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Editorial

Alternative Paradigms

Donald G. Perrin

In good times we continue to build onto paradigms that made us successful. Changes in the world around us can invalidate those paradigms. Drucker gives some amazing examples in his Theory of the Business (1992). Joel Barker(1992) talks about *Paradigm Paralysis* where we continue in the old way with blind disregard, and Paradigm Pliancy where we question our paradigms and consider possible alternatives. In times of stress, people and organizations are more open to experiment and try paradigms that show promising results. We are approaching this point in education. We are not ready to abandon the old paradigm, but it is exceedingly painful to find resources to keep it going. The option of preparing smaller numbers of students because of the bad economy is counter-productive to our future needs, so what are we going to do?

The first paradigm I would challenge is that everything has to be learned as part of a *course* or *program*. New industries have developed that enable people with limited skills to buy complex systems they assemble for themselves – like desks, book cases, and office chairs, or install by themselves like computers, software, and networks. Step-by-step instructions, diagrams, and a checklist make instruction of the traditional kind unnecessary. The backup phone or internet connection is rarely needed. The result is substantial cost savings for the manufacturer, who can grow a bigger and more profitable business, and for the customer who gets affordable goods and services. Once I was at a faculty retreat where several hundred people had to be fed breakfast. The dining room had one person to set up and prepare food and one person to clear tables. The high point of the breakfast was individually made waffles with fresh strawberries. A simple sign told you how to use the waffle maker and prepare your own. The waffle maker became a social center like the water cooler. Everybody helped each other to prepare a delicious breakfast.

The second paradigm I would challenge is learning in the classroom. This solves management problems when working with young children, but for all of our attempts to make classrooms attractive and data rich, they are an intellectual desert compared to the world outside. In industrialized countries, homes have superior communication options to most classrooms with one or more audio record/play devices, radio, television, computers, internet, and multimedia cell-phones that encompass all of the previous options for adults and children.

The third paradigm I would challenge is traditional teaching - a lecture or instructor-led discussion. This tends to be one-way communication dominated by the instructor. Voice is one of the slowest means of communication, typically about 250 words per minute (wpm). The bandwidth for 30 or more people in the learning space is limited to one 250 wpm channel of communication at a time. Print is faster, audiovisual is richer, and interactive learning is more motivating. You can increase the amount of productive communication and learning that takes place by breaking into smaller groups or having learners work one-to-one with each other or with interactive technologies. We have tools that can double or triple individual learning yet 98% of instruction that takes place in schools and higher education is lecture-demonstration-discussion.

The fourth paradigm I challenge is the curriculum. Its roots are in the past, it rarely encompasses the present, and it is ignorant of the future. Our mission is to prepare learners for an emerging world and society. Do we really give them the knowledge, skills, attitudes, and higher levels of learning that will make them successful in this ever changing world? Can our graduates anticipate paradigm changes, recognize them when they occur, and change successfully in ways that will make them healthy and productive citizens? Do we need to change our paradigms for teaching and learning, curriculum and instructional design, and management of the educational enterprise?

Editor's Note: We immediately categorize almost everyone we come in contact with, including our immediate family. However, distinction between "artistic" and "analytical" have been documented since Plato and Aristotle and bear a close resemblance to the classical description of dissimilar minds and learning propensities. The editors are intrigued and cautious about the conclusions and inferences.

Digital Natives vs. Digital Immigrants: Myth or Reality?

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USA

Abstract

Marc Prensky (1998; 2001a; 200b) argues that students today, *digital natives* as he calls them, having grown up in the Digital Age, learn differently from their predecessors, or *digital immigrants* as he terms them. As such, the pedagogical tools we use to educate the Natives are outdated. Intuitively it seems that Prensky is correct: few people who teach digital natives fail to note their students seem to think and learn differently. Attractive as this thesis is, there is little evidence to support the proposition. That does not mean Prensky is wrong. He is onto something, perhaps something seminal, regarding today's pedagogies and the need to change them. But further research is required before we can conclude with any certainty that digital natives learn differently.

Digital Natives vs. Digital Immigrants: Myth or Reality?

Teachers or trainers of today's students realize at some point that they do not understand how many young students learn, or at least how they prefer to learn. Most do not analyze and articulate this realization. Few resolve to understand the apparent communication gap, and fewer still attempt to bridge it. Prensky is a pioneer in attempting to define the gap. If he is right, someday he may be considered a revolutionary thinker who alerted us to these notions. Our entire educational system—primary, secondary, and tertiary—may utilize pedagogies very different from those developed for the Industrial Age model of education, which in many ways is still used today.

Unless the language gap between the natives and immigrants is closed, or at least narrowed, it is possible that the greater part of teaching efforts will be misdirected and ineffective. We are wasting the organization's resources, whether teaching in formal education or in the workplace (Barnes, Ferris, & Marateo, 2007; Bennett, Karvin, & Maton, 2008). It is likely that global expenditure on education overall is ~$3-trillion.[1] Significant wastage of this money is hardly a trivial concern.

The difficulty with Prensky's propositions is the astonishing lack of research supporting them. Given the importance of the thesis, one would think that seven years later a respectable body of research would permit definitive expositions of the gap along with suggestions for further research and suggestions on closing the gap.

This paper reviews literature regarding the brain and learning, showing that digital natives probably learn differently from digital immigrants. A literature search on the thesis that digital natives learn differently reveals no significant empirical evidence to support it. Our first approach

[1] For brevity, we do not cite sources for the following figures. In the US K-12 sector alone, we are approaching an annual expenditure of $550-billion, which equates to ~5% of the GDP. We do not yet have a good estimate for tertiary, corporate and government training/education, but if we assume as a very broad generalization that the world GDP is ~$55-trillion[1], and assume that the percent of global GDP spent on all these forms of education is 6% (back of the envelope calculation), we are looking at total education spending of ~$3-trillion/year.

to this subject was to examine both the pros and cons of Prensky's thesis. On attempting this, however, we found that persons on both sides of the argument use "common sense," meaning neither those supporting or denying Prensky's theory have empirical research to support their position.

The Environment Affects Brain Wiring

The environment affects our perception of the world, and in turn, our perceptions affect the way in which we shape our world. For decades the only way in which we could "see" into the brain was by the use of psychology and psychological experiments. The experiments were analyzed using statistical science. These were the tools employed by educational giants of the 19th and 20th centuries, (for example, Bandura, Dewey, James, Montessori, Paiget, Skinner, Vygotsky). In a sense, the psychology/physiology of learning was like astronomy. Astronomy is a science in which we must rely entirely on remote observation. Just as we cannot visit Alpha Centuri to determine its physical characteristics, scholars had no direct way of knowing how the brain worked.

With the development of brain scanning tools in the past 30 years, and with the continuing emergence of increasingly powerful tools, we can finally prove the proposition that environment affects our brain wiring. A few examples suffice.

Neurons in Brains from Childhood to Maturity

Neurons connect our brain cells and are the wiring of our brains. In a newborn's brain, the connections between brain cells are sparse. As the individual grows to maturity, the connections multiply and thicken to become hugely complex networks akin to national highways, state highways, urban/rural roads, streets, and paths. The construction of the wiring depends on our experience.

Post-Traumatic Stress Disorder (PTSD)

Trauma can almost instantly and permanently change brain-wiring patterns. If exposed to traumatic stress and left untreated, the brain's wiring patterns can be changed for a lifetime (National Institutes of Mental Health, 2008, *para* 1).

Plasticity of the Brain

Early, critical periods exist during which the brain is wired/rewired on a large scale. As an animal matures, there are certain critical periods early in development during which brain plasticity is highly active. By the time the animal reaches adulthood, plasticity is greatly reduced (Howard Hughes Medical Center, 2002, *para* 16). Also, brain wiring changes every day: up to 20% of synapses disappear, to be replaced by new ones, leaving the overall synaptic density the same. Thus**,** the brain's size and wiring is an ever-changing landscape. Not just the wiring, but also the physical brain itself keeps changing from birth to death (Sowell et. al., 2001).

Contrary Ideas Regarding Brain Wiring

"Experience-wires-the-brain" is not universally accepted. Some argue that brain wiring is inborn, "with experience acting merely to preserve and enhance existing connections" (Duke University, 2000). Currently, however, the mainstream theory is that experiences matter regarding writing/rewiring the brain.

The problem the brain wiring research creates for analysis of Prensky's idea is: how do we get from here to there? Brain wiring is affected by environment; so digital natives have different brain wiring from digital immigrants. How does this translate into Prensky's thesis that natives learn differently than immigrants? The difference must be addressed.

The Literature on Natives vs. Immigrants

Tapscott (1998), the author of the influential book Growing Up Digital, is a pioneer in the idea that digital natives learn differently from digital immigrants. He spoke of Broadcast vs. Interactive Learning. In many ways, some suggest that Tapscott initiated the idea, while Prensky gave it a catchy name.

Table 1
Broadcast Learning vs. Interactive Learning

Broadcast Learning	Interactive Learning
o Linear, Sequential/Serial	o Hypermedia learning
o Instruction	o Construction/discovery
o One size fits all	o Customized
o Absorbing materials	o Learning how to learn
o School	o Lifelong
o Teacher-centered	o Learner centered
o School as torture	o School as fun
o Teacher as transmitter	o Teacher as facilitator

(Adapted from Tapscott, 1998, Figure 1)

Even a cursory examination of Tapscott's thesis shows he is conflating interactive learning with digital natives. Educators such as Montessori, who developed her methods 100 years ago, would have approved of Tapscott's interactive learning; she followed the same principles.[2] Indeed, it's hard to think of educational leaders in the second half of the 20th century who supported the broadcast learning model. Broadcast learning was the industrial Age model of teaching. By the 1880s the Industrial Age had grown to maturity and educators were already questioning the efficacy of the model (Berge, 1999).

Today "multimedia" means digital technology. In the pre-computer age of teaching/learning, good teachers routinely used a variety of media – print, pictures, movies, slides, audio etc. in their classrooms and training. Winteringham (1943) was a military analyst who made the point that weapons change tactics, and tactical needs change weapons. But at no point did he claim weapons *are* tactics or tactics *are* weapons! Tapscott mistakes interactive learning for digital learning whereas one is pedagogy and the other is a set of tools. Knocking down broadcast learning for any reason is knocking down a straw person. Except for the all-important consideration of efficiency for mass education, no educator believes broadcast learning is the way to go.

In a summary of his ideas, Tapscott (1998) cites just one UCLA research study on web-based learning versus traditional learning, and claims, "initial research strongly supports this view." The study, with 33 subjects in two groups, however, shows only that a course using web media produced 20% better scores compared to the course using voice and print. It tells us nothing about how, when, why, where – if at all, digital natives learn differently from digital immigrants. If the traditional class was taught using broadcast learning and the web class using interactive learning, this shows only that interactive learning is superior; as we've indicated; interactive learning is possible without digital technology.

[2] In particular, see a current examination of Montessori's methods of teaching geometry (Feez: 2007, p. 241-311).

Tapscott (2008) has updated his thesis in a new book *Grown Up Digital*. Unfortunately, this book has not yet been released. From an interview with Tapscott, we learn the new book has the results of a $4.5-million study that "draws upon more than 11,000 interviews conducted as part of a research project, as well as scientific studies and input from academic, business and government leaders" (Hoffman, 2008). Hopefully the book will provide quantitative research to support the thesis digital natives learn differently. Until then however, attractive as it may be, we must consider Tapscott's thesis unproven.

Oblinger

Diana Oblinger is a name hard to miss in any web-search on education and the digital generation. Recently she co-edited *Educating the Net Generation* (Oblinger & Oblinger, 2005), an Educause publication. In reviewing the 15 chapters in this publication, it became clear that digital natives conduct their learning differently from the immigrants. But none of the authors had any hard research in the proposition that digital natives learn differently from immigrants. All that can be concluded is that *natives use different tools and that they have different learning preferences.*

As an example, look at the questions below that Oblinger uses for self-identification as a digital native versus digital immigrant. Oblinger does not use the term "Digital Native," but Prensky's term clearly applies.

- Are you more comfortable composing documents online than longhand?
- Have you turned your "remembering" (phone numbers, meetings, and so on) over to a technology device?
- Do you go to meetings with your laptop or PDA?
- Are you constantly connected? Is the Internet always on whether you are at home or work? Is your cell phone always with you?
- How many different activities can you effectively engage in at one time?
- Do you play video or computer games?

Now, pretend that it is fifty years ago in the 1960s, before digital technology became available to everywoman and everyman. Let's reword the survey.

- Are you more comfortable composing documents using your IBM Selectric than longhand?
- Have you turned your "remembering" (phone numbers, meetings, and so on) over to a technology device such as voice recorder?
- Do you go to meetings with your voice recorder?
- Are you constantly connected? Is your radio and/or TV always on? Do you have a telephone constantly available?
- How many different activities can you effectively engage in at one time? (For example, listening to radio, talking on the phone, and doing homework simultaneously.)
- Do you play sports, participate in crafts and hobbies, read, play cards, do crosswords and number puzzles etc.?

Did the availability of technology tools such as typewriters, telephones, radio, TV, tape-recorders etc. in the 1960s mean ipso facto that kids who grew up with these technologies learned differently from kids who did not? Perhaps. But wouldn't a scholar of the 1960s making that assertion be required to support it with empirical evidence?

Lane and Yamashiro

Lane and Yamashiro (2008) conducted two surveys at the University of Washington of the sort that is typical of the research on digital natives:

In this climate of constant change, understanding how the university community becomes aware of and employs new technologies is critical. While personal anecdotes and the perspectives of early adopters are readily available, it is much more difficult to understand the general technology climate. A well-planned technology survey can provide evidence that extends beyond anecdote, allowing technology units, administrators, and other interested parties to make informed decisions that better meet the needs of the community. (Lane & Yamashiro, 2008, p.1)

Three important conclusions were:

- 1.5x Students bring laptops to class vs. Instructors
- 2.5x Students thought course websites should be required vs. Instructors
- 4x Students use Instant Messaging vs. Instructors for educational purpose

Fair enough. So we have a quantitative assessment of how natives use digital technology, and the unsurprising conclusion is that their instructors, who are on average, older and as such immigrants, use digital technology much less frequently. But what information do we gain on learning styles? Again, nothing.

Brown

Brown (2000), chief scientist at Xerox, discusses learning characteristics of the net generation. He researched how adolescent digital learners function. He concludes[3]:

- Multiprocessing: The digital learner can do several things at once despite what parents think. One can listen to music, talk on the phone and answer email. (See critique below.)
- Multimedia literacy: The digital learner's literacy is beyond text and includes images and screen literacy. Discovery-based learning. Comment: 100-year old stuff.
- Bricolage: The digital learner's form of reasoning is not deductive or abstract but more similar to Claude Levi-Strauss' concept of Bricolage, the science of concrete. Comment: we are unsure if Brown is aware that in K-12 education, for at least the last 30 years, the stress has been on Bricolage. This way of learning has nothing to do with Digital Natives.
- Bias toward action: The digital learner focuses on learning in situations. Learning is as much social as it is cognitive and becomes situated in action. Comment: figuring what this means requires smarter people than ourselves. If Brown is talking of informal learning outside the classroom, he need not worry. Students of all ages have always learned outside the classroom.

Unfortunately, the only data point presented in the article is:

People my age tend to think that kids who are multiprocessing can't be concentrating. That may not be true. Indeed, one of the things we noticed is that the attention span of the teens at PARC—often between 30 seconds and five minutes—parallels that of top managers, who operate in a world of fast context-switching. So the short attention spans of today's kids may turn out to be far from dysfunctional for future work worlds. (Brown, 2000)

While we appreciate Brown's enthusiasm and sympathy for the digital natives, does he suggest the best way to learn Multivariate Calculus is in attention bursts of 30-300 seconds? Are all digital natives going to become managers? Every different way of thinking has its place. Fast

[3] This is an edited version of the schemata from Skiba (n.d) as Brown uses drawings we were unable to interpret. The references used date from 2002.

context-switching is an absolute requirement for military officers, for example. But we may doubt Brown will risk surgery with a doctor/nursing staff with 30-300 second attention spans.

Most important: has anyone done research on multi-taskers in the context of how well they perform each task? Further, does this suggest that educators/instructors can now throw multiple tasks at their students, all to be simultaneously performed? If Brown wants expert multi-taskers who may never have seen a digital device, he should research mothers/housewives.

As with other sources, we are left with the same problem: there are a lot of perceptive insights into how digital natives behave differently from digital immigrants. But is their behavior different because they have access to so many more tools than immigrants had or are they learning differently? We still don't know.

Dosaj and Jukes

Dosaj and Jukes (2006) are a perfect example of creating a framework of thinking and then looking for data that supports the framework. For example:

Digital natives learn differently

Digital natives on the other hand, pick up new devices and start experimenting with them right away. They assume the inherent design of the devices will teach them how to use a new gadget intuitively. This is because the digital native has adopted a mindset of rapid-fire trial and error learning. They're not afraid of making mistakes because they learn more quickly that way. They use devices experientially, and have no problems getting help online. . .

Digital Immigrants do not understand this

> *. . . But many digital immigrants just can't conceive how anyone can learn like this. So by the time a digital immigrant has read the table of contents of a manual, the digital native has already figured out 15 things that will work and 15 things that won't. While the digital immigrant is afraid they'll break the device, the digital native knows they can just hit the reset button and do it all over again. In fact, for many digital natives, they see the world as one great big reset button. (2006, p.15)*

How many people do Dosaj and Jukes know that actually read a manual before using a gadget? Yes, there are people who read the manual, usually engineers, but they are in a distinct minority. People learn to use computers the way they learn to ride a bicycle or a car or cooking or sewing, by watching someone else and then doing it themselves. A big reason immigrants might be nervous about breaking digital devices is because they are expensive - they do not know in advance how robust digital devices can be, and they've heard horror stories about people hitting the wrong button and losing all their work or harming the machine. Natives, i.e., children, usually do not have to pay for the devices, so they can afford to bang away.

Furthermore, digital natives start with digital devices when they are toddlers. So what manuals are they reading? In the days we played with blocks and erector sets instead of digital devices, did we read manuals before starting? Trial and error is the standard way of learning, digital device or not.

Conclusions

As yet no significant empirical evidence exists to support Prensky's Conjecture. Before suggesting the need for empirical research, perhaps we should take into account:

- Since brain wiring is ever changing, digital immigrants may not start with advantages possessed by digital natives, but possibly the gap between native students and immigrant instructors is not as wide today as it was ten years ago.

- If we count those born after 1980 as natives, the first cohort is now approaching age 30. Natives are then likely to already form some significant percentage of schoolteachers, and some percentage of college instructors and corporate trainers. Their numbers can only increase each year.
- Given that several years of research is needed, and then several years more will elapse as research is translated into policy and then on to the classroom floor, it is possible by the time immigrants learn to teach natives, the divide – if it exists – will become irrelevant.

Nonetheless, Prensky's ideas are fascinating and useful because they cause immigrant teachers to rethink their assumptions regarding their native students. This may cause better teaching regardless of their students' technological learning preferences.

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Editor's Note: The contributions of the LISTENER to language learning can and will be extensive. It is hoped that this project receives all of the academic and fiscal support required to fully realize its potential. Dr. Aguilar is to be congratulated on this research.

LISTENER: A New Personalized Multimedia Interface for Ubiquitous Learning

Gabriela Aguilar
Mexico

Abstract

The present paper introduces a new personalized multimedia interface for ubiquitous learning called LISTENER. This interface will consist of headphones and microphone, and a special device to input the document to be read. LISTENER will consist of three main processes. These are SPEBC (an adaptive computer-based assessment system), the content analysis module and the Natural Language Processing Module. On one hand, students will be able to interact with LISTENER by inputting spoken text or by inputting a textbook, paper, etc and SPEBC will generate questions based on request in order to assess the student's understanding levels. On the other hand, the content analysis module will ask questions to the students about the omitted information in their answers. The Natural Language Processing Module will allow the input and output of data through the processing of speech synthesis and speech recognition, as an alternative media.

Keywords: Ubiquitous learning, Questions Generator System, Multimedia interface, Content Analysis of Written Text, Formative Assessment, Assessment of Multiple-choice and Open-ended Questions, Spoken Dialogue System.

Introduction

The present work introduces LISTENER, a new personalized multimedia interface for ubiquitous learning. LISTENER is the result of the improvement of SPEBC (Author, et al., 2006), an adaptive computer-based assessment system and of the content analysis of written text.

The first prototype of SPEBC was implemented. This is the Factual Questions Generator System (FQGS) (Author, et al., 2008). The FQGS was implemented to prove the feasibility of the questions generation approach. When the questions generated by the FQGS were being analyzed, the author realized that for some well-formed questions, there were no answers in the text document given as an input. So the author came up with the idea that this kind of questions can be very useful for users when they are writing a paper or analyzing a software requirement specification or useful for learners when they are writing an essay or answering an open-ended question. The generated questions without answer will be filtered by the content analysis of written text module. The filtered questions will help learners to think about the missing points in their answers for open-ended questions or in their essays, because the missing points will be pinpointed by the generated questions.

Furthermore, after the first prototype of the content analysis of written text was implemented, the author came up with another idea: to design and implement, a new hardware and software in order to give to the learners a new interface which allow them to interact with SPEBC and the content analysis module, through speech synthesis and speech recognition. This new hardware and software was called LISTENER.

Previous works about the development of intelligent tutoring spoken dialogue systems have been developed. One of those is ITSPOKE (Litman, et al., 2004). ITSPOKE uses the Why2-Atlas text-based tutoring system as its “back-end”. A student first types a natural language answer to a qualitative physics problem. ITSPOKE then engages the student in a spoken dialogue to provide feedback and correct misconceptions, and to elicit explanations that are more complete. On other hand, Mostow (et. al., 1997) implemented an interactive reading tutor called LISTEN, which listens to children read aloud, and helps them learn to read.

Students will be able to use LISTENER, to record the activities such as the teacher’s explanation, to record an experiment, etc. On other hand, learners will be able to talk with the interface to answer an open-ended question, to dictate an essay, etc. Moreover, students will be able to work in a collaborative way and they will be able to ask LISTENER to function as the discussion moderator. Students will be able to learn anywhere they want, because the portability of this interface. At the same time, LISTENER will help them to comprehend the not understood topics or to have a greater understanding, through a questions and answers process.

The functions of SPEBC, the functions of the content analysis and a spoken interface will be combined. The result of this combination will be LISTENER, a new personalized multimedia interface for ubiquitous learning.

This paper is organized as follows: The first section is the introduction above; the second section presents the antecedents of the problem to be solved; the third section introduces an overview of LISTENER; the fourth section gives the architecture of LISTENER; the final section of this paper provides conclusions.

Antecedents of the Problem

LISTENER, as an improvement and as the spoken interface of SPEBC (Author, et al., 2006) and of the content analysis of written text module, will try to improve, at the same time, the solutions for the problems that SPEBC and the content analysis will try to solve.

SPEBC will try to support teachers and learners in the solution of the following problems: The first one is about the low levels gathered by 15 year old Mexican students in reading literacy (PISA, 2006). The second problem is about the need for tools, which help teachers address the class diversity that can be found in Mexican schools. SPEBC will support teachers and learners in the solution of these problems as follows: SPEBC will generate personalized assessments based on the learners’ background knowledge and external representation types (Giere, R. et al., 2003). SPEBC will include initial, formative and summative assessments. Furthermore, SPEBC will generate multiple-choice and open-ended questions, personalizing the responses according to each learner and knowledge content. Moreover, SPEBC will provide two personalization levels: individual and team (Author, et al., 2007).

LISTENER will go a step further by implementing a mobile and easy to use interface (See Fig. 1) and it will support teachers and learners in the solutions for the two above stated problems, by providing a spoken interface for the questions and answers process. The spoken interface will implement what was found by Koedinger (2000) and by Chi (et al., 1994).

Koedinger (2000) found “that students learn with greater understanding, when they are required to explain their solutions steps, that is, by naming the rule that was used. However, the tutor may be even more effective if students explain their solution steps in their own words and if the tutor helps them, through dialogue, to improve their explanations”.

Moreover, Chi (et al., 1994) concluded, “that learners having articulated an incorrect explanation, they continue to read the next sentence or sequence of sentences in the text. Eventually, the text sentences, because they always present correct information, may contradict knowledge embodied in the incorrect self-explanation. While reading, there are many opportunities whereby what is read contradicts what is being created or existed a priori in one's mental structure. Self-explaining thereby gives rise to multiple opportunities to see conflicts between one's evolving mental structure and the verbal description of it from the text". (Chi, et al., 1994).

By using LISTENER, students will be able to input spoken answers and essays. LISTENER will be able to ask questions about the learner's spoken inputs. LISTENER will try to support learners in two ways: First, LISTENER will ask them questions based on the text document given as an input in order to evaluate their understanding levels of that given text, in such a way that LISTENER will ask factual questions to the learners about the document that they are studying. Second, LISTENER will evaluate the student's answers or essays by generating some others questions from each learner's answers. And these questions will be those, which pinpoint the omitted information in each learner's input, in such a way that learners will be able to improve the draft of their answers or essays. SPEBC is a domain independent system, therefore, the content analysis module and LISTENER will be also domain independent systems.

Overview of LISTENER

The proposed interface will consist of headphones, microphone and a special device to input the document to be read by the system. Optionally, users will be able to use a video camera with LISTENER.

Some possible scenarios in which LISTENER will be used are as follows. The first possible scenario takes place in the classroom. Students will use LISTENER to record activities such as the teacher's explanation, interactions among students when they are solving problems, and details of an experiment. This will be saved as a video clip in a USB flash drive and learners will access them by using a computer to watch the video or by using only LISTENER to listen the audio. LISTENER will be able to apply speech synthesis to generate a written text of the audio of that video clip.

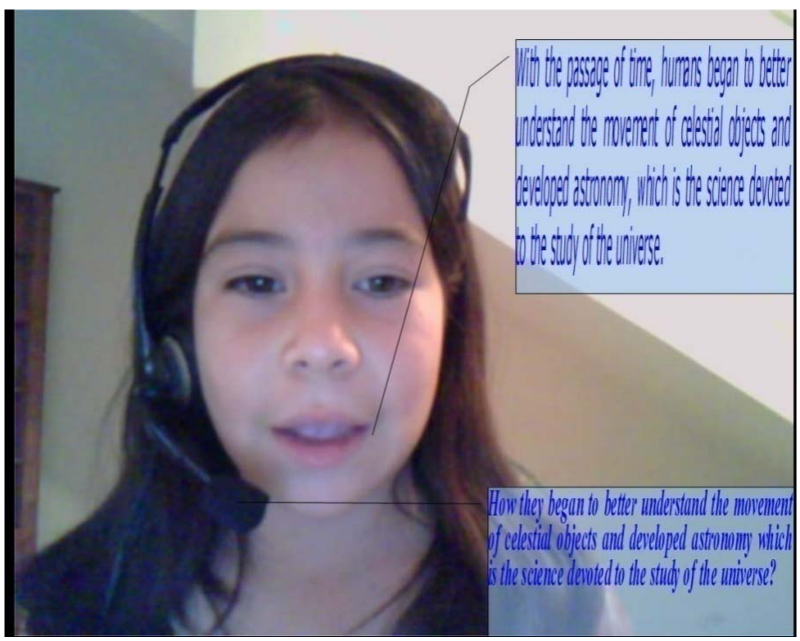

Figure 1: Second possible scenario in which LISTENER can be used.

The second scenario is interaction between the student and LISTENER. The learner talks with the interface to answer an open-ended question, to dictate an essay, or just to think aloud expressing ideas about a given topic (See Figure 1). And LISTENER will help learners to complete an answer or essay or clarify their ideas through generation of questions.

The third scenario will support collaborative work among students and LISTENER. One computer with an internet connection will be required for each student. Students will be able to establish a connection from anywhere they are to the classroom or to any other place. Students will able to ask LISTENER to function as the discussion moderator. LISTENER will generate questions about the text documents given as an input or about the conversations among students. Furthermore, each student will be able to use LISTENER as explained in the second scenario so learners will be able to share with other students the personal feedback given to him or her. Moreover, LISTENER will save a record of the discussion and this will be available s text or audio. It will be necessary to implement a specific web application that facilitates collaborative work among students and LISTENER.

The Architecture of LISTENER

The software to be included in LISTENER consists of SPEBC, content analysis module and the natural language processing modules. A brief description of each module is given below:

SPEBC

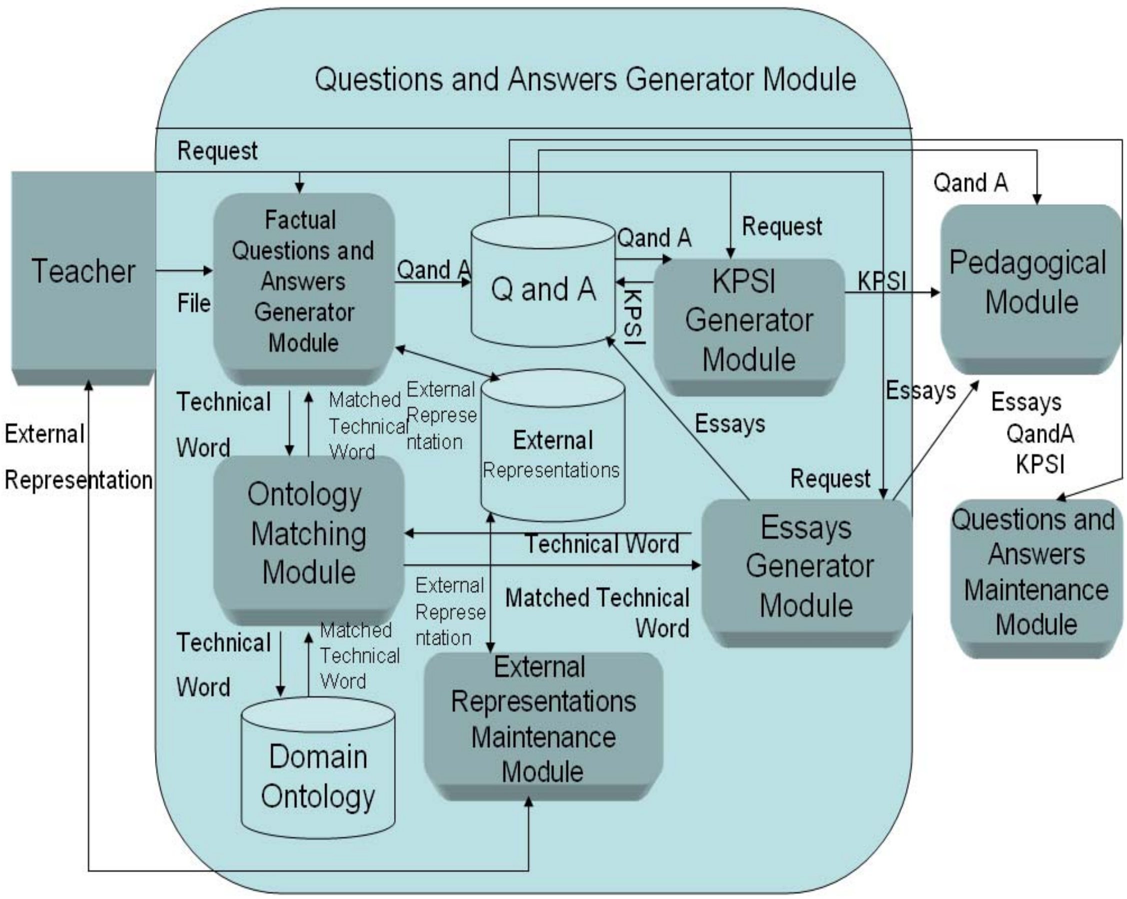

Figure 2: Design of the Questions and Answers Generator Module (Author, et al., 2007)

Figure 2 shows in detail the design of the Questions and Answers Generator Module. The key characteristics of the functionality of this module are as follows.

> *Teachers will have to request the generation of a KPSI, factual questions, and/or essays. The factual questions generator will generate the questions to be included in KPSI or in an assignment consisting of factual questions. This module will interact with the ontology-matching module in order to identify meaningful tokens such as names, places, models, etc. These data will be saved on the domain ontology database. The factual questions generator will access the representations database, in order to generate personalized responses.*

Three kinds of representations (Giere & Moffat, 2003) for each knowledge content will be saved on the representations database. The output of the factual questions generator will be the generated questions and answers and these will be saved on the Q and A database.

The Q and A database will contain essays and KPSI inventories. The essays generator will interact with the ontology-matching module in order to identify the technical words to be included in the essays. The KPSI generator will obtain the questions to be included in the assignment from the Q and A database. These questions are going to be previously generated by the FQG and saved on the Q and A database.

The representations maintenance module will allow to capture and record of representations on a database. The outputs of the FQG, KPSI generator and essays generator will be the input for the pedagogical module. The pedagogical module controls the selection of questions and help teachers in the planning of the generation of assignments. The outputs of the pedagogical module are the assignments" (Author, et al., 2007).

The adaptation process to be included in SPEBC is based on the creation of the knowledge and learner's models, being the contribution of this approach the incorporation into these models, the required and background knowledge, grade of difficulty and external representation types (Giere, R. et al., 2003). The learner's personalization factors are: background knowledge and external representations. The knowledge content personalization factors are: required knowledge and external representations. The external representation factor is divided into understanding level, grade of difficulty and representation type (Author, 2007).

Content Analysis of Written Text Module

The content analysis module is based on a check of the learners' responses, through an automatic generation of questions from their answers, in order to pinpoint the omitted information in each sentence given as an input.

The text given in Table 1 and the questions presented in Table 2, exemplify what the author means with "omitted information". Table 1 shows a paragraph of an elementary school textbook, from which questions were generated. Table 2 gives a more specific example of the kind of questions generated by the FQGS and filtered by the content analysis prototype. These questions pinpoint the omitted information in the text given as an input.

The content analysis approach consists of filtering and deploying factual questions, which do not have an answer in the text given as an input. In the current implementation state, the content analysis for written text generates only how questions with no answers. The FQGS and the content analysis prototype process only text written in Spanish, therefore, the text presented in Table 1 and 2 are a translation from Spanish to English.

Natural Language Processing Module

The Natural Language Processing techniques to be included in LISTENER are speech synthesis and speech recognition. The approaches to be followed for the implementation of speech synthesis and speech recognition are those given by (Morris, 2000).

Table 1
Text taken from a Natural Science Textbook used in Mexican Public Elementary Schools

TRANSLATION
Thus, our ancestors built the first observatory. The Maya, for example, studied the motion of celestial bodies and brought the registration of phenomena such as eclipses of the sun and moon. They also created a calendar, which they used to measure the time and predicted important dates in accordance with their beliefs. With the passage of time, humans began to understand better the movement of celestial objects and developed astronomy that is the science devoted to the study of the universe. Thanks to it, today we know not only the duration of one year and the seasons, but we also know the position that Earth has in the solar system and the latter in the Milky Way, and they are part of the Universe. Only relatively recently and with the development of powerful telescopes and other devices such as computers, astronomers were able to give a scientific explanation to one of the oldest questions that had the human being: the origin of the universe.

Listener

Figure 3 shows the context diagram designed for LISTENER. Figure 3 shows that the user can input a text document such a paper, dissertation, requirement specification document, etc. And then users will be able to request the generation of questions. SPEBC will generate open-ended, multiple-choice questions, KPSI and essays. Open-ended questions with and/or without answer will be the input for the Content Analysis Module, which will filter and deploy questions without answer to pinpoint the missing points in the learners answers or explanations. After selecting and filtering the open-ended questions with no answers, the content analysis module will give these questions as an input for the Natural Language Processing Module.

Also, SPEBC will provide the generated multiple-choice and open-ended questions, KPSI and essays as the input for the Natural Language Processing Module. The Natural Language Processing Module will perform the speech synthesis and speech recognition processes. And spoken text will be the input and output for the Natural Language Processing Module.

Table 2
Generated questions by the FQGS (Author, et al., 2008)

TRANSLATION
How they began to understand better the movement of celestial objects and developed astronomy that is the science devoted to the study of the universe?
How could they give a scientific explanation to one of the oldest questions that had the human being: the origin of the universe?

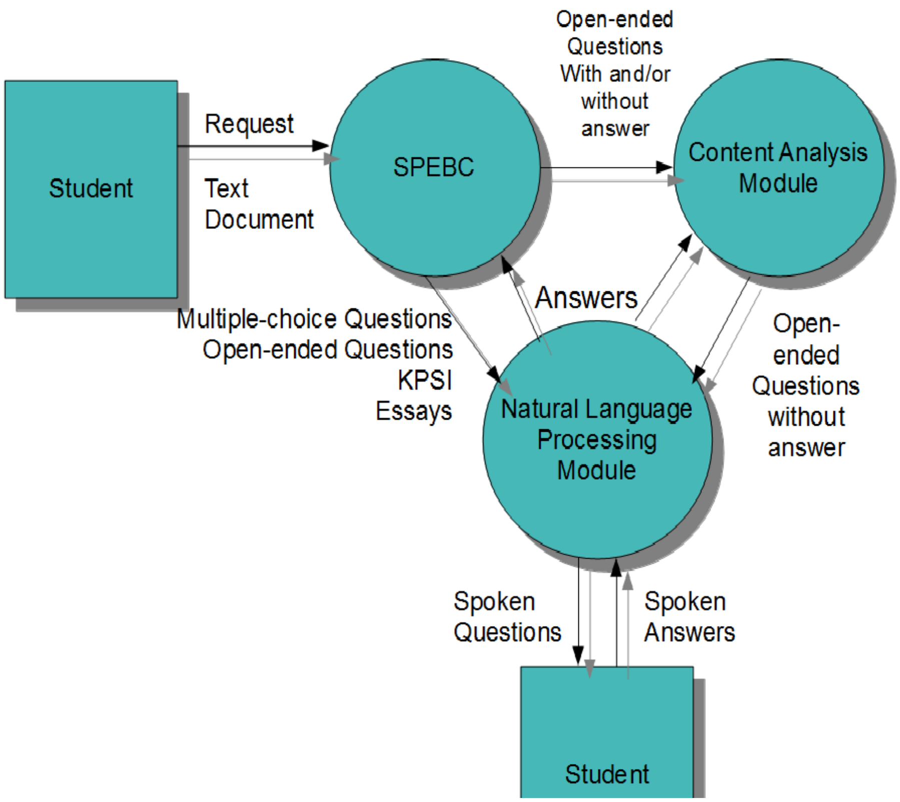

Figure 3: Design of the Context Diagram of LISTENER

Conclusions and Further Research

The present paper introduces a new personalized multimedia interface for ubiquitous learning called LISTENER. This interface will consist of headphones, microphone and of a special device to input the text document to be read. The proposed interface will allow the input and output of data through the processing of speech synthesis and speech recognition, as an alternative media.

A preliminary evaluation of the generated questions was done. The textbook of a 6th grade of a Mexican public elementary school was given as an input. The syntax and semantic of the generated questions were evaluated. From the input, SPEBC generated 255 questions, 28 syntactically incorrect and 33 semantically incorrect. In the evaluated version of SPEBC, the author had to capture the verbs and adverbs included in the textbook. Further research has to be done in order to evaluate the combination of the shallow parser and sentence transformation, which allow the domain independence.

After finishing the implementation of the first prototype of SPEBC, the author is planning to evaluate SPEBC in the classroom. In order to do this, the author is thinking to work with teachers and students of 6th grade of an elementary school. The evaluation process will have two faces: First, the evaluation in the classroom, using a voting system as the interface between SPEBC and the students. And second, the evaluation of SPEBC, when this is used by the learners at home. The effectiveness evaluation results will allow the generation of some useful proposals for teachers.

On other hand, the first prototype for the content analysis was implemented. However, this prototype generates only how questions. Further work need to be done in order to finish the implementation of the prototype which filters and deploys what and why questions. The effectiveness evaluations for the content analysis will be done by evaluating how effective are these questions to pinpoint the omitted information in a given text.

In order to determine the effectiveness evaluation of LISTENER, three scenarios in which LISTENER will be able to be used will be considered. Further work is required in order to implement the speech synthesis and speech recognition approaches. Also, further work is required in order to build the hardware of LISTENER.

LISTENER has a potential application in education; however, its value is not exclusive to education. Researchers and other professionals will be able to use this new interface to help them understand a given topic, to clarify their ideas, etc. LISTENER will be able to really "listen" to users, and it will interact with them through question and answer processes using the same difficulty level, using the same vocabulary, etc., in a personalized way.

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Editor's Note: The editors would be interested to see this research repeated with additional data elements: achievement levels of on-campus students who attended the live lecture and also accessed the video compared with live-lecture only students and video-lecture only students.

Availability of Internet Download Lecture Audio Files on Class Attendance and Examination Performance

Gary N. Elsasser, Eric B. Hoie, Christopher J. Destache, Michael S. Monaghan

USA

Abstract

Objectives. To compare the impact of digitally recorded lecture audio files on student class attendance and examination performance.

Methods. Digitally recorded lecture audio files that had not been available to students for download in the first semester of a two-semester course sequence were made available the second semester. Upon completion of the course students completed a questionnaire describing the usefulness of lecture audio files and its impact on attendance. Similarly, faculty was asked to estimate lecture attendance. Examination scores were compared to the previous semester and the previous year.

Results. One hundred percent of students (n=105) returned completed questionnaires. Ninety-six respondents (91%) reported using the audio files as a replacement for attending lecture. Likewise, 100% of faculty reported a decrease in student attendance by at least 25% from the previous year. Students' spring 2005 mean exam scores increased by 2% over the previous semester and almost 4% higher than the previous year ($p < 0.05$). This is despite having mean exam scores that were significantly lower ($p < 0.005$) when comparing fall 2004 scores to those of fall 2003.

Conclusions. The availability of digital lecture audio files significantly impacted classroom attendance at the same time improving examination performance.

Keywords: class attendance, technology, pharmacy students, attendance, teaching, lecture, policy, required attendance, mandatory attendance, exam performance

Background

The causal dependence of class attendance on academic performance has long been a source of debate and controversy.[1-5] With each new advent of technology there is generated another argument for and against the need for class attendance.[5, 6] In 2000, Creighton University School of Pharmacy and Health Professions became the first pharmacy school to offer a distance pathway leading to the doctor of pharmacy degree in parallel to the campus experience. Parity between the pathways was a primary focus.

The Pharmacotherapeutics (PHA 450, 460) courses are presented over a two semester sequence and team-taught in the fall and spring to students' entering their third professional year. The course met on Monday, Wednesday and Friday from 8:00 A.M. to 9:50 A.M. In addition, the class was divided with each half meeting Monday or Wednesday afternoon from 1:00 to 4:00 P.M. This period served as a case study experience designed to assist the student in the integration of didactically presented material via a case study format. Student assessment was accomplished each semester via 5-100 point short answer examinations, spaced throughout the semester. Distance students were required to take the examinations on the same day as their campus counterparts. In addition, each of the 12 case study sessions was accompanied by a 5 point quiz. Students in the distance pathway met via chat rooms with faculty monitoring discussion. In the fall of 2003, in order to accommodate distance-based students we began to digitally record the campus-based lectures and offered them via internet download to distance pathway students in addition to the PowerPoint® lecture slides. Each digitally recorded lecture was uploaded by the Office of Information Technology and Learning Resources to the campus-based course website immediately upon completion of the lecture. Students were advised of the availability of the audio files along with the PowerPoint® lecture slides during the course orientation. At the same time, only PowerPoint® lecture slides were available for the campus students to download since they had the capability of attending live lectures. This policy was changed for the spring 2005 semester to allow campus students the same access to the recorded lectures as the distance students. With the exception of access to audio files, the format of the class did not change significantly from the previous semester or the previous year. Lecture sequencing, topic instructors and examination format was relatively unchanged from the previous year.

The purpose of the described investigation was to compare the impact of digitally recorded lecture audio files on student class attendance and examination performance of campus students participating in the Pharmacotherapeutics course.

Methods

As a component of a 12-item, Likert-style class assessment questionnaire (Appendix 1), students enrolled in the spring 2005 Pharmacotherapeutics class were asked about class attendance, impact of audio files and opinions regarding required attendance. The questionnaire was distributed during the final exam and students were asked to provide responses anonymously to the instructor of record upon completion of the final examination. In addition, faculty providing lectures both for the 2003-2004 and 2004-2005 course sequence were provided a seating capacity figure for the lecture room and asked to estimate the percent student attendance during their lectures as 100, 75, 50 or 25. Faculty who had participated in the course the previous year was also asked to estimate a percentage change in attendance from the previous year (2003-2004). Finally, examination scores for 2004-2005 were compared to those of 2003-2004. Student questionnaire responses and faculty estimates of attendance are presented as descriptive data. Examination scores were compared using Student's T-test with a p value of < 0.05 considered statistically significant

Results

Table 1. identifies mean examination scores for the 2003-2004 class in comparison to the class of 2004-2005. Mean scores for spring 2005 class (access to audio files) were almost 4 percent higher than the previous year ($p < 0.05$).

One-hundred percent of students (n=105) returned completed questionnaires. Ninety-six respondents (91%) reported using the audio files as a replacement to attending lecture with 12% of students reporting they used the audio files as a replacement for lecture between 16 and 30 times (20% and 37.5% of lectures). Eighty-two percent of students agreed with a statement that the availability of audio files aided their learning. Likewise, 82% reported that they listened to the audio files as a resource to study for exams (Figure 1). Faculty (n=7) described at least a 25% decrease in lecture attendance by students and as high as 75%. The faculty unanimously agreed that attendance had decreased by at least 25% from the previous year.

Table I
Comparison of Mean Examination Scores

	Mean	Std. Deviation
Fall 2003 (n = 103) (no audio files available)	81.89[1]	6.88
Spring 2004 (n = 97) (no audio files available)	76.97[2]	5.43
Fall 2004 (n = 108) (no audio files available)	78.88	8.23
Spring 2005 (n = 105) (audio files available)	80.92[3]	5.90

[1]Statistically significant compared to fall 2004 ($p < 0.005$)
[2]Statistically significant compared to spring 2005 ($p<0.05$)
[3]Statistically significant compared to fall 2004 ($p < 0.05$)

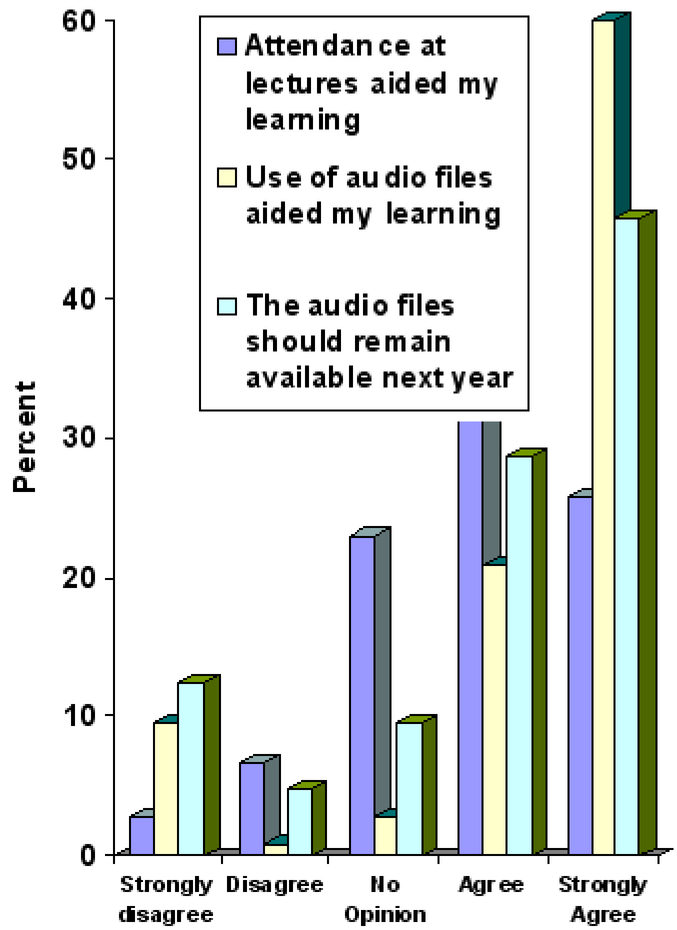

Figure 1. Student Responses

Discussion

For students who have difficulty performing well in a traditional educational setting (lecture-style format in a classroom environment) the assistance of new technology may have a beneficial impact.[5] In our report, the availability of digitally recorded lectures was positively associated with an improvement in examination performance. This is noteworthy given that the same class' mean exam scores were poorer as compared to the previous year (fall 2004 compared to fall 2003) when they did not have access. Students surveyed, overwhelmingly agreed that the audio files were a benefit to their learning and should be made available for the next years' class. Coincidently, as was expected, class attendance decreased as reported by the students themselves and participating faculty members. All of our students are provided laptop computers for their use from the first week of classes and are encouraged to utilize them throughout the curriculum. In addition, the classroom in which the Therapeutics course is presented is equipped with wired internet connectivity. Adams has suggested that "faculty need an internet on/off switch" in the classroom.[6] He points out, and I would concur from personal observations, that given internet access in the classroom, some students will choose to engage in instant messaging, email, on-line shopping as well as any number of other activities unrelated to the instructors presentation at hand. It is certainly possible that students easily distracted in class by activities unrelated to classroom instruction perform better through independent study.

We did not assess the impact of class absenteeism on examination performance on an individual student basis and therefore cannot comment. Aggregate data however, suggests that the potential negative impact of absenteeism may be attenuated by the availability of lecture audio files. Certainly there are other benefits to classroom attendance that cannot be measured by comparing examination performance. The importance of developing social skills, professionalism, self discipline, and mentoring facilitated through class attendance should not be minimized by the results of this study.

This study is of course not without its limitations. Three students enrolled in the fall 2004 semester, did not carry on to the spring 2005 semester (late enrollment – 2 students, and academic difficulty -1) and may have had an impact in the comparison of exam scores. Also, as stated previously, attendance was estimated both on the part of the student and the faculty and may have been over or underestimated. There is however no question that attendance did in fact decline from the fall when no audio files were available in comparison to the spring, when they were made readily available.

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Appendix 1

Student Course Assessment Questionnaire

This questionnaire is being conducted to identify strengths and weaknesses of the Therapeutics course. It does not replace the online course or instructor evaluations. It is not required that you complete this questionnaire and there will be no direct benefit to you. It may help your fellow students in the years to follow. Your responses are completely anonymous as there are no means to identify you in this questionnaire. If you agree to participate, please answer each question by circling the letter that best describes your opinion.

1. I found the course website user friendly and easy to navigate.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

2. I found the course website aided my learning.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

3. I liked being able to download instructor PowerPoint files.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

4. The availability of audio files aided my learning.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

5. I listened to audio files as a resource to study for exams.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

6. I used the audio files as a replacement for attending lecture.
   A. Never
   B. Rarely (1-5 times during the semester)
   C. Occasionally (5-15 times during semester)
   D. Often (16-30 times during the semester)
   E. Always

7. The audio files should remain available for next year's class.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

8. Case Studies helped me apply the formation I learned from lecture.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

9. I wrote/typed out my answers to the questions from Case Studies before going to Case Studies class.
   A. Strongly disagree
   B. Disagree
   C. No opinion
   D. Agree
   E. Strongly agree

10. I would be in favor of "required attendance" for Case Studies with a penalty for absences.
    A. Strongly disagree
    B. Disagree
    C. No opinion
    D. Agree
    E. Strongly agree

11. Attendance at the Case Studies class aided my learning.
    A. Strongly disagree
    B. Disagree
    C. No opinion
    D. Agree
    E. Strongly agree

12. Attendance at the lecture aided my learning.
    A. Strongly disagree
    B. Disagree
    C. No opinion
    D. Agree
    E. Strongly agree

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Editor's Note: It occurs to this editor (who has extensive teaching experience in classroom and distance learning) that two vibrant areas of concern are 1) open book and 2) time. The immediate collection of tests from both classroom and online learners is a key component to assess learning. The editors would be interested to compare knowledge retention each group.

Traditional versus Online Content Delivery and Assessment

Margaret D. Anderson and Mark Connell
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Abstract

The present study compared several dimensions of a traditional course with those of a parallel course offered online. The elements under consideration included: 1) self selection versus assignment to courses; 2) student attrition; 3) performance related to entering knowledge; 4) performance variability in the 2 formats; 5) the effect of open versus closed book tests on scores; 6) performance variability in proctored and unproctored settings; and 7) academic integrity in online assignments. The results indicated no difference in attrition between the 2 sections. Similarly, there was no difference in entering knowledge between the 2 sections, and no relationship between entering knowledge and performance on either chapter tests or final exam for either section. However there was a strong relationship between chapter test and final exam performance in both sections. In addition, students taking unproctored open book tests outperformed those taking the proctored, closed book tests and this advantage remained even when both groups completed the same proctored open book final exam. Results suggest a possible training effect of taking multiple short open book tests. They further indicate that frequent low stakes assessments may encourage higher levels of academic integrity in online students.

Keywords: on-line tests, on-line academic integrity, proctored tests, open-book tests.

Introduction

Distance education, particularly online courses, is increasing at an exponential rate. The most current report from the Sloan Consortium (Allen & Seaman, 2007) indicates that in the fall of 2006 nearly 20% of all U.S. higher education students, or approximately 3.5 million students, were taking at least one online course, representing a nearly 10% increase from the previous year. In addition, nearly all (83%) of the institutions offering online courses expect their enrollments to increase over the next year. With the increase in these offerings come concerns over the quality of the courses and the integrity of the related assessment instruments. While many of the concerns are those with which academics have traditionally grappled, the new delivery medium has introduced a host of new dilemmas for instructors and academic institutions. The present paper addresses seven interrelated areas of concern.

Self Selection versus Assignment to Courses

Regardless of the delivery medium, researchers have explored the effect on academic performance of allowing students to self-select rather than assigned to sections of courses. The concerns surrounding this variable are exacerbated when one of the sections is taught in the traditional face to face lecture method and the other is offered asynchronously online. Waschull (2001) compared traditional and distance courses and reported that regardless of the method of placement (self selection or assignment) attrition rates and performance were similar. Collins and Pascarella (2003) reinforced this finding, concluding that students can learn equally well in traditional or distance classes whether they self-select or are randomly assigned. However, Collins and Pascarella include the caveat that distance students who self select do perform slightly better than other groups, thus possibly compromising the body of research on students' self selection into distance courses.

Attrition

Of equal concern to educators is the attrition rate of students from courses offered in traditional formats compared to online models coupled with self selection or assignment into those courses. Waschull (2001) and Collins and Pascarella (2003) both noted no difference in attrition from on-campus to distance courses, regardless of whether students self selected or were assigned to the section.

Entering Knowledge and Course Performance

Kruck and Lending (2003) studied a question which is of concern to academics and administrators alike, the ability to predict student performance. They noted the earlier contradictory data, with some researchers demonstrating a relationship to performance in prior related courses (Eskew & Farley, as cited in Kruck & Lending, 2003), while others (Marcal & Roberts, as cited in Kruck & Lending, 2003) found that a prerequisite course was not associated with subsequent performance. Thus they undertook a study to investigate the ability to predict academic performance in a college level course. Their findings supported the hypothesis that while motivation and overall GPA do predict performance, prior related courses or background knowledge was not significantly related to subsequent performance.

Performance in Traditional and Online Courses

The recent growth in online offerings naturally leads researchers to study students' performance in these new courses as compared to that in a more traditional course. Once again, findings from these studies are inconclusive. Students in both conditions of the two Waschull (2001) studies demonstrated similar course and final exam scores. However, Liu (2005) reports that there is a significant difference in learning outcomes between students enrolled in equivalent online and traditional sections of a graduate level course, with the online students outperforming classroom based students on both quizzes and final tests.

Open versus Closed Book Tests

One pedagogical element now frequently at the heart of the difference between traditional versus online courses is the use of open or closed book tests and the effect that difference might have on student learning. In comparing open and closed book tests Brightwell, Daniel, and Stewart (2004) conclude that well developed questions are equally effective at discriminating student abilities in either administration modality. Results from the Agarwal, Karpicke, Kang, Roediger, and McDermott (in press) study indicate that while performance on open-book tests was superior to student performance on closed-book tests, the benefit did not persist on delayed tests. However, students do report liking the open book online test better than an open book in-class test because of the immediate feedback (Liu, 2005), and Agarwal et al. (in press) claim that feedback does enhance long-term retention for either type of test. Rakes (2008) points out that, while open book testing may more closely resemble authentic assessments in the work environment, most students may not necessarily be adept in these types of tests. She endeavored to ascertain whether training in taking open book tests would improve student performance on those measures. Her results indicate that the training results, while significant if training is administered immediately prior to the assessment, were not sustained over time.

Proctored versus Unproctored Tests

An issue related to the one discussed above is the effect proctoring might play in student performance. In the traditional classroom it is a simple matter for the instructor to decide to, or not to, proctor an examination. However, this option is more difficult for the online instructor. Lamenting the paucity of research on the effect this dimension has on testing, Wellman (2005) devised a study specifically to address this issue. He administered similar online quizzes in proctored and unproctored settings to assess students' mastery of material which had previously been presented in an online format. His results revealed superior performance for students in the proctored situation over those in the unproctored setting.

Academic Integrity in Online Assignments

Regardless of the method of assessment, one overriding concern centers on the issue of academic integrity. How does the instructor of the online course assure the authenticity of the individual completing the assignments? Rovai (2000) advocates the development of assessment instruments better suited to the constructivist orientation than the traditional tests as a means of dealing with the dilemma. Similarly, Olt (2002) offers strategies for minimizing academic dishonesty in online courses. She points out that the pervasiveness of cheating in the schools is not restricted to online courses. However, she does concede that one of the most difficult issues for the online instructor is to ascertain who is actually taking the assessment and what resources they may take advantage of during the assessment. She advocates using several short assessments during the semester as a possible means of dealing with the first concern, and making all tests open book to address the second.

Method

Participants

A total of 130 students from the State University of New York at Cortland, a small comprehensive college in upstate New York, participated in the study. Forty-nine students were enrolled in the online section and 81 were enrolled in the traditional section. Students in the online section were 100% psychology majors, 90% female, 80% freshmen, 6% sophomores and 14% juniors. In the traditional section 88% were other than psychology majors (most from professional studies), 52% male, 15% freshmen, 58% sophomores, 15% juniors and 11% seniors.

Materials

The pre-test and final exam consisted of 50 multiple choice objective questions drawn from the textbook's accompanying test bank. The 13 chapter tests consisted of 15 multiple choice questions also drawn from the questions provided in the companion test bank.

Procedure

The study was conducted in CAP 100, the introduction to computer applications. Students in the online section were freshmen and transfer psychology majors who were assigned to that section as a part of their program requirements. Students in the traditional section were also completing the course as part of the requirements for their respective programs, however they self selected that section. A common pre-test was administered to students in both sections of the course. Online students were unproctored, and were instructed not to use any materials as the test did not count toward their grades, but was only to inform instructors of their incoming knowledge. Students in the traditional section were given the same instructions, however their test was administered in a proctored class setting. Both sections employed the same text book and associated ancillary support materials, including web based support activities, audio PowerPoint lectures, and online testing modules. Students in the online section received instruction via the assigned text book, the audio PowerPoint lectures, and other materials from the companion web site. Students in the traditional section had access to all those materials, and attended weekly lectures on the assigned subjects. Students in the online section completed online, unproctored, untimed multiple choice tests for each of the assigned chapters. They were required to complete the chapters in a specified sequence, and by certain benchmarks, however they could move ahead of the specified dates. Students in the traditional section completed the same untimed online tests, however they took the tests in a proctored setting on a specified schedule. All students completed the same online comprehensive final exam in a proctored setting with set time limits.

Results

Attrition

Of the 49 students who enrolled in the online section, 3 (6%) subsequently withdrew from the course while 16 (20%) of the original 81 enrolled in the traditional course failed to complete the course. The Continuity Correction for the Chi-Square analysis indicated that this difference did not quite reach significance (.061).

Performance

Scores on the pre-test, 13 chapter tests, and final exam were analyzed using independent samples *t*-tests to compare performance between students enrolled in the online and traditional sections of the course. Results presented in Table 1 indicate that there was no significant difference in student performance on the pre-test ($t = 1.54$, $p = .125$). However, students in the online section did outperform those in the traditional section on both the chapter tests ($t = 3.19$, $p = .002$) and the final exam ($t = 2.01$, $p = .046$). While the magnitude of the differences in the means for the chapter tests was moderate (eta squared = .073) it was small for the differences in the means for the final exam (eta squared = .032).

Table 1
Test Scores for Online and Traditional Sections

	Online		Traditional				
Test	*M*	*SD*	*M*	*SD*	*df*	*t*	*p*
Pre-test	55	15	50	16	103	1.54	.125
Chapter tests	83	12	76	9	80	3.19	.002
Final exam	84	8	80	8	119	2.01	.046

Pearson product-moment correlations were calculated to analyze the relationship between student performance on the pre-test, 13 chapter tests, and final exam. Data presented in Table 2 suggest that there is no relationship between students' performance on the pre-test and the chapter tests in either the online ($r = .008$, $p = .236$) or the traditional ($r = .093$, $p = .438$) sections. Similarly no relationship was detected between performance on the pre-test and the final for the online section ($r = .117$, $p = .515$) or the traditional section ($r = .035$, $p = .782$). However, there was a highly significant relationship ($p < .000$) between the chapter tests and the final exam scores for both the online section ($r = .501$) and the traditional section ($r = .489$).

Table 2
Relationship between Pre-test, Chapter Tests and Final Exam Scores

	pre x tests		pre x final		tests x final	
Sections	*r*	*p*	*r*	*p*	*r*	*p*
Online	.008	.236	.117	.515	.501	.000
Traditional	.093	.438	.035	.782	.489	.000

Discussion

The rapid growth of online courses offers researchers a challenge and an opportunity to reexamine traditional course design issues as well as the related pedagogical questions that arise from the new delivery medium.

With respect to the effects that self-selection versus assignment to courses might have in student performance, the results from the present study were similar to those of Waschull (2001) and Collins and Pascarella (2003), indicating that despite the differing demographics of the two groups, incoming knowledge of the groups was equivalent. Thus, prior knowledge of the subject matter does not seem to affect students' preference for course delivery format. Further, the attrition data are similar to those discussed by Waschull and suggest that completion rates for students in the online and traditional sections do not differ significantly. These findings in combination are of value to administrators who are frequently required to assign students to courses and hesitate when the sections may employ varying delivery methods.

As with Kruck and Lending's (2003) studies, students in the present study showed no difference in performance on chapter tests or final exam based on incoming knowledge. While this finding may seem counterintuitive, it should be encouraging to students and instructors alike in that it seems to indicate that students' performance is more dependent on inherent course factors than on their entering domain knowledge.

Previous studies yield different results concerning the overall performance comparisons between students in online and traditional sections of courses. While Waschull (2001) reports no statistical difference in performance between the groups, Liu (2005) suggests that students in the online section significantly outperformed those in the traditional section on most quizzes and the final exam. The findings from the present study also reveal a significant difference in chapter tests and final exam grades, with the online students once again surpassing those in the traditional section. However, in the present study the performance data may be confounded by the test administration format of the two sections.

In the present study students in the online section completed their online chapter tests in an unproctored and possibly open book format, while the students in the traditional section completed the same online chapter tests in a proctored, closed book setting. Again, previous findings along this dimension are inconclusive, with Brightwell, Daniel, and Stewart (2004) reporting no difference in performance based on open and closed book tests, and Agarwal et al. (in press) demonstrating that initial performance on open book tests was superior to that of closed book tests but, the benefit was not evidenced in delayed testing. Thus, the fact that online students in the present study outperformed those in the traditional section on the chapter tests might be due to the fact that they were able to take the tests open book. With respect to the effect proctoring might play on student test performance, the present study is in disagreement with Wellman (2005) who reported superior performance in a proctored setting. The present unproctored students significantly outperformed the proctored ones on chapter tests.

The performance results for the final exam are a little easier to unravel as both the online and the traditional groups completed the same online exam in a proctored, open book setting. While the difference in final exam grades was not as high as that on the chapter tests, it was still statistically significant, with the online students outperforming those in the traditional group. It is possible that this difference in scores may be a result of training over time. Rakes (2008) contends that most students do not know how to take open book tests and benefit from training administered immediately prior to the test. While no explicit training was offered to students in the online section of the present study, it is possible that there was a practice effect which contributed implicit training in taking open book tests and carried over to enhance their final exam performance.

A final issue addressed in the present study, and one which is unique to the online medium, is the ethical consideration of identity security, particularly ensuring that students who are receiving credit for the course are actually completing their own work. Both Rovai (2000) and Olt (2002) suggest that confirming the identity of the test taker is particularly critical if the course involves high-stakes or only summative tests. Olt recommends using short assessments throughout the duration of the course to lower the value of each test and thus hopefully reduce students' likelihood of cheating. The use of the 13 chapter tests in the present study follows Olt's prescription. The highly significant correlation between student's chapter test scores (both those who were proctored and those who were not) and the proctored final exam grades suggests that the same individuals completed both the chapter tests and the final exam.

Overall, results from the present study suggest that neither method of placement, nor entering domain knowledge affect course performance. Unproctored, open book online tests yield superior performance to similar online tests administered in a closed book, proctored setting. Data further reveal that this performance advantage persists when students are all administered the same online final exam in an open book, proctored format. Finally, it would appear from the present study that the same student who takes the chapter tests also takes the final exam regardless of the format of the course. While this is in no way conclusive, it does suggest that if the online tests are administered frequently and in an open book format, students are likely to complete their own assignments.

Future Research

Further studies are planned to examine the effect of proctored versus unproctored testing in a more controlled manner. In the future two sections of the computers applications course will be offered in which all students receive the same instruction online. Students will also receive the same online chapter tests. However, the tests will be administered to one group in a proctored setting while the other group will complete tests in an unproctored and untimed environment. In addition possible predictors of performance will also be explored using time on test as an indication of effort and overall GPA as a measure of general academic ability.

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Editor's Note: Ambitious research for teaching and learning in a critical arena. The statistics need amplification as more support for this format is accumulated and verified.

Design, Development, Implementation and Effectiveness of Web-based Learning Software for Number Systems

Vijay S. Kale
India

Abstract

e-learning is an umbrella term that is used to refer to any of the following: CBT (Computer Based Training using CD), WBT (Web-Based Training using PDFs, HTML pages or digital content created with tools like Flash-with or without animation, graphics, audio, video), video lectures (also known as Interactive Video Lectures - iVL) and audio lectures (also known as Interactive Audio Lectures - iAL), Live Virtual Classroom etc. e-learning enables the distribution of quality education easier, faster, in a more convenient manner. Contents can be easily modified.

To fulfill the needs of students and to achieve goals of the educational system, an attempt is being made to design, develop and implement a web based learning module of "Number system" of Digital Computer Electronic subject (Yashwantrao Chavan Maharatstra Open University (YCMOU) DCHMNT programme subject). The number system topic was chosen because of its importance in the computer field. Web pages are designed and developed with different media: text, graphics, tables, pictures, animation, audio/music etc. Interactivity in software is being developed by using java script and java applets. The self-instructional materials (SIM) have features such as interactivity, immediate feedback, and provide reinforcement or motivation.

The developed SIM is made available in CD form. It was implemented by using local area network. The SIM is loaded at local area network (LAN) server and multimedia PC's are provided to access SIM.

India with a large geography, population and lack of teachers needs should take advantage of e-learning. It can raise the level of education, where technical education is expensive, opportunities are limited, and economic disparities exist. Although e-learning has potential in India, adoption has been slow and will need major efforts to increase awareness of its potential within the education community.

Keywords: distance education, self instructional material, e-learning, computer assisted learning, active learning, audio, video, multimedia, web page, hyper link, lan, internet, web based training, effectiveness.

Introduction

Advancing technology has opened many doors in education. Course materials are available to the learner in a variety of media, usually in four generations according to the technologies [Colletta 1996]. These are mailbag materials, education through air, computer based education, and technologies of immediate future (Internet based learning system) [Kumar 2000]. It is desirable that instructional materials have features such as interactivity, immediate feedback, reinforcement and/or motivation and should play a supervisory role like a tutor/instructor [Garg & Panda 2005, Zhang 2005]. There is a challenge to educators to make use of new technologies to develop a self-instructional material (SIM), to enhance instructional effectiveness for the content which is difficult to grasp [Garg et.al, 2008].

Computer simulations enhance students' problem solving skills by giving them an opportunity to practice and refine their higher-order thinking strategies [Gokhale, 1991, 1996]. In particular, computer simulation exercises based on the guided discovery learning theory can be designed to provide motivation, expose misconceptions and areas where knowledge is deficient, integrate information, and enhance transfer of learning [Mayer, 1992]. Mayer found that, when certain types of material are presented using multimedia techniques, retention increases by an average of 23%; when text and graphics are combined, retention increases goes up an average of 42%; and if the text of presentation is spoken rather than read it, students hear the words rather than read them, retention goes up an average of 30%. With the implementation of properly designed simulation activities, the role of the teacher changes from a transmitter of information to a facilitator of higher-order thinking skills [Aly et. al. 2004].

With the introduction of computers in the teaching/learning process and the emergence of the Internet, a large number of Web-based educational applications have been developed. Computer-assisted instruction plays a very important role in the modern education process and extensive research shows increasing evidence of the use of computers in the teaching/learning process. Some evidence has shown that computer assisted instruction, which focuses on higher-order learning in technical education, has been more effective than traditional instruction. However, comprehensive research is required to determine the best methodology to be applied to the design and development of computer-assisted instruction.

An attempt is made here to design and develop an interactive multimedia system (SIM) for the "Number Systems" in Digital Electronic subjects. The topic is selected due to its importance in computer and other control applications in real life. The web-based instructional technology is used to develop the multimedia SIM [Khan 1997]. The aspect called dynamic Internet is used to provide more interactivity to the learner [Mishra 1999]. Web pages represent the information with different media such as text, graphs, tables, picture, animation, audio etc. Learner interactivity is developed using hyperlinks, java script programs and applets. Java script programming is used to develop immediate feedback for supervised practice sessions. Supervised practice session means that a series of activities are presented by the computer to be carried out by the learner. At the end of each activity the system provides responses similar to a human tutor. Web pages are integrated by using hyperlinks.

Presently, the Internet is not used much in India for education because of the computer network problem (low speed down-loading of information). However, the Internet is expected to dominate instructional systems in the future. The authors developed a SIM that is available in compact disc (CD) form. In the future it will be possible to deliver this SIM on Internet.

In this study, the experimental group used the developed SIM for learning "Number systems"; the control group studied by traditional methods (printed material and counseling). The test was administered three times - as a pretest, posttest and retention test. The investigator analyzed test data to compare acquisition of knowledge and skills for each student against the predetermined objectives.

Such course material with variety of learning media fulfills the need of distance learners as well as it achieves the goals of educational system [Villamil 1998, Turoff 1995].

Y. C. M. Open University and DCHMNT programme

The Yashvantrao Chavan Maharastra Open University (YCMOU) was established in 1989. In university the school of continuing education was established in 1989. This school is committed to provide access to education to all sections of people through relevant courses in both formal and non-formal streams. The Diploma in Computer Hardware Maintenance and Network Technologies (DCHMNT) started in 1999. One of the program objectives for the DCHMNT program is to provide the basic knowledge about computer assembling, maintenance and networking. Completion of the course requires three subjects taught in one semester – two theory courses (DCE 101 and DCE 102) and one practical course (DCE 103). The minimum qualification for the course is X^{th} standard. Different learners have qualification as- XI (science, commerce and arts), First-year Science/Commerce/Arts, Second-year Science/Commerce/Arts, B.A., M.A., M. Com., etc. Learning is in the English language.

Learning mode

YCMO University has recognized different institutes or centers. Learners apply for admission to one of these centers. The Institute appoints counselors that have been accepted as accredited by YCMOU. Learners attend the counseling sessions. Counselors solve the learner's difficulties.

Methodology:

The learner reads the instructional material (Book title- Digital Compute Electronics by Malvino and Brown) provided by YCMOU, Nashik. The learner discusses the instructional materials with the counselor to gain further understanding of concepts presented in the text.

Objectives of the research:

1. To provide sufficient knowledge of the subject to the learner.
2. To develop critical and analytical abilities.
3. To develop the ability to relate and use the knowledge in real life situations.
4. To develop a learner's interactivity and technical competency in using the software
5. To make distance learning more attractive, effective and powerful.

Relevance to communication:

The form of Communication system is shown in Figure 1.

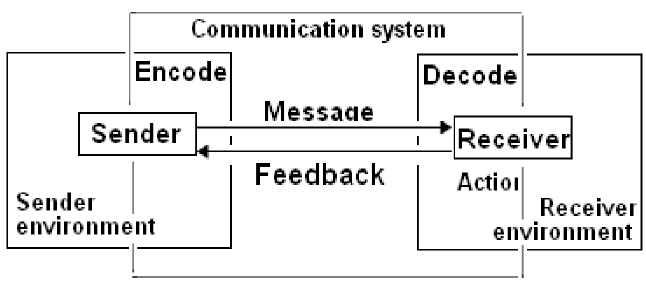


Fig. 1: Communication system

Sender: The person or body responsible for sending the messages is called the sender. The Researcher acts as a Sender of messages (SIM) stored on CD-ROM.

Encoding: Sender puts information in the form that is suitable for the receiver. Software and hardware will convert stored information in memory into the audio and video form.

Receiver: This is a person or a body, which receives the message. Learner will see the computer monitor, and will hear audio from speaker/headphone. The learners are in the DCHMNT program of YCMOU. The learners will receive the message.

Decoding: The learner will interpret the message. If encoded wrongly, distortion likely to occur. Receiver will try to get meaning from displayed information and audio.

Message: The material from which the communication is constructed. Information included in the CD of module number systems. The module contains many web pages. Each web page is designed with text information, tables, java script, applet and audio. It also includes a self-test with a feedback mechanism for each sub topic and a module to test the learning.

Distortion: Can occur in decoding when the receiver interprets a message in a different way.

Medium of the message: Web based multimedia SIM software in English.

Mode of communication: The communication is meant for a specific target group.

Aim of communication: Understanding concepts of Number systems and improve skills in problem solving.

Noise: This is the name given to any factors, which prevent the proper exchange of information between the sender and the receiver.

Feedback: Objective questions will be asked at the time of learning on each topic in multimedia software. Student will have chance to select the correct answer from options provided and receive an immediate response on the screen. Multiple-Choice questions check the learning at the end of the Number Systems module.

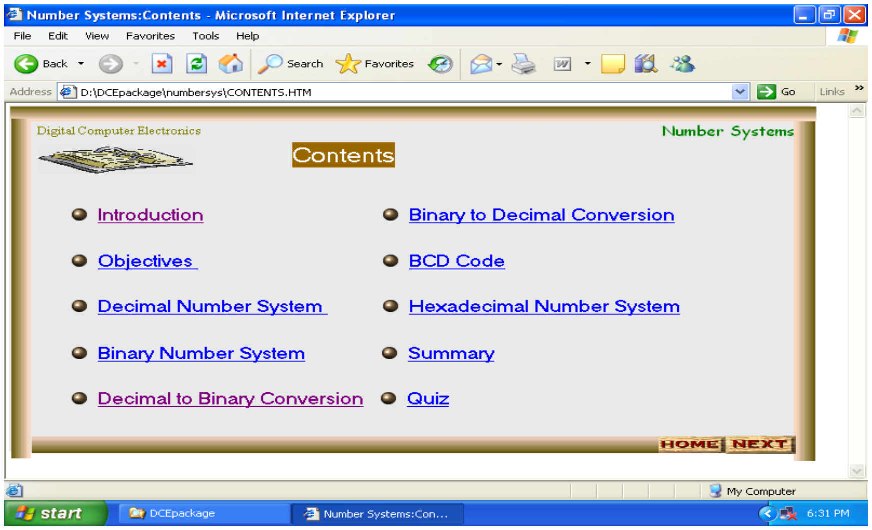
Web-based Multimedia SIM Design and Development:

The goals of distance education can be achieved by using computer technology to develop SIM. The computer can be used to simulate complex situations, provide animated material, and enable instant response for effective positive reinforcement. Self-instructional material development involves the planning an activity unit, selecting instructional resources and media, developing and integrating learning experiences, testing and revision, and duplicating the instructional materials.

The steps in design and development of SIM are text selection, audio selection and recording, script writing, computer programming, web page design, multiple-choice question selection, graphics selection and preparation, and product first try [Steinmetz 1995, Gustafson 1996].

Parker [Parker, 1990] mentioned screen text details to ease of reading and to create learners interest. Screen text parameters include font types (Times New Roman), font size (10, 12, 14 pt), Line length **(**40 to 70 characters), text left alignment, smooth screen color selection etc.

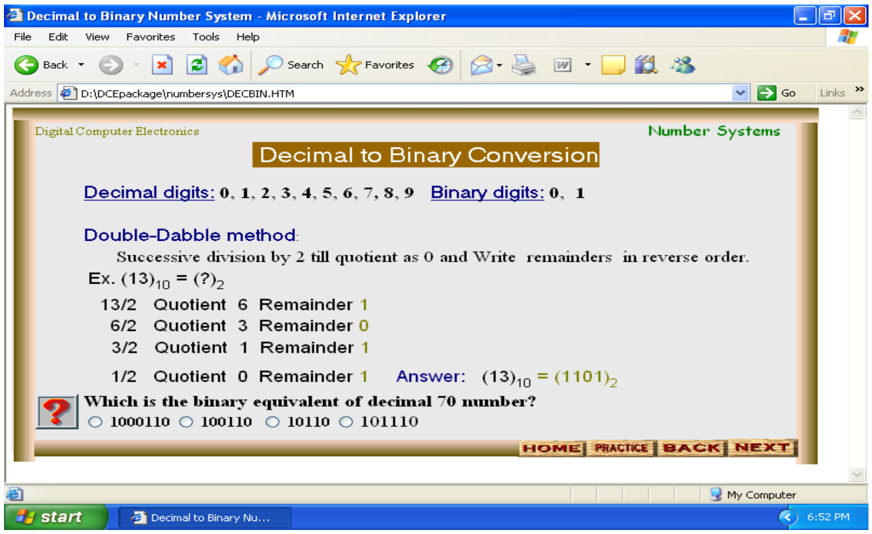
The developed multimedia software is an integration of web pages. Each web page is designed in a frame format to increase the concentration of the readers. Different mouse click buttons are provided to the right side at the bottom of each page to interact with sub units and to perform certain activity such as HOME, NEXT, BACK etc. (Frame 1).



Frame 1: Number system contents

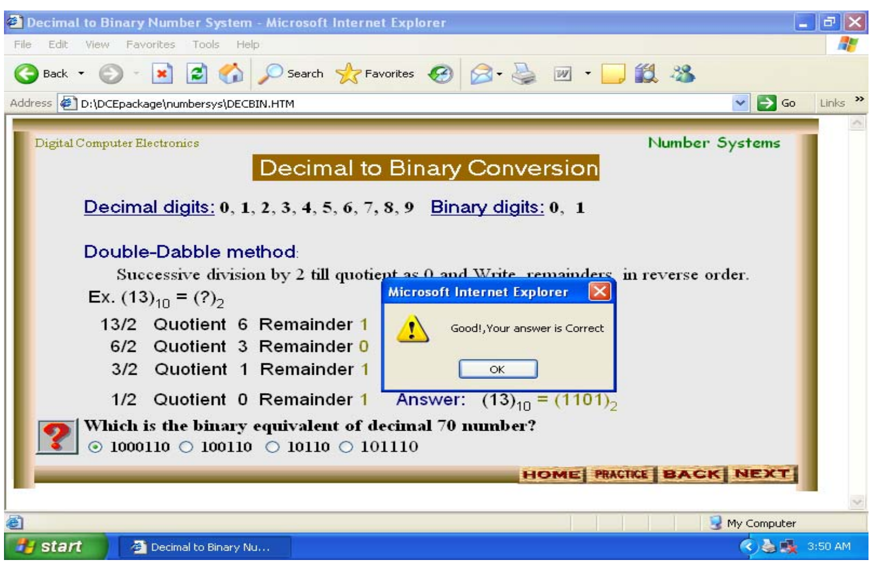
It shows contents of the module number system. It shows subtopic titles such as Introduction, Objectives, Number Systems and their Conversions. Summary and quiz are hyper-linked so that the learner gets the idea of sub-topics and has freedom to select a topic of interest.

One of the subtopic decimal to binary conversion of number system module is shown with Frame 2. Learner sees the video as well as hears the audio like a teacher talk in the classroom. In developed SIM learner can press refresh button to listen the audio number of times.



Frame 2: Decimal to binary conversion

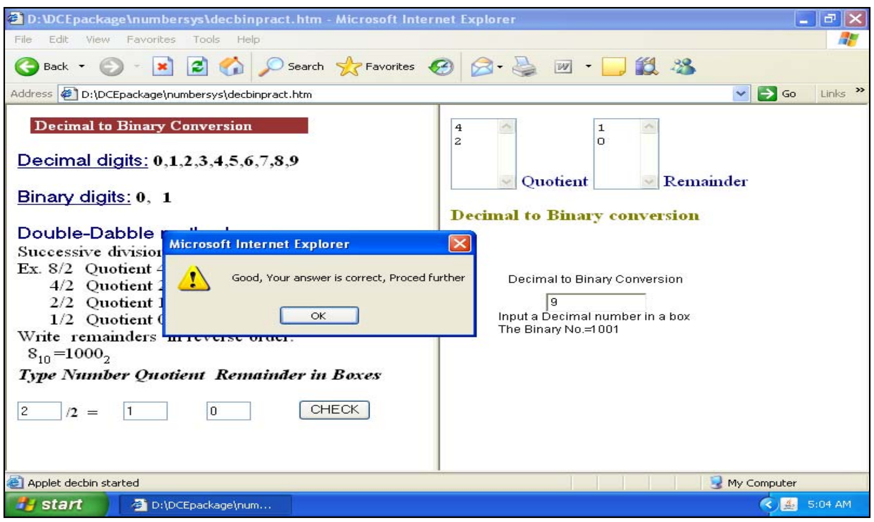
To check the learning of topic, at the end of each frame, one multiple-choice question is asked related to the information displayed. Four choices are displayed with radio buttons to accept learner's response using mouse click. When user clicks the radio button, a small frame is displayed indicating whether the answer is correct or not. A correct answer is confirmed immediately with a remark such as "Good, Your answer is correct" to motivate learner as shown in Frame 3. If the answer is not correct, a remark such as, your answer is not correct is displayed, followed by the correct answer. The learner gets the immediate response as he/she is guided through the learning process. It is a simulation of what a teacher does in the classroom.



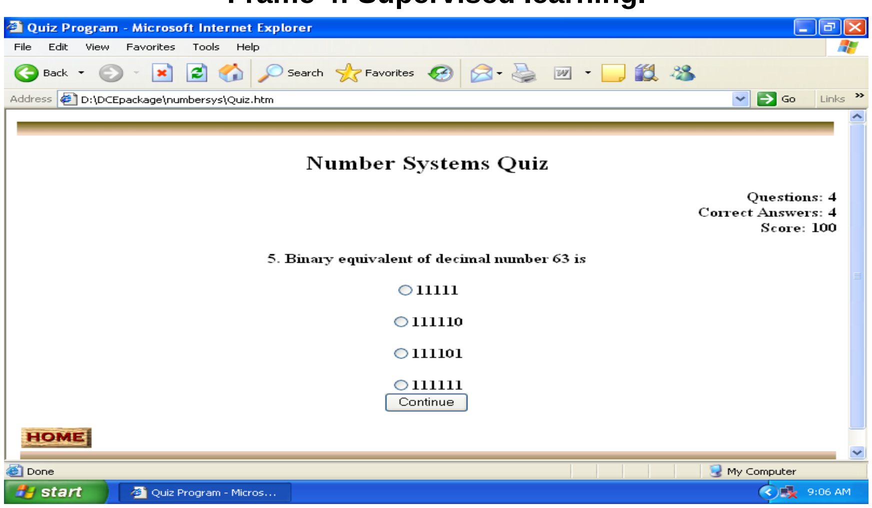
Frame 3: Interactivity and feedback mechanism.

Flexible activity selection is designed and developed by providing meaningful buttons labels. The learner can go to the next frame, back frame, home or practice session by clicking a button. Hyperlink buttons on the bottom border provide NEXT, BACK, HOME and PRACTICE. If the button labeled 'NEXT' is clicked, the learner will see the next frame. Similarly, if 'BACK' button is clicked, the previous frame will be displayed. If HOME is clicked the main topics and sub-topics are displayed on screen. The learner can select any subtopic to learn in sequence, skip items, or adapt to his or her personal preferences. Such mechanism is similar to a book; learners can select topics that meet their needs.

The button labeled 'PRACTICE' is to develop problem solving skills. The learner solves a particular problem. To obtain the answer,; he/she follows number of steps. If mistake is made in any step, the answer is wrong. The software checks every learner activity. Feedback to the learner provides a response similar to a human teacher. Java applets are developed for different number system conversations. The learner gets a numerical answer, such as the equivalent of the number system entered, in a provided input box. Frame 4 shows one such screen. These activities are designed to increase the confidence level of learner.



Frame 4: Supervised learning.



Frame 5: MCQ with its choices and feedback to display immediate result.

At the end of the module summary a quiz is provided. Frame 5 shows the multiple choice question with options. The response of the learner and score are displayed.

Implementation stages

A pretest was administered to students from DCHMNT program (Yashwant Institute, Pune) that have completed Digital Computer Electronics subject through regular counseling. The implementation procedure is shown in figure 2. The sample is divided in to experimental and control groups. These groups are formed by random method of sample selection.

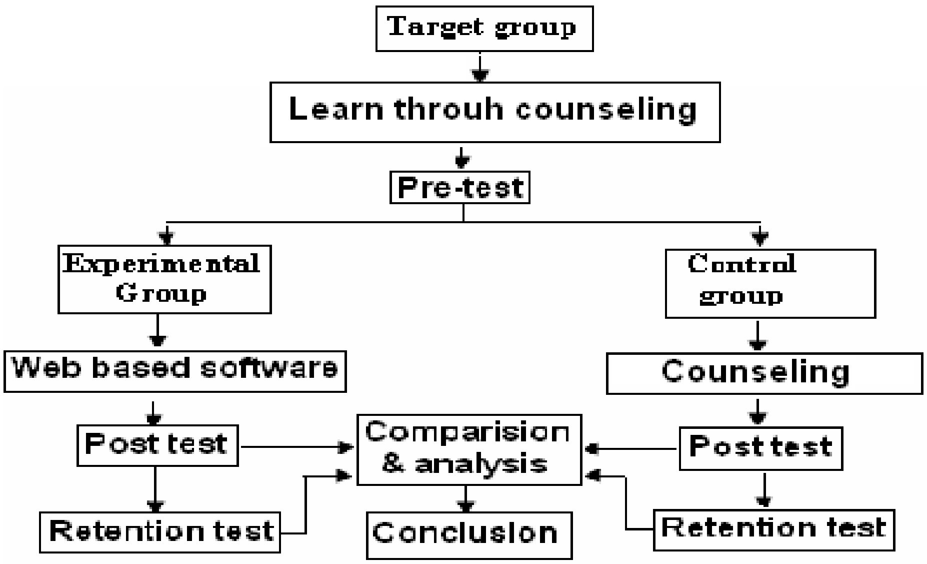


Figure 2: Implementation stages.

Tools Construction:

The investigator selected the Number system module of subject DCE 101 syllabus of DCHMNT programme of YCMOU. The module contents are:

a. Decimal number system
b. Binary number system
    i. Decimal to binary conversion
    ii. Binary to decimal conversion
c. Hexadecimal number system
    i. Decimal to hexadecimal conversion
    ii. Hexadecimal to decimal conversion
    iii. Hexadecimal to binary conversion
    iv. Binary to hexadecimal conversion
d. Digital codes
    i. BCD number
    ii. ASCII code

In the first phase, the pretest contained 25 multiple choice questions constructed to measure achievement. A tryout of the test was administered to 30 students of the DCHMNT program:

DCE101 subject. The same test was administered to the same learners at a later date, and the two sets of scores correlated to determine the reliability of test items. Validity was measured by correlating the achievement test score. The pretest was administered to participating learners to assess prior knowledge of selected experiments and initial equivalence between groups.

In the second phase, web based computer software was given to the experimental group. The control group was taught by the traditional method. In the third phase, a posttest was administered to measure treatment effects. This test was designed to assess the content that was previously learned and how students applied the learned material. The pretest, posttest and retention test were the same test. A retention test was conducted on both groups one month later.

Population and Sample

For convenience, the investigators limited this experiment to the YCMOU center Yashwant Institute PC hardware and networking institute, Pune, Maharastra (India). The centers are all over the Maharastra. The total population for DCHMNT program is approximately 700. Yashwant Institute was selected for samples because of its learner's strength and availability of required hardware (LAN network).

Selection of Groups:

Respondents for the investigation were DCHMNT program digital computer electronics (Subject-DCE101) learners (first semester) of Yashwant Institute PC hardware and networking institute, Pune, Maharastra (India).

On the basis of learner performance in achievement test on the Number system, the students were divided into two groups (experimental and control), each with 27 learners. Sampling was done by a stratified random sampling method.

A 't' test was administered to find out the significance of the difference between mean scores of the control group and experimental group in the pre test. The analysis provided that there was no significant difference between the two groups. It established the fact that the two groups selected on the basis of the achievement test were nearly equivalent.

Data collection

Data was collected with the help of pre-test, post test and retention tests to study the effectiveness of the SIM. The Experimental group used the developed interactive web based multimedia SIM for learning. Then a post-test was administered on experimental (EG) and control group (CG). Finally the retention test was administered on both groups after one month.

Analysis of Data

The main point of this study was to determine the results of adding web based software support to learning. After collecting the data, analysis was made. Mean, Standard deviation and Coefficient of correlation were calculated for the pre and posttest scores for the control group and experimental group. Using "t" test, significance of the difference between the mean of the pre, post and retention test was computed for both the groups separately. Further, relationship between pre and post test scores for control and experimental groups were studied. The significance of difference between the pretest, posttest and retention test scores for control group and experimental group was tested employing "t" test. The level of significance (alpha) was set at 0.01 for all tests of significance.

Achievement Test Analysis:

Table 1 summarizes the analysis of pre, post and retention test scores both the groups of DCHMNT learners.

A 't' test was conducted on the pretest scores for two treatment groups. The mean of the pretest scores for the experimental group students (13.26) was not significantly different from the control group (12.85) ('tcal' =0.3346) at 0.05 alpha level. The mean of the pretest scores for the experimental group was not significantly different from the control group for all classification. Hence it was concluded that treatment groups were similar.

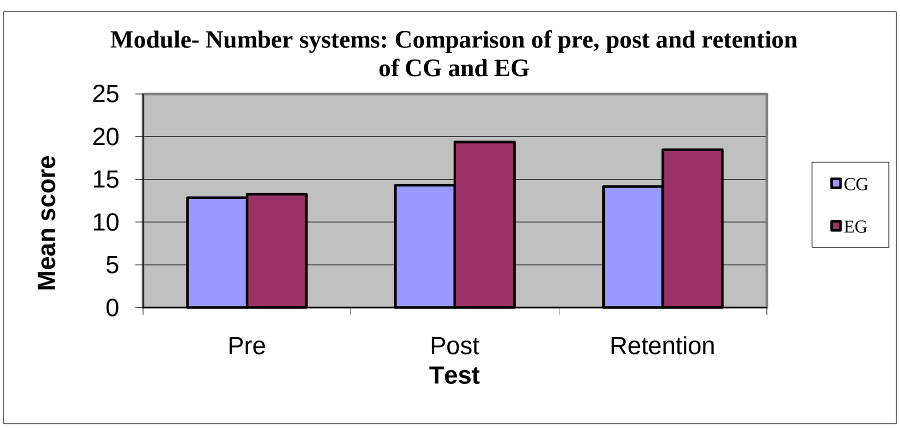
Table 1
The mean, standard deviation of pre, post and retention test of control and experimental group.

Group	Test	Sample	Number systems	
			Mean	Std. dev.
Control group	Pre	27	12.85	4.41
	Post	27	14.33	4.532
	Retention	27	14.15	3.37
Experimental group	Pre	27	13.26	4.60
	Post	27	19.37	2.57
	Retention	27	18.46	3.35

The mean of the post test scores (19.37) for the experimental group was significantly higher than the control group (14.33). This difference was significant at the 0.05 alpha levels ('t_{cal}' = 5.029). Hence it was concluded that the knowledge level of experimental group learners was higher compared to control group students' knowledge level.

The mean of the retention test scores (18.46) for the experimental group was significantly higher than the control group (14.15). This difference was significant at the 0.05 alpha levels ('t_{cal}' = 4.712).

The mean score comparison of pre, post and retention test of control and experimental groups is shown in graph 1. It shows that the knowledge of experimental group students was raised higher and retention was better when compared to the control group.



Graph 1: Mean score comparisons of pre, post and retention test of CG and EG.

Table1 show that there is significant difference of mean and standard deviation (SD) of post and retention test for experimental and control groups of DCHMNT learners. It indicates that mean score for post and retention of experimental group is at higher level than the control group. The result indicates that the web based software help the students to enhance their acquisition of knowledge, understanding and retention too.

Advantages of web-based multimedia sim:

The advantages of interactive web-based multimedia are listed below:

- Learning is self-paced; retention is increased.
- The interactive nature of multimedia computer-based instruction assures an active and constructive learning process. Students can control of their own learning.
- The use of interactive multimedia will reduce the time required for learning.
- Interactive multimedia lesson use feedback for reinforcement.

The learning process can also be improved at the higher education level when the teacher presents online interactive multimedia as part of their class lectures. This can increase the students attention, clarify complex concepts and stimulate analytical thinking.

- Higher educational teaching-learning process can be significantly enhanced by the hypertext/hypermedia tool that is incorporated in the multimedia software.
- The SIM is low cost and available on CD.
- The content of developed SIM can be easily made available on Institute computer networks or stand-alone computer stations. This valuable campus service makes it possible for the learner to learn at any time, in his own way, for study, review, or make-up if he or she misses a particular topic or lecture.
- Education and training cost will be significantly reduced.

Equipment: Development of web based interactive multimedia software required multimedia computers and peripherals (Pentium IV, CD-R/W drive, Speakers/Headphone, Microphone etc.).

Software: Operating system Window 98/XP and other software such as Microsoft FrontPage, Microsoft Internet Explorer, Gold wave (recorder/editor, player), Java platform.

Recommended learner computer system: Pentium multimedia system with windows operating system, audio & video drivers, Microsoft Internet Explorer or equivalent, jdk.exe, speaker/ headphone.

Conclusion

Web based interactive multimedia software is designed and developed for module “Number systems”. It is the integration of web pages. Module sub units are presented in a frame format. A learner can see the video content as well as hear the audio. In the learning process, whether he/she has acquired sufficient knowledge or not is tested using a multiple choice question. When the learner selects the answer, feedback provides motivation and also guides the learners.

Once the learner starts problem solving, learning steps are checked and he/she is guided up to the final answer. At the end of module, interesting activity is given in the form of a quiz. To test the understanding of module, multiple choice questions (25) are given. Questions and the answer options (four) are displayed on the screen. The learner’s activity response is immediately displayed on the screen. Java script and Java applets increase the learner interactivity. If the learner has solved the problem and wants to check whether the answer is correct or not, this can be checked using a Java applet. Such effective use of technology in SIM will increase self-confidence of the learner.

Learner may learn by using their multiple senses, which will provide new and enriched experiences. The learning process is an active one where learners can learn on their own. The interactive lesson provides a stimulating environment that can improve the learning process by enhancing understanding and retention of the subject matter.

The module effectiveness was examined. After conducting a statistical analysis on the test scores, it was found that learners who used the web based software were significantly better on knowledge and problem skills than the students who were taught using counseling plus a print medium of instruction. The number system module analysis of control (CG) and experimental group (EG) shows that, the scores acquired by the experimental group in post and retention tests are higher than the control group. The results of study indicate that web based multimedia software for "Number system" is useful to enhance the knowledge, understanding, and problem solving skills and helps in retaining the acquired knowledge.

The learners may learn by using their multiple senses, which provide new and enriched experiences. The learning process is an active one, leaving the learners to learn by their own. The authors have developed a new form of SIM, which is available in compact disc (CD) form. It can be used by individual learner or group of learners by using a LAN server. In the future it will be possible to provide the SIM via the Internet. Course materials with a variety of learning media will fulfill the need of learners and achieve the goals of the educational system.

It is recommended that further research be conducted to evaluate the effects of using guided-discovery instructional strategies on enhancing the problem-solving ability of students with different achievement levels, using different academic subject material. Also, there is a need to investigate the different cognitive models that students employ in understanding and evaluating technical concepts. This will provide the research community with tools to design computer simulations for improvement of higher-order cognitive skills.

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Editor's Note: Learning communities provide rich communication opportunities for teachers and learners. They are widely used in business and industry to foster peer learning and enhanced overall performance. Currently education focuses on individual performance. Are we doing this to the detriment of collaborative skill development and high-performing teams where the whole is greater than the parts?

Professional Learning Communities

Brent Muirhead

USA

Introduction

The purpose of this paper is to discuss professional development for K-12 teachers. The narrative will discuss professional learning communities and highlight their potential benefit for teacher growth and improving student achievement. Professional learning communities may help teachers to integrate technology into their classrooms.

Teachers are often central targets for educational reform efforts. The *No Child Left Behind Act* (NCLB) created federal pressure on schools to improve student achievement. Watson (2006, p. 155) states that "using technology effectively in the classroom is also a major thrust of the NCLB." Teacher's technological competency varies for various reasons including the quality of the technology classes in their university education programs. The literature reveals that technology training will improve teacher skills and enable them to use computer technologies in their classes. Unfortunately, weak or nonexistent professional training hinders integration of technology into daily instruction (Watson, 2006).

School based professional development programs have been characterized as disjointed and ineffective (Schlager & Fusco, 2003).The programs are not able to connect with teacher practices because of weak and misaligned pedagogical content. Limited school resources (e.g. not enough staff) can make it difficult to support technology training (Fullan, 2007). The lack of coordination of efforts and inconsistent planning among staff development providers can create gaps and redundancies in training (Schlager & Fusco, 2003).

Teachers can be ambivalent toward using computers in their classes. Internet oriented lessons represent potential ethical issues such as student plagiarism. Working with youth, colleagues and administrators who are more technology literate can make teachers uncomfortable being around others with more expertise (McGrail, 2005). Those who desire to acquire new technological skills and knowledge can become frustrated with local school staff development programs that fail to meet their needs (Schlager & Fusco, 2003). The organizational culture of schools reveals major barriers to implementing changes and providing effective professional growth opportunities. School cultures can be resistant to change. It is difficult to foster professional relationships when there is a lack of trust. Teachers are hesitant to critique their colleagues' practices. In fact, some teachers struggle at times reflecting on their own educational philosophy and methods. Schlager & Fusco (2003) attribute the reluctance to reflect on teaching practices due to three issues: a close connection to their personal identity, culture built on privacy and missing reflective skills.

McGrail's (2005) highlights how teacher attitudes toward instructional technologies can be an important factor that influences whether technologies will be used in classrooms. Levin & Wadmany (2008) identifies an assortment of teacher attitudes that impact technology adoption plans: positive or negative experiences with technologies, general attitudes toward making school changes and the level of openness to change their teaching methods and philosophy of education. Hopefully, teachers who have had negative technological experiences will consider participating in learning communities which can offer support and encouragement. Professional learning communities can promote technology skills and develop innovative teaching methods and practices that improve student learning. Reform advocates and professional organizations (e.g. American Federation of Teachers) are encouraging schools to develop communities of practice as a positive way to foster innovative uses of technology in teaching. Communities of practice describes "… a variety of school based collectives of professionals which may aim to do any number of things: enhance student learning, provide professional development, or 'improve the culture" (Gulledge, 2007, p. 1). The groups share knowledge and instructional resources. The key unifying feature of these groups is the focus on practice which highlights the emphasis on the member's daily work (Wing et al, 2006).

The absence of trust between K-12 educators and their administrators can make it difficult to establish professional learning communities in schools. Schools who are experiencing major problems with professional trust will struggle to make significant changes necessary for development and implementation of vibrant learning communities. Teachers need the support of their administrators to start and sustain learning communities. Fullan (2005) recommends creating learning communities that can address serious issues. Educators must have a sense of security when exploring practices that have an assortment of academic and ethical implications. Principals should show empathy when relating to teachers who are working under difficult environments while affirming high instructional and ethical standards. "Schools that promote trust in this way are more likely to motivate people all around, and in turn more likely to do better" (Fullan, 2005, p. 50). Professional relationships should be characterized by dignity, trust and respect. This requires having principals and teachers working together with a shared vision and striving to build trust within their schools.

Professional learning communities provide a support system that can encourage teachers to create individual technology improvement plans. Individual plans should be based on need assessment surveys that help establish the priority of learning needs. The surveys help individuals have a clear picture of their current use of technology applications. School leaders can use the surveys to identify faculty needs. Common obstacles to using instructional technology involve the lack of computer software and hardware, limited understanding of the technologies and inadequate computer training (Levin & Wadmany, 2008).

Besnoy (2007) recommends that individual technology improvement plans should include measurable competency objectives, short and long term goals and foster collaboration. The actual goals could involve learning basic software programs (e.g. Power Point) and creating technology based lesson plans. Teachers will have training constraints based on the available technology resources within their schools. Those who invest time sharing and working with their colleagues will be able to enhance their abilities to implement technology based learning experiences.

The ability to implement and sustain professional learning communities in schools faces several major challenges. Fullan (2005, p. 10) notes that "…a growing problem in large-scale reform; namely, the *terms* travel well, but the underlying *conceptualization* and *thinking* do not." Schools can claim having professional learning communities but fail to sustain a culture where knowledge sharing is a reality. Administrators and teachers have busy and demanding daily schedules will be challenged by any professional growth initiative. Professional learning communities could clash with school cultures that are resistant to making changes. Educators must be willing to make learning communities and technology integration higher priorities in their work schedules. (DeFour, Eaker & DuFour, 2005).

Professional learning communities can play a major role in addressing the standards and accountability concerns found in the No Child Left Behind Act. Educators want autonomy in their daily work but it has often undermined collaboration and fosters a solitary instructional approach. In contrast, educators working together on school improvement projects can affirm the values of autonomy, collaboration and mutual accountability. This approach enables teachers to develop a set of standards that are relevant, focused and integrated with effective classroom assessment. The excessive attention on testing has missed a major problem that students are actually being “under-assessed” (Reeves, 2005 p. 46). Students are not being effectively evaluated which creates flaws in the design and delivery of educational programs.

Popham (2001) wants teachers to examine their assessment procedures and practices. The student-centered model of learning encourages teachers to view their students as academic partners who work together to produce meaningful learning experiences. Boud (1995) related “they will need to become researchers of student perceptions, designers of multifaceted assessment strategies, managers of assessment processes and consultants assisting students in the interpretation of rich information about their learning” (p. 42). Learning communities can help develop assessment methods that involve using Internet search engines to cultivate critical thinking and problem solving skills. Dykstra (2008) offers insights into using case studies that require research to develop written student reports. This is an example of how computer technologies can be integrated into daily instructional activities.

Professional learning communities offer a format that gives educators the opportunity to share with their colleagues what are the most important skills and knowledge that students need for being successful in their next grade. Teachers can design relevant lesson plans and wisely devote their time to what are considered curriculum priorities. An excellent assessment exercise is to retrieve one student assignment involving technology work from each teacher in a grade level and delete the grades and comments from the assignments. Then, the faculty evaluates each assignment and assigns a letter grade. The faculty can compare their grades with the original ones to see if their grading practices are consistent (Reeves, 2005).

The assessment scenario is an illustration of how teachers can collaborate throughout the school year. DuFour (2005) describes a group of elementary language art teachers in Franklin County, Virginia who are using learning communities. Teachers began their project by becoming familiar with curriculum standards at the district, state and national levels. The joint study enabled the teachers to understand the student achievement standards. Teachers created design teams who formulated a series of assessment activities that were based on standards and district goals. Team members established evaluation criteria which help promote grading consistency and personal ownership of the process. Teachers meet throughout the year which provides opportunities to analyze student achievement and consider ways to refine their assessment procedures. The constant knowledge sharing helps foster a school culture built around collaboration and removed barriers to implementing the curriculum. Teacher morale improves when teachers themselves are trusted to shape instructional plans. The school climate evolves into a place that energies teachers and improves the quality of education (Fullan, 2005).

Schlager & Fusco (2003) argue for aligning professional development programs with teachers who develop social networks. The learning communities meet for a specific purpose and time duration. Well designed activities encourage collegial relationships, mentoring and professional growth. Teachers become change agents because their participation in team projects can provide them insights and positive experiences to start individual professional projects. Learning communities have the potential to generate educational changes within schools. Roger’s (2003) model of innovative-decision process that involved five major stages: “knowledge, persuasion, decision, implementation and confirmation” (p. 169). The model reflects a realization that genuine educational changes must evolve over time and requires having leaders who understand how to advocate and guide the change process. Learning communities can cultivate leadership and technological expertise that are essential for changing organizational cultures. Teachers can work with the professional development staff to design technology training for workshops, small group meetings and individual mentoring (Leh, 2005). The diversity of training formats helps meet a diversity of technological needs. The goal should be to creatively develop plans that enable teachers to have the most effective training (DuFour, 2005).

Eason-Watkins (2005) discusses how monthly professional development meetings for principals can help increase leadership capacity for change. In Chicago Public Schools, principals would meet on a regular basis to share insights from research literature on teaching and leadership. The meetings focused on improving the principals' knowledge of curriculum issues and promote innovative ways to support their teachers. Professional learning communities were used in the school district in the following ways (Eason-Watkins, 2005, p. 199):

1. Instructional coaching and mentoring
2. Support for building professional learning communities at the local level
3. Study groups for common problems and common professional development activities
4. Formative and summative data for continuous monitoring of instruction.

The school leaders used computer software programs to help create more data driven decisions for administrators and teachers. The technology provides information on student achievement. Standardized test results were benchmarked against state and national standards. Educators used the information to modify their curriculum to make instructional adjustments. The entire process enabled teachers to improve their ability to meet student learning needs (Eason-Watkins, 2005).

There are practical ways to improve professional learning opportunities. Time can be built into the daily schedule for professional development. Teachers and principals can work together to develop learning communities that involve projects aimed at effectively using computers and other technologies (Wenglinsky, 2005). School tours can be another way to view learning from the student's perspective and observe the areas that require professional training. Professional learning communities can use this information to create relevant short and long term action plans that address teacher and student needs. Principals can creatively use school tours to communicate with students, teachers and parents. For instance, one elementary principal conducted a school tour using a video recorder that kept a visual record of students and teachers working on various class projects. The principal created "...links to class resources, pictures, podcast interviews, information and reflection---to his blog on the district's website" (Soule, 2008, p. 140). This example highlights how principals can use technology to communicate within their school, parents and local communities. Also, students and teachers appreciate the positive recognition which builds good will and trust within the school.

Larry Cuban relates that "US reformers have a tradition of overselling technology and under-using technological innovations" (Forum, 2008, p. 45). Cuban predicts technological changes will be incremental within schools due to teachers who view technology as a burden to their daily work. Professional learning communities can play an important role in helping integrate technology into their classrooms. Teachers can form teams involving teachers who have demonstrated creative instructional practices, mentor new faculty members and are willing to experiment with new technologies (e.g. innovators/early adopters, Rogers, 2003). Teachers can act in leadership roles that help reduce resistance toward technologies. For instance, teachers can develop a technology mentoring program that helps new teachers learn software programs such as electronic grade books. Principals can empower teachers by encouraging them to take on significant duties (Sergiovanni, 1987).

Face-to-face technology professional development activities can be supplemented with online community activities. The literature indicates that teachers appreciate the flexibility of sharing online and it can increase collaboration between teachers and between teachers and principals (Vavassaeur & MacGregor, 2008). The online setting enabled principals to have a social and cognitive presence with their teachers. The online format encouraged the discussion of technology issues related to sharing subject content with less emphasis on software. Teachers enjoyed the freedom to discuss different curriculum topics with others who were being challenged by similar technology issues. Vavassaeur & MacGregor's (2008) research highlighted how principals used the online dialogs to listen to teachers and better understand their technological needs.

Online professional development is an innovative approach that requires further study. According to Sprague (2007, p. 147), there are four common learning theories that work in combination or singularly within online format:

1. Guided social constructivism
2. Coaching
3. Mentoring
4. Communities of practice

Educators continue to investigate how the four learning theories will work when used in conjunction with different types of media arrangements such as interactive, synchronous or blended learning.

Conclusion

The subject of principals, learning communities and technology integration must involve a discussion of current leadership challenges. Principals are often considered by educational reformers as change agents but their job descriptions create constraints on this expectation (Fullan, 2007). However, principals play a vital role in providing the support for having successful learning communities which offer the potential to improve the quality of education. Sharing knowledge and practices enables teachers to devise authentic assessment techniques to meet curriculum standards, develop leadership skills, collaborate with principals and foster new online education networks. Professional learning communities represent an opportunity to integrate new technologies into schools and prepare students for working and learning in the Information Age.

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