one student commented as follows: "The organization of materials is most important to me so that I can easily find what I need and see what is important." Others said that the "layout and presentation of material" helped them "coordinate class material." When a class Web site has poor site architecture, students become frustrated with their inability to locate the necessary information and navigate the site (Brush, 2001). Students who were confused and frustrated by their attempts to move from page to page would likely give up on the use of the Web site to locate desired information. This may lead to negative perceptions toward online courses. As one respondent indicated said, "The organization of the class Web site is not streamlined, very busy and cluttered."

This study showed that the interface navigation scheme of the Web site should also be considered in online courses. Interface design influences students' focus on learning and their ability to obtain the necessary course information. When students can utilize the interface to navigate from one section of the site to another without too many distractions, the user interface design is effective. Approximate 73 % students listed easy site navigation as an important aspect of online courses. "Easy of navigation through the site is an important aspect of online courses," and "It was easy to navigate through the site."

Nearly half of students (47%) reported that they understand course material better when their online courses use multimedia components to represent the information. Regarding the important aspects of online courses, a student from the study the research team conducted commented that "animation helped me a lot to understand the concepts of this course." The idea is that if multimedia is not designed properly, it can have a negative impact. The results from the research study revealed that the time spent on downloading course was a factor that should be considered in the online course as well.

This study found that the links to new sections of the course should be clearly related to course objectives. Fifty-one percent of students were not satisfied with clarity of objectives in new sections. Study findings indicated that many instructors were not considering certain factors such as the objectives of the course and the objectives of each individual lesson when designing online courses. Clearly stated objectives (or the lack of them) affect students' perceptions regarding online courses, the results showed. The results were closely correlated with student responses regarding the important aspects of instructional quality of online courses, such as clear instruction, interaction, design, convenience, feedback, and usability. According to the research conducted in this study, nearly 86% of students responded that the most important aspect of instructional quality of online course was "clear instruction."

Instructional Design Model. The clarity and ordering of online documents in relation to course content, according to the Instructional Design Model (IDM), increased the students' sense of connection with the course (Dick, Carey, & Carey, 2001). Dick et al. (2001) identified a systematic process of designing instruction that ensures the quality of knowledge transferred from an instructor to a learner in their model. The findings from this study provided empirical evidence for the Instructional Design Model (IDM). The results of this study indicated that instructors should incorporate an instructional design model in their online courses because the model enables learners to learn effectively and to engage in activities that promote practice. Twenty-two percent of students in this study perceived clear instruction as the most important aspect in their online learning experiences. The result indicated that clear instruction is an instructional design issue, as commented by one student who valued "clear, concise, and detailed directions." Students called for "order and clarity of instructions," and "letting students know the due dates, where to read, which chapter is on the exam." If the instructions were not clear, students "didn't know what each assignment was worth," "didn't know how the final grade was computed"or even"felt lost the entire semester." Students' responses in this study indicated that clear instruction directly affects their learning, their understanding of content materials, and their participation in online learning activities.

Principles of Good Learning and Practice. The findings support Chickering and Ehrmann's (1996) principles of good learning and practices for online courses. The first principle of good practice encourages interaction between students and faculty. Online communication components such as e-mail, discussion boards, chat, and whiteboards available within the course management system (CMS) provide more opportunities for students and faculty members to interact and communicate online compared to traditional face-to-face instruction in the classroom. Interaction was the second most important aspect of instructional quality of online courses in this study (21%). Student comments from this study were as followed: "communication from the professor is key," and "the message board and e-mail on WebCT help students and professors to communicate with each other." One respondent cited "frequent interaction with instructor," as a positive aspect. When students interacted with instructors frequently, they felt that "the online course was very successful," "the instructor was helpful to all students," and "[they] learned a lot from the teacher."

The second principle of good practice encourages cooperation among students. Another good practice is prompt feedback. Students in this study (29%) stated that timely responses from peers and from their instructors were important factors in determining the instructional quality of online courses. The results support study that students have positive perceptions of online courses when the instructors facilitate frequent contact between themselves and students, use active learning techniques, convey high expectations, emphasize time on task, and provide prompt feedback.

*Major Reasons for Taking Online Courses***.** Previous research mentioned flexibility, convenience, and accessibility and learning enhancement were the top reasons for taking online courses. Results of this study indicated that 12% of the respondents perceived "convenience" as an important aspect, especially for "students who are very busy and may not have the time to get to campus to attend class." Students felt that the convenience that online courses provide made them able to "access to material 24 hours a day," view "their assignment outside the classroom," and "attend class without leaving work or home," as well as "visit their course more often than they are able to sit in a class." The course offered "flexibility of work." This study concluded that convenience is a vital aspect of the online course. In this study, 62 % reported that ease of use of WebCT was an important aspect in their learning. Six percent of students reported that "the old version of WebCT is easy to use," and "the older version of WebCT was clear and straightforward. Students' negative perceptions of online courses were often based on computer access (McMahon et al., 1999). Students who did not have computers at home were often vexed by the additional time required to visit a computer lab and by the lack of convenience. Though computer access was an important issue at that time, in this study, only 15% of students reported accessibility to class material as an important aspect of instructional quality. Other aspects reported from the results included the availability of instructors, the quality of content, and the personality of the instructor.

Conclusions and Implications

The findings of the report show that students found that the navigation, design of instruction, time needed to download materials, web design aesthetics, and accessibility of the course information, were all important factors that affected the instructional quality of online and web based course. The student also revealed that the web-based learning environment would allowed them to be more active participants in their learning process, increasing their critical and creative thinking skills as well as improving their problem-solving skills, if the aspects that affect the instructional quality of the online course were taken into consideration and implemented. They also revealed that by adhering to the instructional design process and the effective design of the course website, they could learn to develop learning skills such as communication, teamwork, collaboration and time management, which would assist them in achieving ownership of the course learning outcomes, but also master the online web based course environment. The use of online and web-based tools for their online courses allowed them to be innovative in their course work, making their learning experience valuable and rewarding. On the practical side, this research provides instructional designer, educators, and trainers with the necessary information on the aspects that affect the instructional quality of online and web based courses as well as innovative approaches to teaching with technology.

As a whole, the results obtained in this project were positive and encouraging. Students in general enjoy the online and web based learning environment, but nevertheless were eagared to indicate the critical factors that affect the instructional quality of online courses. The research examined in this study provides educators with the relevant factors to the instructional quality and over all success of the student learning outcomes via online and web based courses. This method of course design and learning engages students actively in participating in their own learning process, thus leading to the promotion of quality teaching and student learning for a more consistent and dynamic web based educational learning environment.

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Editor's Note: Norma Scagnoli examines the impact of technology on the educational process and finds the traditional classroom is lagging behind other sectors of society such as business, communications and entertainment. This may present a threat to higher education as the center of knowledge creation.

Impact of Online Education on Traditional Campus-Based Education

Norma Scagnoli

Abstract

The use of the Internet has produced a great transformation on people's lives and on the way that people do things. And although the changes brought about by the use of the Internet have not transformed campus teaching and learning at the same speed as they have transformed everyday life, there is no doubt that it is gradually producing an impact in campus-based education. This impact is especially noticeable in three aspects: access, the definition of classroom space and the implementation of practices that were unusual for place-based education. This paper relies on the literature and expands on those aspects, and on the implications of introducing online learning in the traditional classroom and how it affects the people (teacher and learner), the processes (teaching and learning), and the organizations involved.

Introduction

The use of the Internet has had an impact on people's lives and on the way that people do things. It has produced a great transformation in commerce, entertainment, personal communications, learning, and socialization (Ayers, 2004; Ayers & Grisham, 2003; Bates & Poole, 2003; Hsu, 2002; Spector & Teja, 2001). Many everyday things are done differently and referred to differently because of the Internet. If people need to find information about something, they can "google" it; to buy or sell anything, people use "e-bay"; people don't commute to work, they "telecommute"; colleagues or people with similar interests can "meet in a virtual chatroom." New friends are made over the Web, and single people get into matchmaking Web sites to find a date or a mate; prescription drugs, greeting cards, birthday presents, even flowers can be purchased or delivered online. People go to college without ever physically attending a university campus, pay bills online, and manage their bank accounts without stepping into a bank.

This impact is also affecting university campuses. The use of new information technologies has had an impact on faculty life and work, it has "transformed the research and scholarship component of faculty life by easing the process of collegial communication and collaboration"(Baldwin, 1998, p. 11). Through the Web, faculty can check out books from the library, look at the roster of students, and verify that their paychecks have been posted. Technology has become a commodity, and higher education students and professors take it for granted (Ayers & Grisham, 2003; Baldwin, 1998). It would be rare to find a university in the U.S. that has no Internet connection and reasonable technology infrastructure. However, the use of the Internet in classroom teaching is not as widespread as the use of the Internet for information, entertainment, communication, and research.

Impact on campus-based education

Although the changes brought about by the use of the Internet have not transformed campus teaching and learning at the same speed as they have transformed everyday life, there is no doubt that it is gradually producing an impact in campus-based education. Because this transformation is under way, the eventual outcome is still to be seen, however, it is not too soon to talk about the effects of online learning on the traditional campus based education.

The impact is especially noticeable in three aspects: access, the definition of classroom space and the implementation of practices that were unusual for placed-based education.

The first impact that online learning produces in the traditional classroom is *immediate access* to facts, information, people, services, and live events (Barab, Thomas, & Merrill, 2001;Bates & Poole, 2003; Gillespie, 1998; Harasim, 1990; Paloff & Pratt, 2001). Face-to-face classes can use thousands of educational resources that are available on the Web. Access to information is not limited to class materials, and access to class materials is no longer limited to the class time or to the physical space of the classroom. Online communications facilitate access to the instructor, the students, support staff or administrators, and the class is open twenty-four hours a day. This immediate access has had an impact in campus students' retention and learning achievement. Virginia Tech, for example, was faced with the high drop out rates in first and second year math, caused by problems in transfer of learning. The Math Department created "The Math Emporium," a center that hosts over 500 workstations and is open 24/7. Students can access all the contents and practice of the two first years of math at the Emporium to refresh what they have seen in class, or they can take the class online, in which case they also have tutors as consultants available in person or online to help. Also senior college students can come any time to refresh their knowledge (Bates, 2000, p.31).

Also, and perhaps most exciting, online education provides easy access to peers, which allows the establishment of a network of scholars for the purposes of intellectual exchange, collaboration, collective thinking, and socialization (Baldwin, 1998; Harasim, 1990; McDonald, 2002). This has an impact on institutions and faculty professional life. When choosing collaborators, faculty is no longer limited by geographical boundaries. Faculty and adjuncts from a variety of geographical locations can collaborate and teach in a same institution while working and living in another area. On-campus teaching benefits from having access to experts in different disciplines; institutions are forming consortiums by which they share faculty and courses. Faculty benefits because the online environment broadens his opportunity as teacher and researcher in other campuses.

The second impact can be seen in the notion of *classroom space*, which takes a whole different meaning as a synonym of *learning space* (Burbules, 2005). Online education blurs the line between distance education and traditional, place-based education, primarily because of the opportunity for discussion, collaboration, and the potential for building a sense of community among participants inside and outside of the classroom (Barab et al., 2001; Boetcher & Conrad, 1999; Harasim, 1990; McDonald, 2002; Paloff & Pratt, 1999). Faculty can choose between several available online applications to encourage online interaction via synchronous and/or asynchronous methods. These methods are used to extend the classroom discussions, to allow for student insights on a new topic, to enhance a lecture, or to discuss readings. Collaboration among students in the same class, or between students and researchers residing in different geographical locations is possible as long as they can all share the virtual collaborative space of the online classroom.

Online education represents an "augmented environment for collaborative learning" (Harasim, 1990, p.60). The Web becomes a virtual learning space where knowledge is shared and collaboration happens not only between those who are geographically dispersed, but also among those who work on similar ideas at different times and contribute to that knowledge creation. An early example of this is the "White Papers" of EPS313 (http://lrs.ed.uiuc.edu/wp). These are documents on different topics that were started in the summer of 1999 as a class project by students who were geographically dispersed. The information in this papers was enhanced and expanded by the students in the same class in subsequent semesters -2000, 2001, 2002, and continues-, resulting in a series of research based documents on different topics that are accessed daily by dozens of hits from campus students and others looking for information on "Credibility and Web Evaluation", and other themes. Today, new developments, such as shared Web-spaces in which people contribute to a knowledge-based system, are increasing in popularity.

Organizations try to capture their collective knowledge in closed, password-protected systems at the same time as open-access sites gather people's knowledge and information in Web-based encyclopedias, such as *Wikipedia*—where anyone can create, edit, and access information on many topics. Learning and collaboration in virtual spaces is another impact that online learning is having on classroom education.

The third element considered here as an impact of online learning on classroom education is the implementation of practices that were unusual for placed-based education. Distance education practices have been adopted in the face-to-face classroom affecting design and implementation of campus-based instruction. Traditionally, distance education was regarded as the "poor and often unwelcome stepchild within the academic community" (Merisotis & Phipps, 1999, p. 4). It was considered as lower quality education, or a poor replica of campus education (Allen & Seaman, 2004). However, distance education turned out to be more and more noticeable as a part of the higher education family because of the uses it makes of educational technologies and new pedagogical strategies that improve the process of teaching and learning. The instructional insights gained in the online distance world produced a transformation that also reached campus-based education. The developments that occurred with the incorporation of the Web into distance education practices—such as synchronous and asynchronous class discussion; extensive peer review of class documents; constant comments and reflections on opinions and answers given by classmates; online collaboration; document and application sharing—were rare or never part of campus-based courses for very practical reasons.

In a face-to-face class, document sharing and peer reviews involved printing copies of documents, thus adding costs. Group work and collaboration or class discussions were limited by time and classroom space boundaries. Comments and reflections on contributions by classmates were also restricted to the duration of a class period and to the opportunity of *being seen and heard* in the classroom. These practices were incorporated in distance education with the advent of online learning, and they were later integrated into face-to-face teaching. Adopting practices of distance education is also reflected in the flexibility of class schedules. Many courses using a mix of online and face-to-face components have less classroom meetings, and this also affects campus education in the availability of classroom spaces, in the skills needed by students to take a course, in the students expectations when they sign for a campus course, and finally in faculty time and preparation to teach the course. Faculty with experience in distance education feel more confident to adopt distance education practices in their campus teaching (Quinn & Corry, 2002; Smith, Ferguson, & Caris, 2002). These research results will also make an impact on faculty professional development.

Implications

The immediate access, the definition of classroom space, and the implementation of practices that were unusual for placed-based education can be considered the main impacts of online learning in classroom education. And the implications of introducing online learning in the traditional classroom are multiple, and affect the people (teacher and learner), the processes (teaching and learning), and the organizations.

The People.

Campus-based faculty need to be prepared to: develop new teaching approaches that will gain from the immediate access to information; be willing to give up control in order to empower the learners to exploration; create opportunities for collaboration that go beyond the classroom boundaries in time and space; develop some familiarity with the technology in use; and be open to learn from others, including colleagues or students (Bates, 2000; Palloff & Pratt, 2001).

Students also need to be prepared for the changes that occur in the classroom. They come to the traditional, campus-based classroom with the expectations that classroom interaction happens only within the physical boundaries of the classroom, and they may have limited skills in the use of technology. Their previous learning experiences may not have prepared them for the "place-independent" (Harasim, 1990, p.60) learning that happens in the interaction with classmates or others who only participate via online communication and within a more flexible schedule than the rigid four-hours-per-week classroom meeting.

A successful implementation of online learning in the classroom requires training in technology and pedagogy; the development of a good support system, both academic and technical; and the availability of hardware and software for faculty and student use (Bates & Poole, 2003; Palloff & Pratt, 2001). Without satisfying these minimal conditions, the incorporation of online strategies in the classroom may be overlooked or have a negative impact on the experiences of the people involved.

The Process.

Traditional campus-based teaching and learning is making a shift to a new way of education. The mix of distance and place-bound educational strategies in the classroom has an effect on the processes of teaching and learning (Dziuban, Moskal, & Hartman, 2004, Kaye, 1990; Harasim, 1990). Teaching strategies imply collaboration with others that can help students, not just as content experts but as technology experts and as instructional designers. Learning is not limited to classroom interactions, and interactions are not limited to instructor-student, student-student, and student-materials; there is also an interaction with the interface (Hillman, Willis, & Gunawardena, 1994; Moore, 1989) and an active (and constantly transforming) pool of information and materials existent on the Web.

The Organization.

The adoption of online learning in classroom teaching will have implications for the educational organizations (Bates, 2000; Estabrook, 2002). Changes may include a) flexibility in schedules; b) availability of classroom space; c) incorporation of staff specialized in educational technologies and instructional design; d) shared decision-making in the selection of hardware, software, and infrastructure; e) issues of evaluation and assessment; f) concerns about faculty time and compensation systems; g) changes in program planning and development; and h) considerations of support, training, and development (Bates, 2000; Bates & Poole, 2003; Estabrook, 2002; Palloff & Pratt, 2001)

The incorporation of online learning into classroom education does not compare to the changes involved in updating or replacing a textbook or hiring a new faculty member. The changes that online education brings to the classroom are more profound and should be part of the long-term strategy of educational institutions (Allen & Seaman, 2004; Bates, 2000). Online education has implications that will affect the way educational organizations work and that are comparable with the changes to administrative systems brought about by the advent of computers (Bates, 2001).

Conclusion

Although people are getting their information and entertainment from different sources and they are processing and using it in different ways, many college classes still go on as they have for generations, isolated from the powerful networks that people use in the rest of their lives (Ayers & Grisham, 2003). What Seymour Papert said almost 10 years ago is still true: a doctor or a banker from the 1890s wouldn't know what to do in a modern hospital or bank. But a teacher from the 1890s or from a medieval university classroom could probably find his or her way around the modern classroom (Bates & Poole, 2003; Swan, 2004).

The use of Web technologies has had an impact on classroom teaching, but this influence is not as extensive or widespread as it is in communications and entertainment. Higher education institutions have invested in hardware, software, and wired classrooms, but not as much in resources for research, or in training, and support. Therefore, the center of knowledge creation—teaching and learning—still remains very much unchanged. Both the impact and the implications of online learning for classroom education need to be seriously addressed. Online education entails a new educational paradigm, closer to the transformative mindset that is ongoing in the twenty-first-century world outside the classroom.

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Editor's Note: This study uses a new kind of measuring tool, the Spatial Probability Measure (SPM), to detect gender bias and compare its gender related component to multiple-choice and other forms of testing.

Gender as a Variable in Graphical Assessment

David Richard Moore

Abstract

This paper presents the Spatial Probability Measure (SPM). The SPM is an adapted assessment instrument that attempts to ascertain a learner's strength of response or response certitude relative to other options. This instrument is unique in that it has many of the characteristics of a multiple-choice assessment instrument but differentiates itself by collecting data from a continuum instead of the discrete options provided by multiple-choice. In particular, the issue of gender is examined. The question the study seeks to address is; does gender influence the degree to which the variable response-certitude is expressed through the SPM instrument. Results indicate that gender is not a significant factor in responding to the SPM. The SPM may be of interest to creators of computer-based instructional software because it retains much of the efficiency of the multiple-choice technique while potentially providing designers with additional useful information that can be used to adapt instruction.

Keywords: instruction, technology, computer-based instruction, assessment, gender, user-interface, spatial probability measure, multimedia

Introducing the Spatial Probability Measure

The Spatial Probability Measure (SPM) is an assessment instrument adapted by Moore (2005). In general the instrument, displayed in Figure 1, provides the opportunity for a learner to express varying degrees of certitude in their response by selecting a position within the triangle.

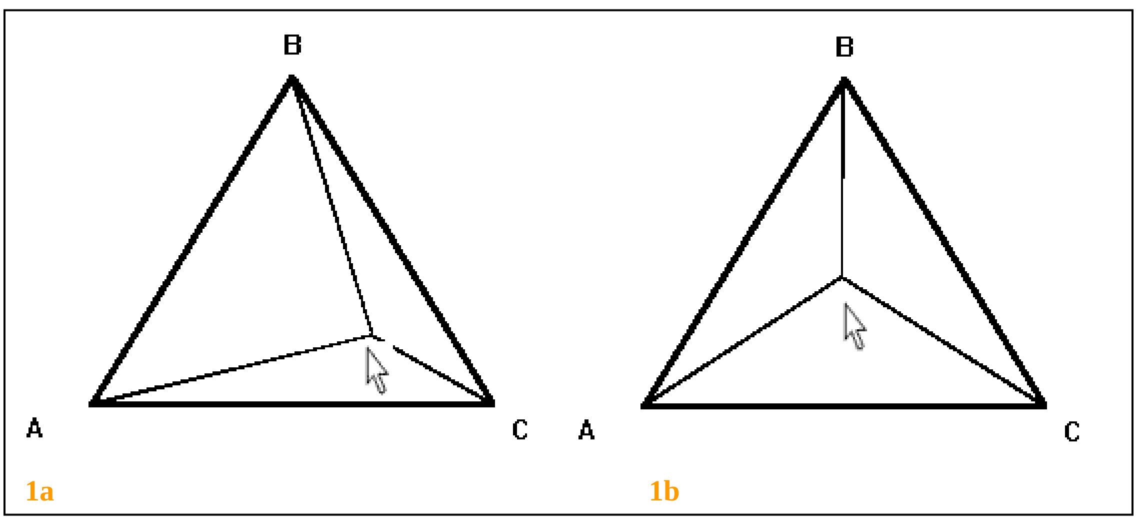

Figure 1. Spatial Probability Measure (Moore, 2005)

The cursor in 1a suggests that the learner favors answer C relative to the others, while the cursor in 1b suggest the learner's is neutrally uncertain. In contrast to multiple-choice questions, the SPM allows learners to express their opinion on a continuum, potentially providing a more accurate assessment of their knowledge (Bruno, 1987; Klinger, 1997). Landa (1976) calls this type of instrument an Admissible Scoring System; he states, "An admissible scoring system…. enables and encourages the student to give honest answers to all questions, freely and frankly identifying the gaps in his knowledge" p.14.

One potential advantage of this system is that not only is confidence in an answer expressed but also additionally the relative correctness of all the distracters is expressed.

Gender Effects and Response Certitude

Gender has often arisen as a significant factor in instructional settings and with instructional technology in particular. Technology has been viewed as having the potential to encourage performance differences on the basis of gender (Mangione, 1995). Gender effects are often a controversial topic in the literature base (Kirk, 1992). In particular, there is some evidence that, performance differences in standardized multiple-choice tests can be attributed to gender (Wainer & Steinberg, 1992). On multiple-choice type tests women appear to changes their responses more often than men (Skinner, 1983). Additionally, studies show that the probability of guessing on multiple-choice tests is correlated with gender (Ben-Shakhar, & Sinai, 1991).

The SPM instrument presents a number of separate variables that may be influenced by gender. Since the instrument is delivered through the Internet it may be of concern that a few studies have shown that males have in general greater skill and experience with computers (Reinen & Plomp, 1993; Scragg & Smith, 1998; Rajagopal & Bojin, 2003). Secondly, the SPM instrument attempts to ascertain a measure of response certitude relative to available choices. Response certitude is a measure of one's confidence in one's response and is related to one's knowledge base and experience but additionally may be an inherent learner characteristic (Kulhavy & Stock, 1989; Mory, 1991). Response certitude may be influenced by gender (Linn & Hyde, 1989). Of particular interest is the suggestion that females may be less likely to guess when responding to testing (Linn, De Benedictis, Delucchi, Harris & Stage, 1987).

Thirdly, the nature of the SPM instrument is requires somewhat of a spatial mechanical response which there is some evidence that females may perform such tasks in certain circumstances with less success than their male counterparts (Casey, Nuttall, R.L. & Pezaris, 2001). While these gender effects are often reported there is some evidence that these effects are minimal if not absent (Linn & Hyde, 1989).

Method

Purpose

The purpose of this study was to determine whether gender influences response certitude as measured by the SPM instrument.

Participants

The participants for this study were undergraduate students in the College of Education at Ohio University. Students were offered the opportunity to participate self-selected from four separate sections of an Introduction to Instructional Technology course. Sixty-two students participated in this study. Participants declared knowledge of the study's subject matter as being very low.

Materials

The SPM instrument used to collect data was created using Macromedia's Authorware™ multimedia environment. The instrument, presented content, and tracked results. Participants where presented a brief tutorial on the trochaic poetry form (chosen for its unfamiliarity among participants. At the completion of the tutorial participants were presented with 15 classification questions delivered through the SPM response triangle. Each question was displayed in a similar format as Figure 2. The instrument was delivered over the Internet. Data was collected and recorded to a database through a secure Internet connection.

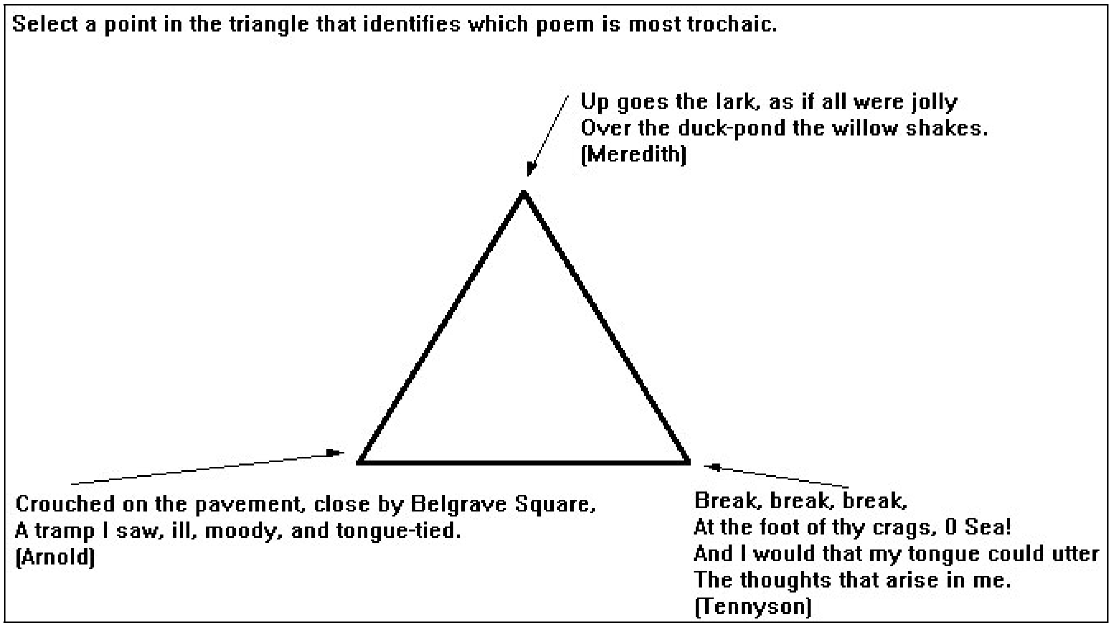

Figure 2. Presentation of Questions (Moore, 2005).

Procedure

Participants where asked to log onto the experiment program. All participants received a demonstration on how to respond to the SPM instrument. The program then randomly assigned participants to either a non-instruction or an instructional intervention group. The instructional group received instruction and examples of trochaic poetry concepts. The examples provided in the instructional treatment were not repeated in the assessment portion of the experiment. The subject matter for this experiment was trochaic meter in poetry. Treatments and assessment items were similar to those used in a previous study by (Merrill & Tennyson, 1971). The treatment was presented on the screen for three minutes. This concept presentation was followed by the SPM instrument that asked the participant to select the correct un-encountered example of the concept in question. There were fifteen questions in the SPM assessment. All participants received the same questions in the same order. The results where then transmitted to the researcher through a secure e-mail system and included a unique participant number to identify the participant's gender, as well as their scores on the post-assessment. The hypothesis tested was that learners of different gender would respond with different response certitude measured by a smaller pixel distance.

Results

Data for each gender was collected and placed into Table 1.

Statistical tests used

The data was then submitted to a standard one-way ANOVA statistical test to provide a basis for determining if the differences between males and females were significant enough to warrant the assertion that one gender responded with more certitude than the other using the SPM instrument. The data from the ANOVA computation is described in Table 2.

Table 1

Average pixel distance from correct corner

Gender	*Count*	*Sum*	*Average pixel distance from correct corner*	*S.D.*
Female	N=40	4300.29	M=107.51	15.94
Male	N=22	2498.46	M=113.57	16.37

Table 2

ANOVA results

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	521.0979	1	521.0979	2.01	0.16	4.00
Within Groups	15541.89	60	259.0315			
Total	16062.99	61				

Analysis of Data

Females recorded, on average, a smaller pixel distance than their male counterparts. However, this difference is not significant according to statistical computation. The ANOVA test revealed an F value of 2.01 and a corresponding P-value of .16. The P-value is above the selected alpha value of .05 which suggests that neither gender is more likely to express certitude than the other using the SPM instrument.

Discussion

The use of the SPM in this experiment indicates that gender does not contribute to different levels of response certitude when using the SPM instrument. This finding, although limited in scope, provides evidence that the SPM may be used universally and the results are not unduly influenced by predispositions to express ones response certitude based on gender alone.

The results run contrary to a variety of studies that identify gender as a significant variable in the use of assessments instruments, delivered traditionally and through technology. The results in this study may be attributable to a number of factors including, a potentially savvy sample of technology users, and a comfortable and non-threatening environment among others. These results may also be attributable to the unique characteristics of the subject matter (trochaic poetry). It is possible than a different subject-matter or a different domain of knowledge may have resulted in more differentiation in reported scores.

The SPM is a relatively new assessment device and requires further study on a number of variables to determine its efficacy; however, the results of this study indicate that one substantial objection to its use, that of gender equality of responses, may not be a barrier to producing valid and reliable results.

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Editor's Note: Transition from analog to digital technologies introduces challenges and opportunities. This article informs technical decisions that will determine efficient and affordable use of these technologies.

Satellite Earth Stations for Distant Online Learning

Jivesh Govil

Abstract

Present day satellites are limited in their ability to provide high data rate communication services for online and distance learning due to the limited availability, and high cost of satellite resources such as power, energy, and frequency bands. Moreover, present communication satellites were designed almost exclusively for supporting stream traffic such as voice, video or bulk data transfers, and are not efficient for the transmission of "bursty" data traffic such as Internet traffic. With data traffic constituting an increasing fraction of the demand for communication services, future satellite systems must be designed to effectively support emerging advanced data applications for distance learning application. Doing so requires a paradigm shift from traditional circuit switched technology, used for voice communication, to packet switched technology, used in data networks. This paper exposits basic architecture and underlying aspects of such networks. It also highlights various access techniques and issues involved with them. Finally, a brief overview of satellite teleconferencing is also given.

Keywords: Distant online learning, satellite teleconferencing, Satellite packet networks, ALOHA, random access schemes, TDMA, CDMA

1. Introduction

Broadly viewed, distance learning is an educational process that occurs when instruction is delivered to students physically remote from the location or campus of program origin, the main campus, or the primary resources that support instruction. In this process, the requirements for a course or program may be completed through remote communications with instructional and support staff including either one-way or two-way written, electronic or other media forms.

Distance education involves teaching through the use of telecommunications technologies to transmit and receive various materials through voice, video and data. These avenues of teaching often constitute instruction on a closed system limited to students who are pursuing educational opportunities as part of a systematic teaching activity or curriculum and are officially enrolled in the course. Examples of such analog and digital technologies include telecourses, audio and video teleconferences, closed broadcast and cable television systems, microwave and ITFS, compressed and full-motion video, fiber optic networks, audiographic systems, interactive videodisk, satellite-based and computer networks.

A significant problem for networks involving distance learning is to reliably connect widely dispersed locations at low cost for voice and data. Data communications is the fastest growing of the two. Potential advantages of satellite networks for data transmission are low cost, low data error rates, insensitivity to distance, great flexibility of network configuration and use of multipoint distribution. Fortunately, a variety of small low cost earth stations using different techniques, especially for low speed packet data networks, are available today. The industries in the developed countries have come up with new names like micro earth stations, micro terminals, personal earth station (PES), and on premises terminals (OPT) etc. all belonging to a class of Very Small Aperture Terminals (VSATs).

The need to have private networks for distant online learning has a different thrust in developing countries as compared to the developed countries. While the developed countries have had well developed public data networks using terrestrial facilities, developing countries do not have one yet. VSATs can provide bypass facilities for common carriers to lower costs in developing countries and enable them to provide required services without alternatives. In this sense, VSATs are bound to play a larger and more significant role here. Because of their importance and the need to choose an appropriate transmission technique, this paper concentrates on the various issues involved in satellite packet networks for distance learning.

2. Transmission Needs of a Distance Learning Center

The most common transmission needs of a distance learning center are [1]:

1. To interconnect remotely distributed processing facilities.
2. To maximise resource (computer) sharing
3. To access data bases at different locations and update them frequently.
4. To transmit pictures/documents (facsimile)
5. To share electronic mail and messaging between different locations.
6. To provide Audio/Video conferencing using slow scan video or freeze frame TV techniques.

While all these capabilities are not required by every distance learning center, the network is capable of offering these services, provided data service rates and the VSATs are properly selected. For example under the requirements of item 1 and 6, one would provide high speed circuits (up to 56 kbps), under item 2 & 3 one would provide quick response transactional circuits. Under item 5, no real time transmission facilities are required.

3. Transmissions Speeds

The transmission speed on the satellite channel is an important parameter for the choice of VSAT and this would finally determine the network cost as well as the transponder requirements. Typical data speeds required depend on the circuit applications mentioned below in table 1:

Table 1

Data Speed by Application

No	Application	Terminal	Typical Circuit Speed
1	Calculations (Basic)	Teletype	10 chrs/sec
2	Email	Typewriter	15 chrs/sec
3	Online Chat	Application built display	1.2 to 4.8 kbps
4	Video tape	VDU	1.2 to 4.8 kbps
5	Web-based education	Data transfer	9.6 kbps
6	Circuit Design CAD/CAM	Graphic Terminal	56kbps

While these transmission speeds are typical depending on the application, the duty cycle or the average time the circuit is busy in a given period, is extremely important. This factor viz. the peak to average ratio is important because, if a high speed fixed rate transmission channel is chosen for a high peak to average bursty data terminal, the channel would be used inefficiently. In such situations, the channel should be such that it transmits in bursts with a very short response time. In this sense, the choice would be for a packet satellite network as compared to circuit switched channels.

4. Advantages of Satellite Packet Networks

The few basic advantages of satellite packet networks may be listed as:

1. Costs are independent of distance of location
2. Possibility of point to multi-point or broadcast transmission facilities.
3. Provision of receive only facilities corresponding to 1/2 circuit costs.
4. Availability of end-to-end digital transmission with arbitrarily low error rates using VSATs [2].
5. Provision of asymmetric data rate channel unlike terrestrial telephone networks. This can result in savings in cases of question and answer sessions as in data collection systems.
6. Ease of network design and reconfiguration of VSATs to suit changing network requirements.
7. Ability to multiplex data together on a common channel independent of geographic locations by time, frequency and code division multiplexing unlike data multiplexing on terrestrial circuits, which is done by co-located multiplexers or concentrators.

5. Basic Network Architecture

A mesh architecture provides full interconnectivity with single hop links, and high G/T earth stations. Although higher C/I earth stations would permit distributed network functions with higher transmission bit rates and with lesser transmission delay (due to single hop), such a scheme is not suitable for VSAT network because of the very small size of the earth station. VSATS cannot communicate with each except through a central station called 'Hub' because of their low E.I.R.P. capabilities.

Thus full connectivity of VSATS requires using double hop links with Hub as a control station. Such a star network incorporates complicated network control schemes for earth stations [3] but permits small station VSATs to be located at urban centres, either or roof tops or in backyards. Since two frequencies are involved at the satellite transponder associated with VSAT to Hub direction (in bound) and Hub to VSAT direction (out bound), two different access schemes are associated with each of these two carriers.

6. Packet Satellite Networks

Packet networks using terrestrial media have been in evolving stages for more than a decade. Packet switching which is a form of message switching as opposed to circuit switching is advantageous for high peak to average, bursty traffic as in computer communication [4]. Packet switching using satellites have special features:

1. Broadcast nature of satellite transmission as opposed to point to point transmission in terrestrial circuits

2. Reduced switching functions at nodes and
3. Higher flexibility and reliability as compared to terrestrial based packet transmission.

6.1 Major Disadvantages

Substituting a satellite circuit for a terrestrial circuit in a packet network without changing equipment or software at the terminals can have major disadvantages all related to propagation delay [5]. These are:

1. The circuit throughput can be severely degraded,
2. Mechanism regulating flow or pacing of data can be interfered with,
3. Response time of devices can be lengthened; sometimes terminals may cease working.

6.2 Remedies

To avoid these problems, the following control procedures will have to be followed for data transmission on satellite circuits:

1. Stop and wait ARQ should be avoided and protocols such as Binary Synchronous line control may be used.
2. Continuous ARQ with pull back as used in High Level Data Link Control (HDLC); Synchronous data Link Control (SDLC) is efficient only if a suitable frame sized is employed.
3. When a high bit rate for transmission is used with HDLC protocol, a high value of M (>127) as well as a low bit error rate channel is needed. In other words, the satellite link shall be engineered to give a low error rate performance.
4. Selective repeat ARQ can be employed provided proper link control equipment is used.
5. When pacing and flow control mechanisms are used for distributed processing; computer networks should be properly selected [6].
6. Polling of satellite circuits for interactive systems is to be avoided.
7. Although terrestrial protocols work well over satellite, they do not take advantage of broadcast capabilities of satellite links.

7. Services and access techniques using satellites

The service objectives of any satellite data network would be to provide for

1. Interactive terminal to computer working
2. Distributed resource sharing
3. File transfer
4. Question and answer sessions to and from a central source
5. Electronic Mail/Facsimile.

With the above service objectives in mind and the capability of satellite to broadcast information from a point to several points, various access schemes suitable for packet switched networks are described below. These accesses are suitable only for DATA and in a few special cases digitised voice or slow scan/freeze frame video.

8. Types of Packet Satellite Networks (PSN) access

The most prominent ones are:

1. Fixed Assignment Time Division Multiple Access (F – TDMA)
2. Random Access
    i. Pure Aloha
    ii. Slotted Aloha
    iii. Implicit reservation
    iv. Explicit reservation
3. Hybrid schemes
4. Code Division Multiple Access (CDMA)

8.1 F-TDMA

In a fixed assignment TDMA, each frame is divided into slots of fixed time duration among stations of the network. The assignment of stations to slots is permanent similar to TDMA systems carrying digitised voice except F-TDMA does not have network synchronisation - Packets are sent asynchronously, with no frame sync. signals. TDMA itself is a flexible multiple access scheme and can carry digitised voice, DATA and video of widely different capacities from each station. Them is no intermodulation problems caused by multi-carrier working. Consequently transponder utilisation is the highest. A typical frame is of the order of 1msec or more. The only synchronisation required is that the burst from stations must arrive at satellite exactly in the allocated slots without overlap.

8.2 Random Access Schemes

8.2.1 **Pure Aloha**. In the simplest form, also called pure or unslotted Aloha. Stations transmit packets randomly and packets from different stations may collide. Stations retransmit the packets until they are received correctly. To avoid repeated overlaps, time interval of packet transmission is randomised. Prof. Abramsan and others gave analysis of the Aloha channel throughput [4,7] in term of traffic offered as $S = Ge^{-2G}$ where S is the average no. of packets transmitted successfully and G is the average no. of packet attempted to be transmitted.

8.2.2 **Slotted Aloha.** It is seen that the maximum throughput of an unslotted Aloha channel is limited to 18% (Fig. 1) due to collision and to reduce the probability of such collision, time slots are introduced so that the transmission can begin only at the start of slots. This network discipline reduces the collision and hence increases the maximum throughput efficiency of the channel. In S-Aloha, each station has 2 queues – the new packet queue and the retransmit packet queue.

Only if the retransmit queen is empty, a new packet is sent. The analysis of a slotted Aloha channel shows that $S = Ge^{-G}$ and maximum channel throughput is 36%. It may however, be noted that the bands (in Fig. 1) apply to large uniform networks. It is quite common to see a kind of dynamic reservation in slotted Aloha. Reservation of slots are monitored by all stations and synchronised by maintaining tables showing outstanding transmission requirements. The Reservation table is used by the channel scheduler to assign future slots on demand-access Round Robin-Fashion.

8.2.3 **Implicit Reservation** (Reservation via S-Aloha). In this form of slot reservation, it is indicated only by the use of slot in a frame time, slots having high traffic rates have one or more slots by reservation. These stations are removed from contention from the remaining slots. Control is distributed at each station based on global information of the network [8]. When a station uses the slot successfully by contention in a particular frame, this slot is assigned to that station in each successive frame till it stops using it. The frame time must at least be equal to the lime of transmission of a single hop, otherwise there are instabilities. This scheme has a higher throughput than either S-Aloha or F-TDMA depending on traffic.

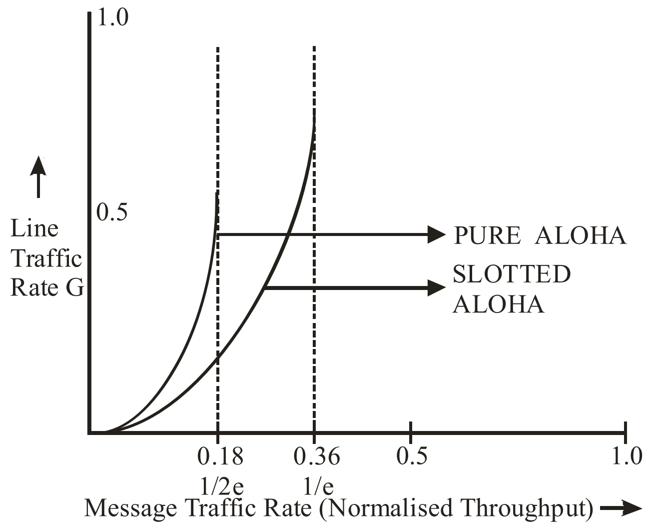

Fig. 1 Slotted ALOHA

* Transmission from each station must begin at the start of slot time

8.2.4 **Explicit Reservation**. This is a form of reservation scheme implemented on a TDMA system. A Network scheduler makes a distinct assignment of slots to users in a TDMA frame. The slots not claimed by original allotee may be re-assigned on a Round Robin bases to stations having traffic to send.

8.3. Hybrid schemes

There are many other schemes essentially based an either TDMA or Aloha but implementing features like Priority Oriented Demand Assignment (PODA) or a contention based Priority Oriented Demand Assignment (C- PODA) etc. All the schemes however will generally take into account the following one or more features:

1. Efficient use of satellite Bandwidth
2. Satisfaction of multiple Delay constraints
3. Can incorporate multiple priority levels
4. Handle variable packet (message) lengths
5. Handle different transmission rates
6. To have fairness in allotting slots to nodes. That is to say that one node does not use the slots all the time.
7. Incorporate efficient message acknowledgement procedures [8].
8. Network is robust in operation.

A comparison of the various access schemes described so far is represented in Table 2 incorporating Delay vs. Normalised Throughput in a 3-station configuration.

8.4 Code Division Multiple Access (CDMA) or Spread Spectrum Multiple Access (SSMA)

Spread spectrum technology was initially applied to military and radio astronomy applications. Only a few years ago, spread spectrum technology could be used by VSATs with no complexities or cost penalties. In addition it is also claimed to offer certain advantages.

The general features of a CDMA system are:

1. All stations operate on the same transponder frequency using a larger bandwidth than needed for the data rate.
2. The network needs no time or frequency coordination.
3. Provide anti-Jam capabilities or protection against interference.
4. Provide for a graceful degradation of network performance as the number of simultaneous users increase
5. Low spectral density compared to conventional emissions

The mostly widely used CDMA technique for VSAT application is Direct sequence (US) or Pseudo-Noise (PN) sequence modulation using a chip sequence to represent I or 0 of data bits. Frequency hopping and chirp modulation techniques are not so common yet for VSAT application. While advantages offered by CDMA techniques are unquestionable [10] (like low power spectral density and interference resistance of VSATs), certain drawbacks of SSMA techniques can not be left without mention. These are:

1. Larger transponder bandwidth requirements
2. Due to imperfect code orthogonalities, expected simultaneous users may be much limited.
3. Results in a highly complex Central Earth Station for the star configuration.
4. VSAT technology using SSMA is presently available only for a narrow band segment to cater to low bit rate applications.

9. Satellite teleconferencing

Satellite teleconferencing is technology used to send a one-way video broadcast from one site to many sites through the use of satellite equipment. This one-way video broadcast is made interactive through the use of telephones and fax machines. Satellite teleconferencing is a one-way video, two-way audio (1V-2A) experience where participants can see and hear the presenter, but cannot be seen by the presenter and can interact with the presenter only through the use of other audio media such as telephone or fax. Satellite teleconferencing should not be confused with "videoconferencing" which is a two-way video, two-way audio (2V-2A) technology in which all parties are able to see and hear each other in real-time.

9.1 Key points about satellite teleconferencing

satellite uplink equipment and a production studio are required to produce your own satellite teleconference

satellite downlink equipment is required to receive (downlink) satellite teleconference events

satellite programs are purchased from the program provider in the form of site licenses satellite programs are made interactive through the use of phone/fax by participants

satellite programs can often be videotaped (if authorized by the provider) for later viewing

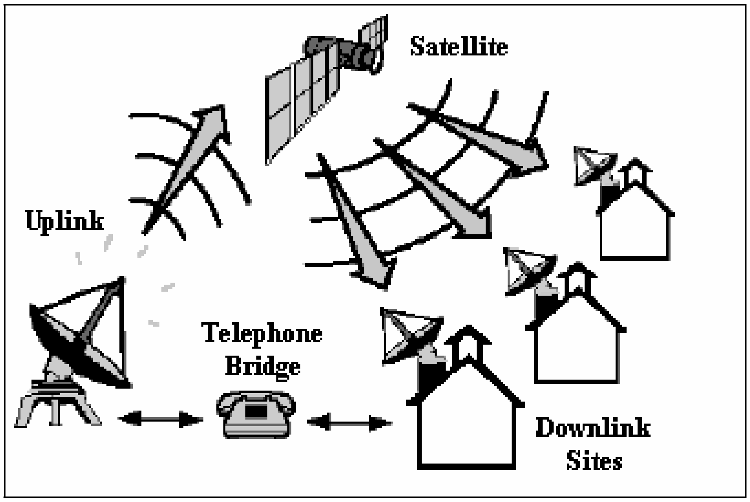

Figure 2. Satellite Teleconferencing

The producer of the teleconference leases satellite time from a satellite owner and uplinks its program to the satellite at the time of the broadcast (Fig.2). The broadcast can then be down-linked by sites with appropriate satellite equipment – these sites simply need to be given the satellite downlink coordinates in order to do so. Once the program is down-linked to a particular site, participants at that site can view the broadcast and there is usually time allotted during the broadcast for phone/fax questions from participants to the program presenters.

10. Concluding Thoughts

The comparison of various access techniques is provided in Table 2.

Table2

ACCESS	THROUGHPUT EFFICIENCY	AVERAGE RESPONSE TIME	COMMENTS
Pre Assigned TDMA	68%	2.0sec or greater	Lowest complexity Excellent efficiency Excessive response time
Slotted ALOHA	10%	0.45sec	Low complexity Poor efficiency Moderate response
Reservation TDMA	50%	1-2sec	High complexity Moderate efficiency Moderate response
CDMA with Thresholding	80%	0.25sec	Complex Best combination of efficiency and response time

Satellite teleconferencing has been very expensive until now. It would not be cost-effective for most distant learning centers to use uplinks to originate distance-education classes unless the centers were in a position to market classes over wide geographic areas. It is reasonable, however, for a learning center to use a downlink to receive commercial courses that are delivered through satellite channels. One example of an educational system that makes use of satellite communication is EMG (Educational Management Group). Using the access techniques described above, various overhead costs in satellite communication for distance learning may be diminished or eliminated. In addition, as per the requirements of different distance learning centers, various access techniques cited above may be used.

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Editor's Note: Australians are making innovative use of satellite television to teach **T**echnical **A**nd **F**urther **E**ducation (TAFE) courses in rural areas of Northern New South Wales. This paper describes successful delivery to remote homesteads and communities and explains how satellite technology is addressing the "digital divide" in remote areas.

Interactive Distance Learning

Jo Sedgers, Julie Johnson, Denise Smyth, Virginia Waite

Abstract

The **Interactive Distance Learning Satellite Project (IDL)** involves partnerships between Optus, NSW Department of Education and Training, Northern Territory Department of Education, local communities and schools to support flexible delivery programs. With satellite technology, TAFE NSW Western and North Coast Institute are able to provide interactive lessons and learning to students in remote NSW homesteads and to provide vocational education courses to rural and remote Aboriginal and non-Aboriginal communities.

The IDL satellite project in NSW has been implemented by Outreach and Aboriginal Programs via a partnership between Western and North Coast Institutes and utilising the DET Distance Education, School of the Air studios.

Studios are located in Dubbo, Port Macquarie and Broken Hill. Rural and remote homesteads on School-of-the-Air programs from Broken Hill and Distance Education programs from Dubbo and other school sites are linked to the network, and can receive training from these studios. The Institutes also have a mobile satellite trailer and laptops that can logon to studio lessons.

Remote Aboriginal communities utilise the satellite trailer to access TAFE training.

Students receive interactive lessons on their PC's using specialised software that enables students to see and hear the teacher, hear other students and receive shared applications that aren't directly loaded on their own PC. Teachers are able to hear students and can control what students see and hear and what programs they can access. There is an internal mail feature with ability to share web links, PowerPoint presentations, and documents, and conduct interactive quizzes.

The interactivity of the satellite technology has been hailed by many participants as providing a breakthrough in distance education.

Outreach has identified the learning needs of these target groups and has used the satellite technology to provide training to remote homesteads and Aboriginal communities over the past two years.

The range of TAFE courses and subjects that have been successfully adapted for satellite delivery has exceeded what was previously thought possible. Even very practical subjects are delivered.

Sessions on basic computing, modules that support home tutor training and programs on building maintenance, tractor maintenance, electronics and Aboriginal Cultural Practices have been delivered successfully. Students have warmly received this training.

> *"The TAFE delivery via satellite is fantastic – making learning possible for us out here. I would not have been able to do this course if not for the satellite. It would have been too hard to get the time in town, baby sitters and organise things on the station too. I would have just fumbled my way through and done things the slow hard way or not at all."*
>
> **-** *Student*

This is an exciting project for both students and teachers, and has provided new learning opportunities for students previously unable to attend TAFE.

> *"So far it's been a magical experience. These students are so keen, so positive and so grateful – it's a joy to teach them. It makes you feel that you are making a difference to people's lives" – teacher*

During the past two years over 500 of the most isolated people in NSW have become TAFE students via satellite, many accessing TAFE for the first time.

The IDL satellite project has been so successful that the IDL team has recently won further Federal funding under the Commonwealth Communications Infrastructure Fund, with contributions from Optus, to build a dedicated TAFE studio which will allow for greatly expanded TAFE delivery to existing remote sites and another 400 new sites.

Introduction

In 2002, a consortium comprising Optus, the New South Wales Department of Education and Training and the Northern Territory Department of Employment, Education and Training commenced a national project providing interactive distance education to students located in the Clarence, Murray-Darling and Dubbo areas of New South Wales and the whole of the Northern Territory.

The TAFE NSW partnership involved Optus, the TAFE NSW-North Coast and Western Institutes, the NSW DET Aboriginal Programs Unit and the TAFE Equity and Outreach Unit, with generous support from DET Distance Education IT staff. The TAFE component of the project focused on remote or rural Aboriginal communities and delivery to people on homesteads where there were Distance Education students.

The use of mobile and fixed satellite dishes in this pilot project allowed, for the first time, isolated Aboriginal communities and other rural remote learners to access the Internet to participate in TAFE courses.

The IDL satellite project generated much excitement and innovation amongst participating students and teachers. Many students described as "life changing" the experience of studying TAFE courses in an interactive and supported environment.

The project also contributed greatly to organisational learning as it pushed the boundaries of e-learning and developed new pedagogies. The piloting of cutting edge technology to deliver to remote Aboriginal communities proved the suitability of the technology to address the digital divide for Aboriginal people.

In excess of 500 adults were enrolled in TAFE courses delivered via satellite over the two years of the project. These students lived in some of the most remote parts of NSW, in isolated homesteads with no previous access to interactive training and education. Students' learning needs and interests were assessed prior to enrolment with modules selected and customised to meet their needs.

Due to the innovative nature of the project and the technology it utilised, a great many resource and learning materials were developed or customised to support the students' learning. These resources and the pedagogy of learning via interactive satellite classes have contributed greatly to TAFE NSW's e-learning approach.

Subjects studied via satellite ranged from basic and advanced computing and other IT skills to Aboriginal studies to art to the more traditional TAFE subjects such as farm engines, building maintenance and electrical safety. All modules delivered were accredited TAFE modules and completion rates were very high.

Achievements

This project resulted in people living in the most remote and isolated parts of NSW being able to access, for the first time in many cases, interactive distance education.

The uptake and completion of TAFE courses by isolated individuals and communities exceeded expectations with the target enrolment figures surpassed by both the participating TAFE NSW Institutes. The target enrolment figure for the two years of the project was agreed at 460 enrolments. This target has been exceeded by 57 extra enrolments, funded from TAFE NSW core budgets.

The range of subjects successfully delivered by satellite classes again exceeded what was thought to be possible with even very practical TAFE subjects like Farm Building Maintenance being able to be adapted to satellite delivery.

The many benefits of this project both to the participating individuals and to regional development generally can be summarised under five achievements;

a) Access. For isolated and remote families, communities and schools who previously did not have access to TAFE provision, a range of cutting edge teaching and learning communication technologies were utilised to deliver TAFE courses. Satellite delivery has also enabled access to learning opportunities beyond the learners region and it changed traditional approaches to delivery in small communities.

b) Engagement. The high level of attendance and high completion rates clearly demonstrate that this mode of delivery has the capacity to enthusiastically and successfully engage isolated learners. Aboriginal communities have embraced opportunities for engagement in mainstream technologies and they can now access more technologies within their own organisations. This engagement also has the potential to provide pathways for accredited learning. One respondent believed that the NSW TAFE IDL project had created a *'cultural shift'* in Aboriginal communities keenly considering future possibilities.

Table 1

Completion Rates for 2003 and 2004 IDL Courses

Institute	Enrolments	Completions	Completion Rate
North Coast	218	190	87.2%
Western	199	186	93.5%
TOTAL	**417**	**376**	**90.3%**

c) Collaboration and partnerships. This project enabled much collaboration and many partnerships including some that were not previously envisaged. It was expected that successful collaborations would occur between:

- NSW DET Equity, Distance Education and TAFE NSW;
- the NSW DET Aboriginal Development, Equity and Outreach and Information and Communication Technology Units;

- Optus and TAFE NSW;
- TAFE NSW Institutes;
- Outreach Coordinators, Aboriginal Development and Equity Managers.

These collaborations were extraordinarily advantageous and provided a firm foundation for the project. Enhanced relationships were created through unanticipated collaborations for example between:

- educational and ICT staff who worked together in problem solving to enable maximum efficiency of the technology.
- young Aboriginal people who were experienced IT users and their elders.
- family members who participated in this project eg parents who supported their children's learning and children whose lack of inhibitions using IT supported their parent's use of technology.
- non-teaching TAFE staff visiting isolated locations and 'seeing' the educational/learning process.
- Aboriginal Programs unit and TAFE staff in developing both a learners and facilitators guide in using the technology, which includes case studies specific and relevant to indigenous learners.

In addition, it provided learners with opportunities for group interactions and discussions, thereby minimising isolation.

d) Synchronism and real time learning. The interactivity of the learning process in this project was repeatedly raised by respondents and in student evaluations as providing a breakthrough in distance education. Distance modes previously used in TAFE have often restricted opportunities for interaction across learners and between teacher and students. Strong views were expressed in this Study indicating that projects that include strategies that allow students to share, collaborate and/or converse must be supported.

e) Capacity building within TAFE and communities. Capacity building is about increasing the abilities and resources of individuals, organisations and communities to manage change in their lives and communities. Communities of practice are established during this process as people and groups become involved in creating and managing change. This project developed a community of practice amongst TAFE staff and students that broadened their knowledge, use of, and interaction with, other technologies.

Organisational learning allowed NSW DET to identify the major educational, administrative and technological issues involved in satellite delivery. It enabled administrative, teaching and IT staff to use initiative and creativity in providing services and to consider and clarify their roles and responsibilities in pursuing this mode of delivery. This project not only required interactive technology but also necessitated interactive processes, communication and structures for that learning to be addressed and evaluated and to inform practice.

Communities and individuals have increased their capacity to utilise technologies and engage with education and government sectors and the broader Australian community. Most significantly this project provided cutting edge technologies and effective learning approaches to adult learners who may have not participated in learning since they left school. Satellite delivery provides a means of monitoring and addressing the *'digital divide'*, which is an international concern in communication technology.

The Future

Following the success of this project, the consortium has been successful in winning further Federal funding for 2005 to 2009 to expand the capacity for TAFE satellite delivered courses in remote locations.

This funding will allow the building of a dedicated TAFE studio which will in turn allow for greatly expanded delivery, especially during business hours. The increased capacity that the TAFE studio will provide will ensure satellite delivery becomes further entrenched in TAFE's e-learning responses to the needs of remote learners.

The Federal funds will be matched by the consortium, allowing for services to be expanded to a further 15 Aboriginal communities and another 340 individuals.

To meet the extra demand, curriculum developments are underway and planning commenced to train more TAFE teachers, across several Institutes and the Centre for Learning Innovation, in the pedagogy and technical skill to deliver via satellite.

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Nicole Foreshew DET Aboriginal Education and Training Directorate

Warren Smith, IDL teacher in the Dubbo studio

Dubbo Studio Instructor Station – 2 views.

The Teaching Team – Dubbo, New South Wales.

Mobile satellite trailer used to connect remote Aboriginal communities to TAFE classes.

Students in classrooms - Weilmoring