The aim of the Journal of Asynchronous Learning Networks is to describe original work in asynchronous learning networks (ALN), including experimental results. Our mission is to provide practitioners in online education with knowledge about the very best research in online learning. Papers emphasizing results, backed by data are the norm. Occasionally, papers reviewing broad areas are published, including critical reviews of thematic areas. Entire issues are published from time-to-time around single topic or disciplinary areas. The Journal adheres to traditional standards of review and authors are encouraged to provide quantitative data. The original objective of the Journal was to establish ALN as a field by publishing articles from authoritative and reliable sources. The Journal is now a major resource for knowledge about online learning.

JALN

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A Consortium of Institutions and Organizations Committed to Quality Online Education

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Edited by *Anthony G. Picciano*

JALN

The purpose of the Sloan Consortium (Sloan-C) is to help learning organizations continually improve the quality, scale, and breadth of their online programs according to their own distinctive missions, so that education will become a part of everyday life, accessible and affordable for anyone, anywhere, at any time, in a wide variety of disciplines.

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Editorial and Advisory Boards

Sloan-C has its administrative home at the Sloan Center for OnLine Education (SCOLE) at Olin and Babson Colleges. SCOLE has been established as a center that spans the two campuses of Olin College and Babson College. SCOLE's purpose is to support the activities of the Sloan Consortium, a consortium of higher-education providers sharing the common bonds of understanding, supporting and delivering education via asynchronous learning networks (ALNs). With the mission of providing learning to anyone anywhere, SCOLE seeks to provide new levels of learning capability to people seeking higher and continuing education. For more information about Sloan-C, visit www.sloan-c.org.

For more information about Olin and Babson Colleges, visit www.olin.edu and www.babson.edu.

INTRODUCTION TO THE SPECIAL ISSUE ON ONLINE LEARNING IN K–12 SCHOOLS AND TEACHER EDUCATION

In 2006–2007, the Alfred P. Sloan Foundation awarded a grant to the Sloan Consortium and Hunter College to conduct a survey of online learning in K–12 schools. For more than a decade, the Foundation had been most generous in awarding grants for online learning that focused on higher education, however, this was the first award directed specifically to the K–12 environment. The timing of this grant coincided with the growing perception of the importance and use of online learning in K–12 schools. During the past several years, the editors of JALN also noticed an increase in article submissions related to teacher education. As a result, a decision was made to publish a special edition of JALN focusing on online learning in K–12 schools and teacher education.

The editors have selected five research-based articles that examine important topics related to K–12 and teacher education. As a lead-in to these articles, Chris Dede, Timothy E. Wirth Professor of Learning Technologies at Harvard University's Graduate School of Education, agreed to an interview that provides his views on the overall state of online learning technology in K–12 schools and its implications for teacher educators. Brief summaries of the five articles follow.

K–12 Online Learning: A Survey of U.S. School District Administrators by Anthony G. Picciano, Hunter College, and Jeff Seaman, the Sloan Consortium: This is the first national study of school district leaders to examine online and blended learning in American primary and secondary schools. It establishes important baseline data on a number of issues that other researchers can use as they pursue studies of online learning in K–12 schools.

An Interpretative Model of Key Heuristics that Promote Collaborative Dialogue Among Online Learners by Sarah Haavind, Lesley University: This paper describes a preliminary study designed to begin addressing the challenge of fostering cognitive presence among secondary learners. This study also describes aspects of teaching presence, specifically how to engage in collaborative dialogue, collaborative activity designs and evaluation rubrics that help to promote substantive, collaborative dialogue in Virtual High School™ classes.

The Louisiana Algebra I Online Initiative as a Model for Teacher Professional Development: Examining Teacher Experiences by Laura M. O'Dwyer, Boston College, and Rebecca Carey and Glen Kleiman, Education Development Center, Inc. (EDC): The Louisiana Algebra I Online initiative represents one type of online model than can address both the need for improving course offerings as well as addressing teacher shortages. Using a sample of teachers drawn from six school districts and two private schools, this research suggests that the Louisiana Algebra I Online initiative provides teachers with an effective model for authentic and embedded professional development that is relevant to their classroom experiences.

Learning Science Online: A Descriptive Study of Online Science Courses for Teachers by Jodi Asbell-Clarke and Elizabeth Rowe, Technology Education Resource Center (TERC): Using a sample of 40 online science courses for teachers, this study examines the nature and variety of instructional methods and activities used as well as communication and students' perceptions of supports within the course. This research is unique in that it is the first aggregate study of online science courses offered by a wide spectrum of educational programs.

The Presentation of Self in Everyday Ether: A Corpus Analysis of Student Self-tellings in Online Graduate Courses by Carla Meskill and Gulnara Sadykova, SUNY Albany: This study examines the patterns and substance of student self introductions in nine fully online graduate courses in Education. The question of how, in a tightly defined social/academic context, adults use written language to present themselves to others is taken up through content analysis supported by linguistic concordancing. Two hundred twenty-three "Meet Your Classmates" entries are examined for their form and content.

The editors of JALN hope our readers enjoy this special issue and welcome any comments.

Anthony G. Picciano, Associate Editor
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INTERVIEW WITH CHRIS DEDE

For a special issue of the Journal of Asynchronous Learning Networks (JALN),
Conducted March 9, 2007 by Anthony G. Picciano

I. BIOGRAPHY

Chris Dede is the Timothy E. Wirth Professor of Learning Technologies at Harvard's Graduate School of Education. His fields of scholarship include emerging technologies, policy, and leadership. His funded research includes a grant from the National Science Foundation to aid middle school students learning science via shared virtual environments and a Star Schools grant from the U.S. Department of Education to help high school students with math and literacy skills using wireless mobile devices to create augmented reality simulations. Chris has served as a member of the National Academy of Sciences Committee on Foundations of Educational and Psychological Assessment, a member of the U.S. Department of Education's Expert Panel on Technology, and International Steering Committee member for the Second International Technology in Education Study. He serves on Advisory Boards and Commissions for PBS TeacherLine, the Partnership for 21st Century Skills, the Pittsburgh Science of Learning Center, and several federal research grants. In addition, Chris is a member of the Board of Directors of the Boston Tech Academy, an experimental small high school in the Boston Public School system, funded by the Gates Foundation. His co-edited book, *Scaling Up Success: Lessons Learned from Technology-based Educational Improvement*, was published by Jossey-Bass in 2005. A second volume he edited, *Online Professional Development for Teachers: Emerging Models and Methods*, was published by the Harvard Education Press in 2006. Links to his courses, projects, and writings are available on his webpage: http://www.gse.harvard.edu/~dedech/.

II. INTERVIEW

Interviewer: Over the years, reference has been made to the revolution that is going on with technology and K–12 education. Has this revolution occurred and we don't realize it, or has it been more of an evolution and is slowly changing the way we teach and learn?

[CD] While worthy, the models of technology-based and distance learning implemented by schools thus far are typically oriented to enabling and enhancing conventional forms of instruction. Teachers communicate with students across distance in ways essentially similar to how they interact with students face-to-face; generally, their pedagogy does not shift to take into account the full strengths of media for informing, sharing, and expressing. As an example, two-way interactive television (I-TV) is used primarily to enable students in a geographically remote setting to interact as if they were co-located with the teacher. When teacher professional development is offered across distance, the instructional model is often similar: face-to-face learning repackaged for remote delivery, via video or Internet-based presentations, readings, and discussions.

Research documents that this form of instruction is effective, but the exclusive use of such models of pedagogy can lead to a deficit perspective on learning technologies: A remote participant is perceived to have "almost" as good a cognitive, affective, and social experience as those immediately present with the teacher. Distance media are seen as replicating, as much as possible, a face-to-face learning experience without adding value to instruction beyond that replication.

Advanced developments in technology-based and distance education are now generating novel instructional strategies based on the capabilities of new interactive media and the learning styles and strengths of Internet-generation students. The value of conventional technology-based and distance learning models is well understood and documented; coming next are potentially transformative strategies for teaching and learning that sophisticated information and communication technologies now enable for students, teachers, and communities. Finally, educators are beginning to recognize the added value of information and communication technologies in aiding learning, whether used as a complement to face-to-face instruction (hybrid, blended, or distributed approaches) or as a means of instruction without co-located personal presence (distance education).

Some emerging technologies are incremental improvements on existing applications, perhaps through changes in delivery system. Weblogs ("blogs") and podcasts fall into this category; blogs are similar to an electronically indexed daily diary, and podcasts are much like a recorded radio show. While such media can provide gains over their prior counterparts, usually the hype surrounding them exceeds their actual capacity for adding educational value. In the case of blogs and podcasts, for example, the real value is not the media themselves, but the opportunities for self-publishing and knowledge sharing they enable. The field of education is hopefully outgrowing the "This new medium is magic!" syndrome.

Other emerging technologies offer new, substantial capabilities for learning. For example, wikis provide the opportunity for multiple participants to co-create documents across distance. We know this capability is very useful in face-to-face collaborative learning, exemplified by such activities as design team members sketching simultaneously on a large, shared whiteboard, annotating each other's ideas. As the curriculum standards championed by The Partnership for 21st Century Skills illustrate, the capability to provide virtual collaborative workspaces shared across distance is valuable not only for learning, but also for preparing students to work in a global, knowledge-based economy. Schools may find wikis particularly valuable in distance learning situations in which too small a number of local students are enrolled to enable powerful forms of face-to-face peer collaboration.

Another type of emerging technology likely to add significant value for learning in schools is "sociosemantic networking." With my doctoral student, Adam Seldow, I have a grant from Harvard's Provost to explore this interactive medium. Adam and I believe that the many websites created early in the 21st century fueled efforts to categorize and organize the Web in order to empower users seeking to find "needles in haystacks." Google, Yahoo!, AOL, and others developed complex page ranking systems and algorithms to link information seekers to pertinent resources. Finding what one wanted on the Web became easier, but organizing and saving these resources was increasingly harder. Online communities clamored for intuitive ways to store and share their "gold mine" resources with friends and colleagues—enter the social bookmarking revolution. 2003–2004 marked the release of del.icio.us, furl, simpy, and Flickr, some of the more popular online social bookmarking communities. Instead of saving websites to their browsers and photos to their computers, individuals began saving bookmarks and photos online, sharing them with others, and—most importantly—labeling the items with words they could remember. This bottom-up, participant-driven method of identifying bookmarks and photos with personalized keywords adopted the industry moniker "social tagging" and the process of creating online, community-based meaning for content was born.

Due to their ability to quickly react and adapt to changes in colloquial language, social tagging applications are of particular interest to K–12 schools. When given access to complex, interlinked resources such as the Web, students' emergent language to describe what they are finding evolves faster than most teachers can follow. Social tagging affords students the ability to use their words to describe content and their words to search for content. Social tagging of files and web pages within student communities is a direct and intuitive way to label and access relative content, parallel to how students think about resource navigation in their lives outside of school and easier than the top-down, elaborate, nested hierarchies of pre-specified, narrowly defined terms that characterize formal classification frameworks, such as the Dewey Decimal System.

Further, the same direct access to content that benefits students in social tagging networks can assist teachers in their professional development. Without having to browse through huge educational repositories organized by formal classification frameworks, school communities can efficiently share and find worksheets, lesson plans, and other teacher-related materials in affiliative social tagging networks. For all these reason, sociosemantic networking holds considerable promise of value for small learning communities, such as those characterized by consortia of rural schools.

Interviewer: I do hope that the field of education is outgrowing the "This new medium is magic!" syndrome. Can you discuss what the implications of online learning are for teacher preparation programs? Are schools of education keeping up with the ever changing world of online technology? Or are we facing a crisis of teachers under-prepared to use technology effectively in their teaching?

[CD] My recent book about methods for online teacher professional development (http://www.hepg.org/hep/book/6) identifies ten well-established models. Here are four that seem a good fit for teacher education as well as teacher professional development:

- The EdTech Leaders Online (ETLO) program at Education Development Center, Inc. focuses on enabling clients to develop their organization's capacity to provide effective online professional development to K–12 teachers and administrators. ETLO courses are conducted entirely online, with teams from a district participating alongside teams from other districts around the country. During an initial course, participants select one of the 30 ETLO workshops to implement during their practicum, become familiar with its contents, and plan all the details of offering it locally. In this model, the participants who have been trained via this learning experience then implement and facilitate online workshops provided by ETLO while receiving ongoing support both from ETLO staff and from an online forum. This model is a good match for consortia of rural schools seeking to build their internal capacity for delivering online professional development tailored to specific objectives.
- The WIDE World teacher professional development program offers online courses designed to foster teachers' application of research-based strategies in planning curriculum and aiding and assessing students' learning. These strategies include the Teaching for Understanding framework, applications of Gardner's theory of multiple intelligences, and the synthesis of these models in differentiating instruction for diverse learners and integrating new technologies to improve student performance. WIDE World's primary format comprises online readings, asynchronous discussions, and interactive tools; a central component of the WIDE World model is tailored support from an expert online coach for every participant. This model illustrates an online professional development program geared to improving teachers' generic pedagogy and assessment strategies.
- PBS TeacherLine provides content-focused online professional development for K–12 teachers with the goals of improving teacher quality and increasing student achievement. Online courses center on the areas of mathematics, reading, science, curriculum and instruction, and the integration of technology to enhance student learning. The courses provide opportunities for teachers to assess the current capabilities and potential misconceptions of their students, with the objectives of supporting teachers as they make decisions that improve their teaching strategies and prompting teachers to develop activities or instructional units that they will try in their

classrooms. This model exemplifies an online professional development program geared to improving student outcomes in particular subjects.

- The *eMentoring for Student Success* project is designed to increase student achievement in science by providing early-career middle- and high school science teachers with science-specific mentoring and professional development through an online learning community. Emphasizing inquiry into science content and into the ways students think and learn about science, this model facilitates discussion and collaboration among novice science teachers, experienced science teachers, and research scientists. Each new teacher receives support from a mentor who has taught the same content at the same grade level in the same state, so that conversations about standards, assessment, and curricula take account of local contexts. This model centers on a mentoring-based strategy responsive to individual teacher's specific needs.

The purpose of identifying these resources is not to recommend specific programs, but rather to sketch the range of online teacher education and professional development strategies now available.

Interviewer: Your book on online professional teacher development is surely well-needed! What is the future of K–12 schools and technology? Are we going to move forward or have we reached a threshold where very modest changes will be made over the next few years?

[CD] This is a pivotal time for reinventing the role of information and communications technologies (ICT) in teaching and learning, because emerging tools, applications, media, and infrastructures are reshaping three aspects of education simultaneously:

- The knowledge and skills society wants from the graduates of education are shifting, due to the evolution of a global, knowledge-based economy and a "flat" world.
- Methods of research, teaching, and learning are expanding, as new interactive media support innovative forms of pedagogy.
- The characteristics of students are changing, as their usage of technology outside of academic settings shapes their learning styles, strengths, and preferences.

Combined, these trends suggest that—beyond implementing at scale the types of educational computers and telecommunications research and experience have proven effective—we should also develop alternative models of education that use emerging technologies to reinvent many aspects of teaching, learning, and schooling. We should use ICT to redesign education, not to make historic models of schooling more efficient, but instead to prepare students for the 21st century—simultaneously transforming teaching in light of our current knowledge about the mind.

Interviewer: How do school leaders reconcile experimentation with instructional technology approaches including "developing alternative models of education" and the demands of education policies that suggest more rigidity in curriculum and assessment?

[CD] At present the dominant model for what the curriculum should contain is the federal No Child Left Behind (NCLB) Act, supported by both major political parties and the general public and based on "test-to-standard" strategies. Under NCLB, state content standards are developed by disciplinary experts, professional organizations, and various forms of interest groups; high-stakes tests document whether or not students are learning some subset of that content; and individual students, teachers, schools, and districts are rewarded or punished based solely on test performance. In practice, because states' high-stakes psychometric tests are typically based on multiple-choice and short-answer items that have no mechanism for assessing attainment of higher order understandings and performances, 21st century competences embedded in state curriculum standards are buried in a mass of lower-level material and generally ignored in day-to-day teaching. The curriculum is crowded with low-level facts and recipe-like procedures (e.g., In what year did Columbus discover America? What are the seven steps of historical inquiry?), as opposed to nuanced understandings and performances (i.e., What confluence of technological, economic, and political forces led to the age of exploration around the end of the 15th century? By what process of interpretation of historical data did you reach this conclusion?).

Even though the concept of standards, assessments, and accountability makes sense at a fundamental level, current policies for improving educational achievement based on this concept have many problems from the perspective of preparing today's children for tomorrow's world (Dede, 2005a). For example, current content standards are based on disciplinary "silos" that do not incorporate metrics of contextual value based on degree and kind. Physics experts indicate what pre-college students need to know if they eventually plan to be physicists, historians determine what pupils must master if they are to become professional historians, and so on. This has led to a huge tangle of content and skills that U.S. educators are mandated to cover in just 12 years—an impossible task! Further, much of what is taught within a subject is only useful to the small subset of students who plan to focus on that particular field in college; state curriculum standards in each discipline are typically neither interrelated nor prioritized to emphasize core understandings and performances all students will need to succeed in the 21st century.

Because of the accountability systems built into this model of educational reform, teachers are using weak but rapid instructional methods, such as lecture and drill-and-practice, to race through the glut of recipes, facts, and test-taking skills they are expected to cover. Despite research indicating that guided inquiry, collaborative learning, mentoring, and apprenticeships are far more effective pedagogical strategies, introducing these into school settings is difficult given the crowded curriculum and the need to prepare students for high stakes tests. Simply delivering required information for students' passive absorption takes every second of instructional time. Teachers have no means by which to prioritize what understandings and performances to emphasize in terms of 21st century citizenship; workplace capabilities for the global, knowledge-based economy; and lifelong learning.

Among all these problems, the biggest single issue is that the first generation of high-stakes tests that our nation is using to determine students' educational outcomes has substantial flaws. These are summative, "drive-by" tests, which provide no diagnostic, just-in-time feedback that could help teachers aid struggling students. In addition, while some assessments emphasize on core ideas and measure at least a few higher-order thinking skills, many state legislatures have allocated such limited resources for test development that the resulting instruments often measure only a random assortment of low-level skills and content, rather than core, higher-order 21st century understandings and performances.

Yet this reform movement still has strong bipartisan support and widespread backing from the public. Under these circumstances, researchers, policymakers, practitioners, and the business sector must collaborate in exerting educational leadership to take on the political challenge of arguing what to deemphasize in the curriculum—and why—in order to make room for students to deeply master core 21st century understandings and performances. This is not a situation in which we must eliminate an equivalent amount of current curriculum for each 21st century understanding added, because better pedagogical methods can lead to faster mastery and improved retention, enabling less re-teaching and more coverage within the same timeframe. However, downgrading the importance of some material in the current curriculum is much harder than adding content and skills because omission involves "unlearning." A major challenge in professional development is helping teachers, policy makers, and local communities unlearn the beliefs, values, assumptions, and cultures underlying schools' standard operating practices, such as forty-five minute class periods that allow insufficient time for all but superficial forms of active learning by students. Intellectual, emotional, and social support is essential for "unlearning" and for transformational relearning that can lead to deeper behavioral changes to create next-generation educational practices. Educators, business executives, politicians, and the general public have much to unlearn if 21st century understandings are to assume a central place in schooling.

Interviewer: What advice do you have for education leaders and policy makers in providing resources for instructional technology? For example, have primary and secondary school educators solved many of the infrastructure needs (basic hardware, software, connectivity) of schools and really should be concentrating on the professional development of teachers, administrators and staff. Or are many schools still struggling with maintaining/upgrading basic infrastructure?

[CD] While inequities in access and capability will always exist, the educational infrastructures in all communities—rich and poor—are steadily improving. Moreover, people are acquiring many personal devices (computers, personal digital assistants, smart cell phones, portable gaming platforms) purchased for entertainment and communication, but potentially available for educational purposes if we are smart enough to design for these. A larger problem is the need for sophisticated technical and pedagogical support in school settings. Many schools have good infrastructures, but the security measures the district has imposed are so bizarre and draconian that this investment is unusable. Other schools have solid technical support, but teachers lack an educationally experienced mentor who can model effective ways to use technology in the classroom. At this point, I think the human infrastructure is more in need of crucial investments than the technical infrastructure.

Interviewer: What is the future for Chris Dede? Where will you be, and what will you be doing in the next five to seven years?

[CD] I expect to continue with my scholarship and teaching at Harvard, continuing with the three foci that have characterized my work:

- Using design-based research to study the strengths and limits of emerging information and communication technologies, determining which may be the “golden geese” and which are the “wild geese” in terms of education.
- Developing models of effective leadership for overcoming implementation and scaling up challenges in utilizing innovative educational technologies.
- Articulating policies and perspectives about why and how schooling at every level should transform to prepare students for the 21st century.

This is a fascinating time to be in the field of learning technologies, and I certainly enjoy contributing to the initiatives now underway!

Interviewer: Chris, thank you for your insights! All the Best!

K–12 ONLINE LEARNING: A SURVEY OF U.S. SCHOOL DISTRICT ADMINISTRATORS

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ABSTRACT

The research literature on online learning has grown significantly in the past decade. Many studies have been published that examine the extent, nature, policies, learning outcomes, and other issues associated with online instruction. While much of this literature focuses specifically on postsecondary education with approximately three million students presently enrolled in fully online courses [1], not as much has been published about students enrolled in fully online and blended courses in primary and secondary schools. This is one of the first studies to collect data on and to compare fully online and blended learning in K–12 schools. The purpose of this study was to explore the nature of online learning in K–12 schools and to establish base data for more extensive future studies. Issues related to planning, operational difficulties, and online learning providers were also examined. This study does not necessarily answer all of the issues raised but hopefully will promote further discussion and study of them.

KEYWORDS

Online Learning, Distance Learning, Blended Learning, Distance Education, Asynchronous Learning, Primary Education, Secondary Education, K–12

I. INTRODUCTION

On November 9, 2006, the Sloan Consortium issued its fourth annual report on the extent of online learning in American colleges and universities [1]. Based on a national survey, this report provided information on student enrollments, operational concerns, and planning issues as seen through the eyes of chief academic officers. The report confidently estimates that 3 million students are registered for fully online courses in colleges and universities. An online course was defined "as 80 percent of the course is delivered online." The chief academic officers to whom the survey was sent also reported that online learning was becoming a "critical" part of their long-term planning strategies. This was true especially for those in public colleges and universities where student access to an education is a critical part of their mission.

Earlier in 2006, on March 17th, Penn State University hosted the Sloan K–12 Higher Education Collaboration in Online Learning, a meeting that was held at the Corporation for Public Broadcasting in Washington, DC. Thirty-five individuals were invited to discuss issues related to collaboration in online learning between K–12 schools and colleges and universities. All of the individuals invited had experience or expertise in online learning and represented a wide spectrum of K–12 schools, colleges and online learning providers. While the discussions during this meeting were rich in possibilities for collaboration, the need for more data on online learning in K–12 schools became increasingly apparent. While estimates were discussed, concerns were expressed that hard data were not readily available and that the last major national study done by the U.S. Department of Education that focused on generic distance education, was based on data that were four years old.

There are a number of underlying reasons why these data are not available. First, there are minimal, if any, requirements in many states to collect data on their online students. A number of states have not established any specific guidelines or data collection processes for online students, and those policies that do exist, are inconsistent. Watson, in a study of state policies on online learning in 2005, observed that many “state policymakers have moved … slowly” [2, p. 10].

Second, there is some confusion related to definitions of online learning and distance education. Distance education is not equivalent to online learning. Other instructional modalities not directly related to the Internet, such as videoconferencing and televised courses, are still quite popular in many areas of the country. Furthermore, within the online environment, definitions and terms such as “fully online”, “blended courses”, “virtual courses”, “e-learning”, “hybrid courses”, “mixed-mode”, “asynchronous learning”, “distributed learning”, “Web-facilitated”, and “Web-enhanced learning” abound; contributing to confusion among many educators. Problems of definition are not new especially when dealing with rapidly evolving instructional technologies.

The Sloan-C study conducted by Allen & Seaman [1] distinguished and defined three types of online courses:

- Online — Course where most or all of the content is delivered online. Defined as at least 80% of seat time being replaced by online activity.
- Blended/Hybrid — Course that blends online and face-to-face delivery. Substantial proportion (30 to 79%) of the content is delivered online.
- Web-Facilitated — Course that uses web-based technology (1 to 29% of the content is delivered online) to facilitate what is essentially a face-to-face course [1].

These definitions meet the needs of the Sloan Consortium study well, where consistency of terminology is absolutely essential to ensure the data collected reflect the same activities from year to year.

For research and data collection in K–12 schools, similar definitions need to be discussed and established. Without clearly defined terms, activities that can be considered online learning can significantly overlap and might confuse serious study, rather than add to our knowledge. For example, a high school student enrolled in a fully online Advanced Placement English course at a nearby college and another student who does a Webquest as a research assignment in a history course that meets face-to-face might both be engaged in online learning, yet their learning activities are significantly different. Using the definitions established by Allen & Seaman, the former scenario qualifies as a fully online course with student and teacher physically separated and minimally, if ever, meeting face-to-face; the latter would be considered a Web-enhanced course with student and teacher meeting in a regular classroom, as would any other face-to-face course. Unfortunately, generally accepted definitions have not been established.

Third, some of the difficulty in data collection can also be attributed to the significant growth in the number of public, private and for-profit providers of online services, many of which operate outside of the traditional school district structure. These include:

- Other school districts that provide online learning courses
- Charter schools within a district
- Charter schools outside of a district
- State supported virtual schools within a state
- State supported virtual schools outside of a state
- State technology service agencies
- Colleges and universities
- Consortial agencies
- Private, for-profit entities that offer selected courses
- Private, for-profit virtual schools

While the growth in online learning providers is indicative of the popularity of online learning, it complicates the collection of accurate data by moving students partially or fully outside the school district for educational services. It also allows online learning providers to operate across state lines. In some cases, where the school district pays for the services, it is acutely aware of which students are enrolled. In other cases, school districts have little, if any, knowledge of the number of students taking advantage of online learning from an outside provider. During a follow-up telephone discussion to the present study with one high school principal, he indicated that his school district administration has no mechanism in place for collecting data on online students.

Fourth, the home schooling movement is alive, well and growing and operates almost as a "subculture" with minimum oversight other than meeting compulsory attendance regulations [4]. Many home schoolers use online service providers for a portion of their course work without any need to report same to any educational agency or authority. The data on this population of online students is perhaps the least known of any K–12 population.

The purpose of this study was to explore the nature of online learning in K–12 schools and to establish base data for more extensive future studies. Issues related to planning, operational difficulties, and online learning providers were examined. This study will not necessarily resolve all of the issues raised but will hopefully promote further discussion of them.

II. REVIEW OF THE LITERATURE

Berge and Clark provide an appropriate starting point for examining issues related to online learning in K–12 schools [5]. Their book, *Virtual Schools: Planning for Success*, contains a number of important chapters identifying case studies, best practices, and important planning issues related to K–12 online learning. However, on page one, the authors referred to a study done in 2001 by one of the authors [6] that estimated K–12 online learning at 40,000 to 50,000 students. In all likelihood, by 2005 when the Berge and Clark book was published, this enrollment estimate was too low but exemplified the paucity of research and the need for more accurate and timely data. The authors recommended that a national survey be conducted of K–12 schools. The authors also referred to a pending report by the U.S. Department of Education that might shed more light on K–12 online learning.

Watson, in a national study of state policies on K–12 online learning conducted in 2005 reported that a number of states had not formally established policies on online learning. Furthermore, while there had been explosive growth in online learning, "relatively little was known about the [K–12] programs that conducted online learning." [2, p. 10].

In 2005, the U.S. Department of Education [7] issued the first comprehensive examination of distance education in the K–12 schools, entitled *Distance Education Courses for Public Elementary and Secondary School Students: 2002–03*. This report, referred to by Berge and Clark above, was based on data collected during the 2002–2003 academic year and reported that one-third (36%) of public school districts and nine percent of public schools had students enrolled in distance education courses in 2002–03. In this study, distance education referred to courses taken for credit and offered to elementary and secondary school students where the teacher and student are in different locations. It included any technology or modality for delivering distance education to K–12 schools and did not concentrate exclusively on online learning. Questionnaires for the survey on which the report was based were mailed to a representative sample of 2,305 public school districts in the 50 states and the District of Columbia. The findings in the report were organized under: distance education for public school students; technologies used for delivering distance education courses; entities delivering distance education courses; reasons for having distance education courses; and future expansion of distance education courses. Key findings from the survey included:

- A greater proportion of large districts than medium or small districts had students enrolled in distance education courses (50% vs. 32% and 37%, respectively). In addition, a greater proportion of districts located in rural areas than in suburban or urban areas indicated that they had students enrolled in distance education courses (46% compared with 28% and 23%, respectively).
- The percentage of schools with students enrolled in distance education courses varied substantially by the instructional level of the school. Overall, 38 percent of public high schools offered distance education courses, compared with 20 percent of combined or ungraded schools, 4 percent of middle or junior high schools, and fewer than 1 percent of elementary schools.
- In 2002–03, there were an estimated 328,000 enrollments in distance education courses among students regularly enrolled in public school districts. Students enrolled in multiple courses were counted for each course taken. Thus, enrollments may include duplicated counts of students.
- Of the total enrollments in distance education courses, 68 percent were in high schools, 29 percent were in combined or ungraded schools, 2 percent were in middle or junior high schools, and 1 percent were in elementary schools.
- There were an estimated 45,300 enrollments in Advanced Placement or college-level courses offered through distance education in 2002–03. This represents 14 percent of the total enrollments in distance education.
- The proportion of all distance education enrollments that are in Advanced Placement or college-level distance education courses is greater in small districts compared to medium or large districts (24% vs. 10% and 7%, respectively).
- When asked which technology was used to deliver the greatest number of distance education courses, 49 percent of districts reported two-way interactive video, more than any other technology.
- Of those districts with students enrolled in distance education courses in 2002–03, about half (48%) had students enrolled in distance education courses delivered by a postsecondary institution. Thirty-four percent of districts had students enrolled in distance education courses delivered by another local school district, or schools in other districts, within their state.
- Seventy-two percent of districts with students enrolled in distance education courses planned to expand their distance education courses in the future.
- Thirty-six percent of districts that were planning to expand their distance education courses

selected course development and/or purchasing costs as a major factor preventing their expansion [7].

Approximately 50 percent of the total distance education course enrollments of 328,000 or 164,000 were Internet-based or online. However, because students might be taking courses in multiple or mixed modalities, the actual estimates cannot be considered exact. Also because the data collected were based on course enrollments and not on students enrolled, it is likely that the number of students enrolled in K–12 online courses was substantially lower. The rationale is that a student who takes a full academic program online might be enrolled in multiple and as many as six courses in a semester. While accurate as a course enrollment estimate, these data are not equivalent to the number of students enrolled in online learning.

Based in part on the U.S. Department of Education data reported above as well as several other studies, Smith, Clark, and Blomeyer projected that K–12 online enrollments would be as high as 600,000 students in 2005 [8]. They indicated that this number was an estimate based on other studies and not on primary data that they had collected. Compared to the 164,000 online course enrollments reported by the U.S. Department of Education for 2002–2003 [7], this estimate seems high but it is not necessarily inaccurate. Another report in *Education Week* in 2006 estimated the number of online enrollments at more than one million students based on reports from The Peak Group and WestEd [9]. This estimate also seems high as compared to the U.S. Department of Education data for 2002–2003. Smith, Clark, & Blomeyer aptly concluded that there were significant barriers to research on K–12 online learning, the first of which was limited access to accurate and timely data [8].

While student outcomes are not the specific foci of this study, one major study by Cavanaugh, Gillan, Kromey, Hess, & Blomeyer [10] is worth mentioning. They completed a meta-analysis of fourteen studies focusing specifically on student outcomes. Their conclusion was:

> Students can experience similar levels of academic success while learning using telecommunications and learning in classroom settings. While distance learning as it is practiced in today's virtual schools uses technology that is less than ten years old and advances rapidly, the literature has shown that a student's education online can be as effective as it is in a classroom…
>
> The result shows variation in the degree of success students have experienced, and a need for more information if firm conclusions are to be drawn. [10, p. 21–22].

The findings in Cavanaugh et al. were similar to other studies conducted on online learning in both K–12 and higher education in which "no significant difference" was found in student learning in online courses versus face-to-face courses. It would appear that a body of research is developing on student performance in individual, case study online courses while research on broader issues of the nature of online learning in the larger K–12 universe is less available.

As a conclusion to this review of the literature, the present researchers believe that a study that looks at issues across a broad spectrum of K–12 education will be useful in understanding how online learning is being deployed and more importantly perceived by chief school administrators as a viable option for delivering instruction.

III. METHODOLOGY

This study of K–12 instruction used descriptive analysis relying extensively on a survey instrument (see Appendix A) designed specifically for the project. The instrument was patterned after a similar instrument used by The Sloan Consortium to conduct national surveys of chief academic officers in American colleges and universities. Follow up telephone discussions were also conducted with selected respondents in an attempt to verify and gain further insights into what was reported on the survey. This survey was conducted for the 2005–2006 academic year.

The "universe of interest" for this study included all public school districts in the United States that operate schools (16,098). Information on these districts was taken from the Common Core of Data (CCD) from the U.S. Department of Education's National Center for Education Statistics (http://nces.ed.gov/ccd/ccddata.asp).

The study used three outreach efforts:

1. A postcard invitation to participate in the survey was sent to a random sample of 7,700 school districts using the postal mailing addresses in the federal data. Each post card contained a brief description of the survey, a URL where they the survey could be completed and a unique Survey ID number for the respondent to use to activate their survey form.
2. An email invitation was sent to randomly selected school districts using a commercial source for email addresses. The commercial source was able to provide email addresses for approximately one-half of all the school districts. A reminder email message was sent two weeks after the first message. Both the invitation and the reminder message contained a unique URL that, when clicked, would open up the survey form in a web browser and pass the unique survey ID.
3. Approximately 1,200 randomly-selected school districts were sent a paper copy of a letter of invitation along with a paper copy of the survey form and a business reply envelope. These respondents were also presented with a web-based option to respond. Both the paper and web-based version of the survey contained a unique survey identification number.

All potential respondents were informed of the funding source for the study (the Alfred P. Sloan Foundation), who was conducting it ("researchers at Hunter and Babson Colleges") and that "All responses will be held in strictest confidence and at no time will districts or respondents be identified by name." The survey form was composed of two portions, one that applied to all respondents and a second section to be completed only by those districts with online or blended course offerings. The invitation letter and the survey form itself were carefully worded to encourage responses from all school district representatives, regardless of whether they were involved with online learning or not.

All data collected were entered into an online database, either directly by the respondent or, in the case of paper-based responses, by the researchers. Each entry included the unique survey ID number that was used to link the response to the description data of that school district contained in the Education's National Center for Education Statistics Common Core of Data. The data linked from this source included location information (city, town, state, urban/rural), the grade range in the district, the number of students in the district, and the number of teachers in the district.

All data were investigated for missing or out of range values. All missing data were coded as either structural missing (the question did not apply to the respondent) or as non-response missing (the question did apply, but the respondent did not provide any data). After the survey data were merged with the CCD data, cleaned, and all missing value codes added, they were input into the SPSS statistical package for analysis.

The analysis data set contains 366 records (N=366), representing 2 percent of all school districts of interest. Responses were received from school districts in forty-four states.

The major research questions that guided this study were:

1. What is the nature and extent of online and blended learning in K–12 schools in the United States?
2. What is the perceived importance of online and blended learning for K–12 school programs?
3. What are the issues and barriers that impede the development of online and blended learning in K–12 schools?
4. Who are the major providers of online and blended learning courses to K–12 schools?

In conducting this survey, it was determined that there needed to be a separation of online from blended learning courses. In the absence of any standard definitions for online and blended learning, the definitions used by Allen & Seaman for the Sloan Consortium studies of American higher education were adopted, namely:

- Online — courses where most or all of the content is delivered online. Defined as at least 80% of seat time being replaced by online activity.
- Blended/Hybrid — courses that blends online and face-to-face delivery where a substantial proportion (30 to 79%) of the content is delivered online.

The separation of online and blended courses is important and distinguishes this study from the research previously cited that focused specifically on generic distance education or fully online learning.

IV. FINDINGS

A. Respondent Characteristics

The population that participated in this survey represents a cross section of American K–12 education. Three hundred and sixty-six (N=366) out of a total universe of 16,000 school districts in the United States responded to this survey. The school districts responding represent approximately 3,632 schools, 2 million students, and 67,000 FTE teachers from every region (New England, Middle Atlantic, Southeast, Midwest, North Central, Southwest, Mountain, and West Coast) of the country. The locale of these school districts is presented in Table 1. Definitions of these locales are based on the U.S. Department of Education National Center of Education Statistics (NCES) codes (see Appendix B for definitions).

	Frequency	Percent
Large City	5	1.4
Mid-Size City	18	4.9
Urban Fringe of a Large City	77	21.0
Urban Fringe of a Mid-Size City	56	15.3
Large Town	3	.8
Small Town	42	11.5
Rural, outside CBSA	104	28.4

Rural, inside CBSA	61	16.7
Total	366	100.0

Table 1. Locales of Respondents (NCES code used for locale; CBSA = Core-Based Statistical Area)

B. Nature and Extent of Online and Blended Learning

Table 2A shows that 57.9 percent of the school districts reporting had at least one student who had taken an online course in 2005–2006. It also shows that an additional 24.5 percent of those which did not have any students enrolled in an online class planned to have at least one student take an online course within the next three years. Table 2B indicates that 32.4 percent of the school districts reporting had at least one student take a blended course. It also indicates that an additional 27.1 percent of those which did not have any students enrolled in a blended course planned to have at least one student take a blended course within the next three years. Nearly two thirds of all districts (63.1%) currently have students taking either online or blended courses with another 20.7 percent planning to introduce them over the next three years. These data clearly reflect that the majority of American school districts are providing some form of online learning for their students and many more plan to do so within the next three years.

	Frequency	Valid Percent
No	64	17.6
Plan	89	24.5
Yes	210	57.9
Total	363	100.0
Missing	3	
Total	366	

Table 2A. Responses to: Are students at the [school district name] taking any fully online courses during the 2005–2006 (12 month) school year?

	Frequency	Valid Percent
No	145	40.5
Plan	97	27.1
Yes	116	32.4
Total	358	100.0
Missing	8	
Total	366	

Table 2B. Responses to: Are students at the [school district name] taking any blended/hybrid courses during the 2005–2006 (12 month) school year?

As a follow-up question to the above, respondents in school districts already enrolling students in online or blended courses were asked if they anticipated growth in enrollments over the next two years. A majority of the respondents anticipated growth (60.1% of districts expect growth in their fully online course enrollments and 66.0% expect growth in their blended enrollments). Districts predict that the number of students taking online courses will grow by 18.6 percent and those taking blended courses will grow by 22.9 percent over the next two years.

Table 3 shows the grade levels of the students taking online courses as categorized by fully online and blended/hybrid courses. Not surprisingly, the data show that much higher percentages of students are enrolled in online courses in the upper levels with the majority at the high school level.

	Fully Online		Blended/Hybrid		Total	
	N	%	N	%	N	%
Grades K–5	2733	16%	538	5%	3271	12%
Grades 6–8	1793	10%	3980	36%	5773	20%
Grades 9–12	12625	73%	6519	59%	19144	67%
Other	198	1%	56	1%	254	1%
Total	17349	100%	11093	100%	28442	100%

Table 3. Online Enrollment by Grade Level

An important goal of this study was to estimate the number of K–12 students enrolled in online learning and to help establish baseline data through comparisons with other research. The respondents in this study reported that the total number of students enrolled in fully online courses was 17,349 and the total number of students enrolled in blended courses was 11,093 for a grand total of 28,442 students. An extrapolation of these figures estimates that approximately 700,000 students for the entire population of 48,000,000 public school students were enrolled in online and blended learning courses. This figure is close to the projected 600,000 students enrolled in online courses for 2005 made by Smith, Clark, and Blomeyer [8]. Based on the data collected in this study for 2005–2006 and the Smith, Clark, and Blomeyer study for 2005, an estimated 600,000 to 700,000 K–12 public school students were enrolled in online learning for 2005–2006. It is likely that the higher figure is more accurate given that the data in this study is more current and extends into 2006, a year longer than Smith, Clark, and Blomeyer. A caution needs to be mentioned regarding this estimate. This estimate is based on data collected from public schools only. Approximately six million private school students and one million home-schooled students were not included in the sample. This would indicate that the number may be higher but determining to what extant is beyond the scope of this study.

C. Perceived Importance of Online and Blended Learning

The answers to question number 3 provide insight into the main reasons why online and blended courses are perceived as important by the respondents. For purposes of presentation, the seven-point Likert scale used to provide options in the survey was recoded into a three point scale with 1 = Not Important, 2 = Neutral, and 3 = Important. The mean responses are provided in Table 4. These results indicate that the perceived importance of online learning related mostly to the following:

1. Offering courses not otherwise available at the school
2. Meeting the needs of specific groups of students
3. Offering Advanced Placement or college-level courses
4. Reducing scheduling conflicts for students
5. Permitting students who failed a course to take it again

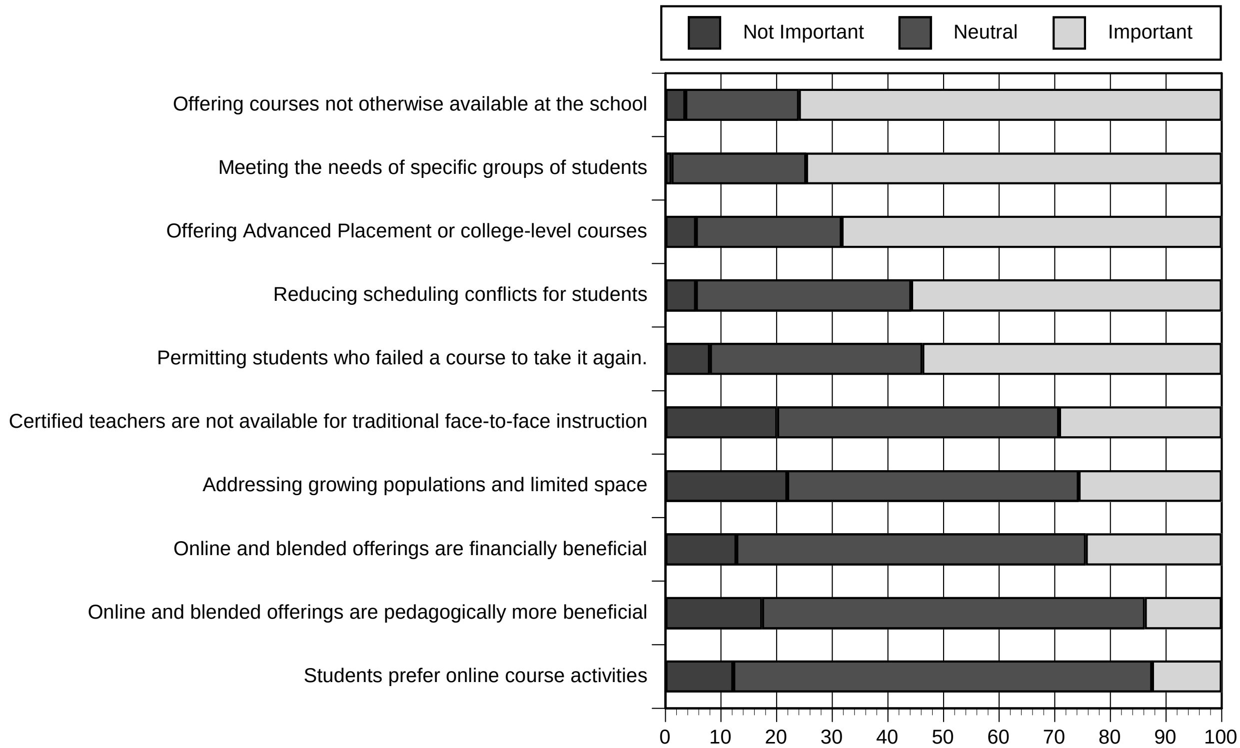

Table 4. Percentage Summary of Responses to: How important do you believe the following reasons are for a school district to offer fully online or blended learning courses?

The respondents were predominantly neutral with regard to the other reasons provided in the survey. In terms of the second reason "Meeting the needs of specific groups of students" a sample of descriptions of these "specific groups" provided by the respondents follows:

> "Student's reasons for taking an online class vary widely. Some were making up lost credits, some were taking AP classes not offered at their own school, and others were trying to get extra credits to graduate early. Still others would take a reduced schedule at their home school and leave early enough in the day to go to a job while making up the online time at their convenience."

> "We only use online courses to enable students to gain credits who otherwise would be unable to graduate with their classmates due to schedule constraints. "

> "We offer online courses for remedial purposes and the occasional homebound student. "

> "Our blended online program is increasing most significantly with our ELL population and our contract alternative schools."

> "The students … take summer courses, mainly in mathematics, from universities such as Stanford to allow them to fulfill a required course… It allows them to take more advanced courses during their 4 years of high school."

> "We're looking into serving kids who have (a) failed a requirement, rather than re-enrolling them

in an on-campus course, (b) selected electives, and (c) Advanced Placement offerings where the local enrollment is too low to warrant an on-campus teacher."

"We have been using online courses for the past few years… to meet the needs of foreign language courses. "

"We use online course work for students who miss school to the point of no longer being able to pass the regular class."

"Many students are enrolled in dual credit college credits through high school regional academies; this is the fastest growing area of course offerings for our students."

"Blended courses give [us] the opportunity to offer advanced and remedial classes we cannot provide."

"It meets the needs of a few students that have mastered our 8th grade curricula and are taking advanced high school courses, especially in mathematics and world languages."

"Online courses have helped especially with students who either want to go ahead in their learning or those who need to repeat courses."

These quotes support the perception that online learning is meeting the specific needs of a range of students from those who need extra help, to those who want to take more advanced courses and whose districts do not have enough teachers for certain subjects.

D. Barriers and Issues

Insight into some of the barriers and issues that school districts face in offering online learning was provided by answers to other questions in the survey. For purposes of presentation, the seven-point Likert scale used to provide options was recoded into a three point scale with 1 = Not Important, 2 = Neutral, and 3 = Important. The responses are provided in Table 5 and indicate that the major barriers and issues for online learning are:

1. Concerns about course quality
2. Course development and/or purchasing costs
3. Concerns about receiving funding based on student attendance for online and/or blended/hybrid education courses
4. The need for teacher training

Issues related to technology infrastructure or government policies were not deemed to be serious by most of the respondents.

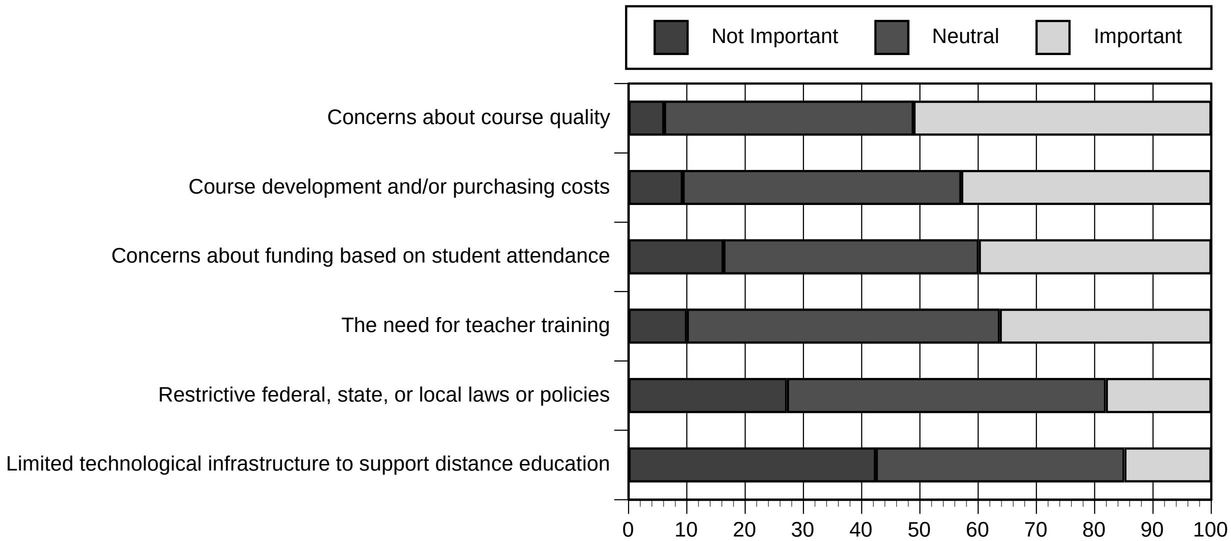

Table 5. Percentage Summary of Responses to: How much of a barrier the following areas would be (or are) in offering fully online or blended learning courses?

E. Lessons Learned

Insight into lessons learned with online instruction were provided by the respondents who already offer online courses to their students. For purposes of presentation, the seven-point Likert scale used to provide options was recoded into a three point scale with 1 = Disagree, 2 = Neutral, and 3 = Agree. The responses (see Table 6) indicate that there is strong agreement on the following:

1. Students need more discipline to succeed in an online course than in a face-to-face course.
2. Fully online and blended/hybrid courses fulfill an important educational need for my students.
3. School district knows and maintains records on students taking fully online or blended courses.

These respondents tended to be more neutral with regard to the other three issues namely:

1. Fully online and blended/hybrid course experiences are comparable in educational value to traditional face to face instruction.
2. Fully online courses and blended/hybrid courses have allowed [school district] to build important relationships with other organizations.
3. Faculty at [school district] accept the value and legitimacy of online education.

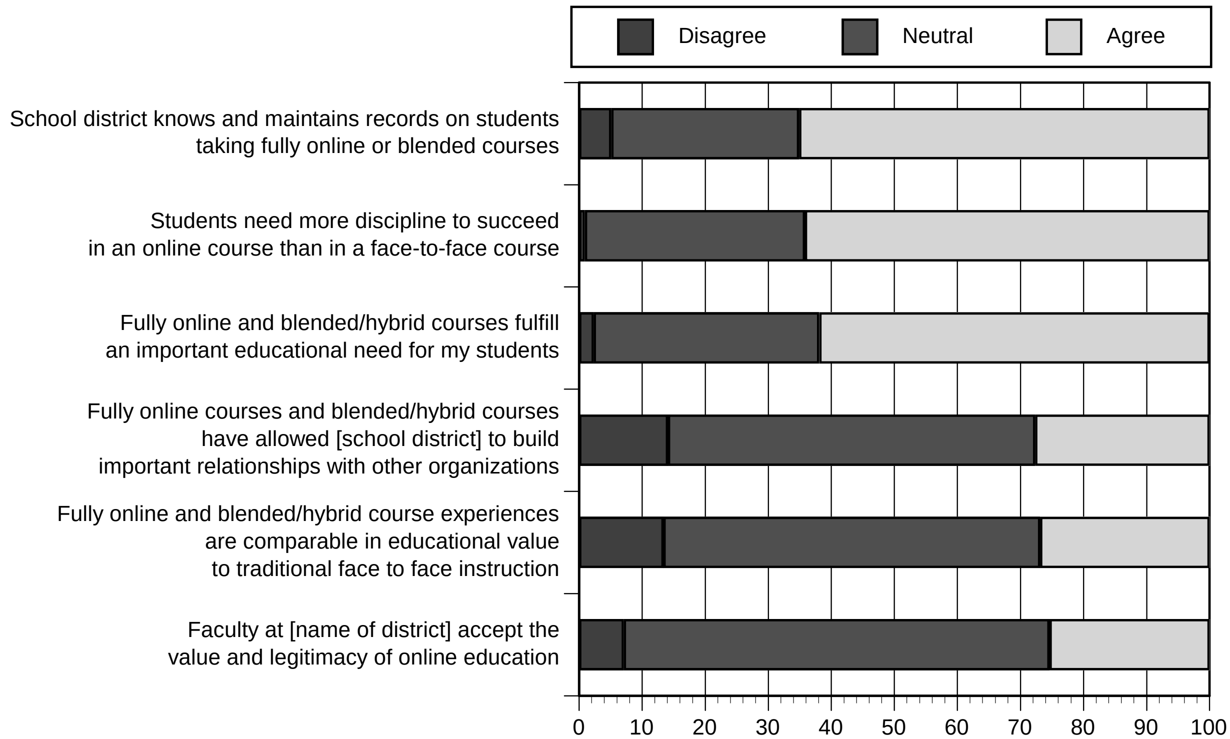

Table 6. Percentage Summary of Responses to: Please select the level at which you disagree/agree with the following statements. (Asked of only those school districts with online or blended that provide online or blended courses to their students.)

F. Major Providers of Online and Blended Learning

An important question for this study was: Who are the major providers of online and blended learning courses to K–12 schools? The assumption was that most school districts were not providing their own online learning services and had to contract or buy these services from other providers. Table 7 provides a frequency distribution of the online learning providers of respondents to this survey who reported that they had students enrolled in online or blended learning courses.

Online Instruction Provider	Fully Online (percentage of districts with fully online courses using this provider)	Blended (percentage of districts with blended courses using this provider)
Your District (i.e., Delivered Centrally from the District)	20.2%	37.1%
Cyber (i.e., online) Charter School in Your District	9.8%	6.7%
Other Schools in Your District	6.4%	15.7%
Another Local School District, or Schools in Another District, in Your State	22.0%	29.2%
Education Service Agencies Within Your State (e.g., BOCES, COE, IU), Not Including the State Education Agency or Local School Districts	24.9%	18.0%
State Virtual School in Your State (i.e., State-centralized K–12 Courses Available through Internet- or Web-based	34.1%	11.2%

Methods		
State Virtual School in Another State	13.3%	3.4%
Districts or Schools in Other States (Other than State Virtual Schools)	5.2%	3.4%
Postsecondary Institution	47.4%	38.2%
Independent Vendor	31.8%	25.8%
Other	2.3%	1.1%

Table 7. Online Learning and Blended Learning Providers

The data in Table 7 indicate that the major providers are:

1. Postsecondary Institutions
2. Independent Vendors
3. State Virtual Schools within the district's home state
4. The School Districts themselves

Also important is the fact that many school districts are using multiple providers and are not relying exclusively on one provider. The total number of online learning providers reported is 545 while the number of school districts responding that they had at least one student enrolled in an online learning or blended learning class was 190. Table 8 provides a frequency distribution of the number of online learning providers being used by the respondents.

Number of Providers	N	%
1	47	26%
2	56	30%
3	32	16%
4 or more	53	28%
Total	188	100%
Missing	2	
Total	190	

Table 8. Number of Online Learning Providers Being Used

The data in Table 8 indicate that school districts are selecting multiple online learning providers depending upon their needs rather than contracting exclusively with one provider. They may develop their own online courses, partner with another provider to offer a course (e.g., blended course), contract with a virtual school for a course that they are not able to offer, or might rely on a postsecondary institution for students to enroll in college-level work. The use of multiple vendors makes sense and allows the school districts to be most flexible in meeting the specific needs of their students.

G. A Look at Participant Comments

Most surveys provide an opportunity for respondents to make any additional comments that they deem important. It was surprising that in this survey the vast majority of respondents had an additional comment. These comments provided further insights into perceptions and issues regarding online learning in their districts. Below are samples of these comments, selected because they represent themes that were repeated. In some cases, providers of these comments were contacted by telephone for further clarification. Also an attempt has been made to provide a balance of comments that reflect both positive statements about online learning as well the issues and concerns.

1. Positive Statements

Small and Rural School District Needs

"Being a small district with limited revenue sources we are looking at ways to increase our course offerings for students without the expense of hiring costly personnel. Affordable online classes would help us offer more opportunities for our students."

"________ Community Schools is a small rural district. We would not be able to provide our students with a quality education without online learning. Students have a wide assortment of classes to choose from."

"Online or blended courses would provide the district with more options if we face teacher shortages as a rural district with lower teacher salaries as compared to large urban districts."

"This will become more of an option for students in rural areas as the secondary teacher shortage increases."

"We are a small district in rural _________ and want to be able to offer our students all the opportunities that larger communities can offer. Online courses may fill that need."

"Online schools serve a vital role in allowing students more flexibility in their schedule at a small school like _________. It also, allows them a large array of courses to choose from."

New Online Schools

"__________ School District has a Virtual High School which is a fully accredited high school. This year we had approximately 2000 full-time students who took 6 classes via the VHS."

"In the fall of 2007, we hope to open a blended charter school that focuses on individualized education plans for each student."

Postsecondary Education Partners

"…We only use online courses to enable students to gain credits who otherwise would be unable to graduate with their classmates due to schedule constraints. These classes are generally offered through our local community college, or a private vendor."

"The _________ University is located within two blocks of our school so the majority of our students wanting more do the Post Secondary Option with the University. We average about 50 students per year in this program."

"We've been offering Community College courses via Distance Learning for the past 4 years."

Diverse Student Needs

"This is a way to differentiate for students. It should allow for students to extend learning beyond the regular school day or provide alternate learning environment for students who do not do well in the school setting."

"We are very interested in any alternatives to the traditional classroom so that we can meet the needs of all of our very diverse (in many ways) student population. Online or blended courses are one of those alternatives."

Blended Courses

"The new Michigan Merit Curriculum/Graduation Requirements make the option of a blended course very desirable."

"Blended courses give the ________ Schools the opportunity to offer advanced and remedial classes we cannot provide."

"We have discovered that blended courses are more successful, because of the personal contact and group learning along with close and direct physically monitoring by an instructor."

"We want to eventually move to having blended courses and more electives and opportunities for students via on-line learning at most grade levels."

"Hybrid courses have allowed for greater engagement and encouragement."

To summarize, these statements indicate that online learning plays an important role in meeting diverse student needs especially in small, rural, and poorly funded school districts. School districts are partnering with a number of providers such as virtual and charter schools and especially with colleges and universities that are in close proximity to the district. Blended courses appear to be of significant interest to these districts for a variety of reasons mostly having to do with the desire for some personal contact and face-to-face engagement.

2. Statements Expressing Issues and Concerns

Quality Issues

"More information pertaining to the pros and cons of online courses is needed for myself and the school administration. At this time the online … program does not seem to be as effective as face-to-face course work."

"My board believes that interaction with teachers is necessary and important. There may be some students who can benefit from online courses. How can these classes be monitored or proctored? The cost is about the same as a traditional course….Human interaction is very important in any child's social growth."

"Our students have been high achieving students who feel very unengaged by computer courses."

"Students enrolled in the on-line academies in __________ have not fared well on the state tests."

"We feel it is important to offer some online classes to give our students a greater opportunity of classes to select from. We also believe that part of educating a child is to learn social and teamwork skills that need to be done face-to-face."

"Students should meet a set of district-established criteria before registering for an online course. Many times students are not self-motivated to complete online coursework."

Teacher Issues

"While teachers take on-line courses for their credit work, they are as a group very opposed to on-line classes for high school students."

"We have major potential resistance from our teacher union as the teachers tend to view such electronic coursework as a threat to their job security."

"There are barriers for a small school district that have prevented the expansion of online learning. First, the staff is traditional and many do not encourage students to take on line courses. "

"Our teachers union is very opposed to any move toward online delivery of instruction."

"Teacher contracts are an issue."

"We are attempting to start some online staff development as a way, not only to deliver staff development, but to get staff comfortable with online formats."

Funding and Policy

"The initial cost for online course software and training is extremely high for a small, suburban district."

"The system in place for paying for and accepting credit for on line course work needs to be addressed for the student's benefit. School funding prevents offering of online courses as the district currently pays for students to take these courses. This is difficult with decreased enrollment and school funding based on enrollment."

"______County has franchised through __________Virtual School to offer classes to our home school and public school students. There are limitations to growth due to the FTE earning structure for virtual education."

"We are just getting started, but are challenged by attendance laws and the newness of the process to our families and faculty."

"We have a high level of technology in our district, and would like to position ourselves to be able to deliver online content. However, state regulations are extremely restrictive at this point."

"Quality and comparability based on state learning standards is a key policy issue."

Regardless of the number of studies that have been conducted supporting the quality of online learning, skepticism still exists in the minds of many educators and local policy makers, further fueled by the concerns of teachers related to job security, instructional change, and the need for extensive and ongoing professional development. A number of funding issues were expressed especially in districts where limited available resources would have to flow out of the district to pay for online courses.

V. DISCUSSION

A. Online Learning: Will the Growth Continue?

As mentioned at the beginning of this study, Berge and Clark cited an estimate of 40,000 to 50,000 students enrolled in online courses in 2001 [5]. Data collected in this study and supported by an estimate by Smith, Clark and Blomeyer [8] put the number of students at closer to 700,000 for 2005–2006. These data indicate that online learning in K–12 schools has increased more than tenfold in six years. Furthermore, data collected from the respondents in this study indicate that the growth will be sustained. The majority of school districts now offering online learning options to their students anticipate growth over the next three years, while those not currently offering online learning options to their students state that they will likely do so in the next three years. This growth pattern mimics the experiences in higher education which became more involved in online learning a good five to six years before K–12 schools. Approximately three million students or almost 20 percent of the total higher education population were enrolled in online courses in 2005–2006 [1], almost double the number reported in 2002. If this pattern were duplicated in K–12 over the next five or six years, the enrollment in online courses would easily approach several million students.

There are, however, issues reported in the findings of this study that will slow growth but not necessarily impede it completely. Concerns about the quality of online courses, costs, and teacher development are important but resolvable. These same issues exist in higher education where they have been and continue to be addressed. Online technology is permeating American society beyond commercial endeavors. Hospitals, governmental agencies, and higher education are rapidly retooling their services to take advantage of online technology in all aspects of their enterprises. Undergraduates in most colleges and universities will probably experience at least one online or blended course by the time they finish their programs. Graduate and professional development programs including those sponsored by labor unions and professional organizations such as the American Federation of Teachers and the National Education Association are increasingly making use of online learning. Every indication is that once committed to online instruction, these organizations will continue its expansion to meet the needs of students who are either geographically dispersed or constrained by time because of family or professional commitments.

Additionally, major policy changes in federal, state and local education governing bodies can influence and perhaps accelerate online learning in K–12 schools. The federal government and specifically the U.S. Department of Education has been enthusiastic in its support regarding online learning. The National Education Technology Plan (2004) congratulates best practices in online learning among the states and observes:

> About 25 percent of all K–12 public schools now offer some form of e-learning or virtual school instruction. Within the next decade every state and most schools will be doing so [11, p. 34].

This report trumpeted "we may well be on our way to a golden age" in American education because of the infusion of technology including online learning into primary and secondary schools.

As reported by one respondent in this study, the state of Michigan in 2006 passed the new Michigan Merit Curriculum that requires all high school graduates either to complete a fully online course or to have online learning substantially integrated into their basic high school coursework (e.g., blended learning). A number of states such as Florida, Kentucky, and Illinois have funded and established statewide virtual schools designed to meet the needs of large numbers of students. The Florida Virtual School founded in 1997 enrolled more than 31,000 students in 2005–2006 [12]. State governing bodies have also tried to develop equitable funding formulae usually through subsidies that allow school districts throughout the state to enroll their students in these virtual schools at reasonable tuition rates. These arrangements, however, have not been perfect and as respondents in this study have indicated, there needs to be further work in many states on the way school districts receive funding and pay tuition for online students.

Large school districts and school district consortia likewise are beginning new virtual school initiatives to serve students in their own districts or regionally. Clark County which includes Las Vegas, Nevada, for instance, established the Clark County School District (CCSD) Virtual High School (VHS) in 2004, which evolved from the Clark County Distance Education Program [13]. Other school districts and regional consortia with established distance education programs are likewise considering whether and how to reorganize themselves in light of the ubiquity of online communications in schools, homes, and places of business. Many of these will likely formally reorganize into virtual schools or at least substantively change their current distance education programs to online formats.

Before concluding this section on enrollment growth in K–12 online learning another brief mention regarding home-schooled students is in order. The U.S. Department of Education estimated that approximately 1.1 million students in the United States are home-schooled and that this number is growing [14]. Many states have little if any data on these students but it is likely that some of them are doing course work online. No attempt was made in this study to collect data on the home-schooled population and the estimates provided would likely increase if this population were considered.

B. The Needs of Small Rural School Districts — Lessons for Other Districts?

Perhaps the voices heard most clearly in this survey were those of respondents representing small rural school districts. For them, the availability of online learning is most important in order to provide students with course choices and in some cases, the basic courses that should be part of every curriculum. Shortages of teachers in high-demand secondary school subject areas such as science, mathematics, and foreign languages have historically been a serious problem for rural school districts. While the data analysis of questions in this study dealing with participation in and plans for developing online learning did not indicate any major differences on the part of rural school districts versus other districts (urban, suburban, large towns), a review of the respondents' comments provided a consistent voice expressing the needs of these districts.

Rural school districts, because of modest property tax bases, generally have the lowest per pupil expenditures compared to urban and suburban districts and need to use financial resources as wisely and effectively as possible. Online learning not only provides many more options for these districts in terms of being able to offer courses where teacher shortages might exist but also does so in a way they see as affordable. In addition, small rural districts have smaller student populations so if they are able to find teachers in high demand subjects, the small number of students that might enroll in their courses would result in very low student to teacher ratios and hence higher per course costs. Online learning provides these districts with a cost beneficial method of providing courses for students that otherwise would require the hiring of teachers who would not have enough students to justify their salaries. This would be particularly true for electives and enrichment subjects and perhaps for required courses as well in some situations.

The online approach to teacher shortages in small rural districts may be an example that other districts with similar teacher shortages might want to consider. Inner city urban districts, for instance, frequently have difficulty attracting and keeping secondary school teachers in science, mathematics, and foreign languages. One common approach to solving this problem has been to have teachers work out of license; teachers who are credentialed in other subject areas such as social studies or language arts teach science and mathematics. Might not an online course where some, if not all, of the content could be taught by credentialed science and mathematics educators be a viable option? A blended course might be particularly appealing where an online teacher credentialed in the subject area would work with a face-to-face teacher not credentialed in the subject area. The two teachers could then work with and support each other: one delivering specialized online content and the other face-to-face instruction, tutoring, and hands-on activities. Online learning provides options for all school districts to consider as they try to meet best the needs of their students.

C. Online or Blended: Which Way Do We Go?

The data in this study indicate that fully online courses are more popular in terms of enrollment than blended courses. The results also indicate that many school districts continue to have concerns about quality, student readiness, and staff development related to online education. It may be that blended instruction is a better option for districts with these concerns. In an interview, Julie Young, the founder and president of the Florida Virtual School, when asked about her vision for the future of her school and online learning, commented:

> "Within five years, there will be lots of blended models such as students going to school two days a week, and working at home three days a week. Another blended model … is where a student takes five [face-to-face] courses at school and two virtual courses…" [15].

The data in this study indicate that respondents perceive that students need to be ready and "more disciplined" to succeed in online courses. Even in higher education, the readiness of students to participate and succeed in an online course has been well-established as a concern. In K–12 schools, especially at the primary and middle school level, the social and emotional development of students is an important aspect of the overall school experiences, so student readiness is legitimately of equal if not of greater concern. A blended approach can ease this concern by providing some face-to-face time.

A focus on blended courses can also ease the process of converting courses to online for those districts that choose to create and deliver their own offerings. Converting a single high school or middle school course into a fully online format is a substantial task for a novice. However, moving portions of a course from face-to-face to online, by starting with a small module and then moving on to the next, is a standard course development approach that can ease the development process for the teacher. Professional development might also be easier and more palatable for teachers who can begin to use online learning in a blended approach that provides them an initial comfort zone of some face-to-face contact with students.

VI. CONCLUSION

The purpose of this study was to explore the nature of online learning in K–12 schools and to establish base data for more extensive future studies. Issues related to planning, operational concerns, and online learning providers were examined. In line with most research dealing with relatively new and ever changing technology, this study adds a little more to our collective knowledge about online learning in the K–12 environment while not necessarily providing definitive answers to key questions. However, much of the data collected and analyzed in this study supports existing research indicating that online learning has been growing in K–12 schools and that this growth will continue for the foreseeable future. A comparison was made to higher education where data are more prevalent and trends have been followed for a number of years. If K–12 follows the pattern of enrollment growth in higher education, it is quite possible that online learning will emerge as a substantial component in K–12 schools, especially at the secondary level. In examining this potential, small rural schools may be providing important experiences for school districts in other localities, especially those that are facing severe teacher shortages. It is also possible that the blended model may prove to be attractive to K–12 schools, especially those that are struggling with issues of online learning quality, student readiness, and teacher professional development. Finally, online learning is not one thing but comes in various shapes and sizes. This study attempted throughout to differentiate fully online and blended learning in order to provide a more refined model for future research.

VII. REFERENCES

1. **Allen, I. E. and J. Seaman.** Making the Grade: Online Learning in the United States, 2006. Needham, MA: The Sloan Consortium, 2006.
2. **Watson, J.** Keeping pace with online learning: A review of state level policy and practice. Naperville, IL: Learning Point Associates/North Central Regional Educational Laboratory, 2005.
3. **Laster, S., G. Otte, A. G. Picciano and S. Sorg.** Redefining blended learning. Presentation at the 2005 Sloan-C Workshop on Blended Learning, Chicago, IL, April 18, 2005.
4. **Saulny, S.** Home schoolers content to take children's lead. *New York Times*, November 26, 2006. Retrieved November 26, 2006. http://www.nytimes.com/2006/11/26/education/26unschool.html?th&emc=th.
5. **Berge, Z. L. and T. Clark.** Virtual Schools: Planning for Success. New York: Teachers College Press, 2005.
6. **Clark, T.** Virtual schools: Trends and issues. Phoenix, AZ: WestEd Distance Learning Resource Network, 2001. Retrieved November 25, 2006. http://www.wested.org/cs/we/view/rs/610.
7. **Setzer, J. C. and L. Lewis.** Distance education courses for public elementary and secondary school students: 2002–03 (NCES 2005–010). U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2005.
8. **Smith, R., T. Clark and R. L. Blomeyer.** A synthesis of new research on K–12 online learning. Naperville, IL: Learning Point Associates, 2005.
9. **Boria, R. R.** States given guidance on online teaching, e-school costs. *Education Week*, September 20, 2006. Retrieved November 23, 2006. http://www.edweek.org/ew/articles/2006/09/20/04virtual.h26.html.
10. **Cavanaugh, C., K. J. Gillan, J. Kromey, M. Hess and R. Blomeyer.** The effects of distance education on K–12 student outcomes: A meta-analysis. Naperville, IL: Learning Point Associates, 2004.
11. **U.S. Department of Education.** Toward a new golden age in American technology: How the internet, the law and today's students are revolutionizing expectations. National Educational Technology Plan 2004. http://www.ed.gov/about/offices/list/os/technology/plan/2004/plan.pdf.
12. **Florida Virtual School.** FLV Facts, 2006. Retrieved January 7, 2007. http://www.flvs.net/educators/fact_sheet.php.
13. **CCSD Virtual School.** About CCSD Virtual High School, 2006**.** Retrieved January 7, 2007. http://www.ccsdde.net/community/about.htm.
14. **U.S. Department of Education**. Issue brief: 1.1 million students home-schooled students in the United States in 2003. National Center for Education Statistics, NCES 2004-115, July 2004. Retrieved January 13, 2007. http://nces.ed.gov/pubs2004/2004115.pdf.
15. **Young, J.** Interview. *The American Journal of Distance Education* 20(4): 245–248, 2007.

VIII. APPENDIX A

K–12 Online Learning Survey

Thank you for participating in the Study of Online Learning in K–12 School Districts.

- Report only about online education enrollments of students regularly enrolled in your district.
- Take into account any online education courses in which students in your district were enrolled, regardless of where the courses originated (i.e., from your district or another entity).
- Include enrollments in online education Advanced Placement or college-level courses in which students in your district were enrolled.
- Respondents may skip any questions they wish.
- Consider only credit-granting courses; do not take into account supplemental course materials, virtual field trips, online homework, or staff professional development.
- Do not include enrollments in distance education courses that are not online, such as courses using recorded video or courses conducted mainly via written correspondence.

1. Are students at [*Name of district*] taking any **fully online courses** during the 2005–2006 (12 month) school year?

☐ At least one student took a fully online course

☐ No students took online courses, but the district plans to offer some within the next three years.

☐ No students took online courses, and there are no district plans to offer any in the next three years.

2. Are students at [*Name of district*] taking any **blended/hybrid courses** during the 2005–2006 (12 month) school year?

☐ At least one student took a blended/hybrid course.

☐ No students took blended/hybrid courses, but the district plans to offer some within the next three years.

☐ No students took blended/hybrid courses, and there are no district plans to offer any in the next three years.

Use the following to distinguish between Online and Blended/Hybrid instruction:

- **Online** (80+% of the content delivered online): A course where most or all of the content is delivered online. Typically have no face-to-face meetings.
- **Blended/Hybrid** (30 to 79% of the content delivered online): A course that blends online and face-to-face delivery. Substantial proportion of the content is delivered online, sometimes uses online discussions, typically has few face-to-face meetings.

3. Please identify **how important** you believe the following reasons are for a school district to offer fully online or blended learning courses.

	Not at all Important 1	2	3	*Neutral* 4	5	6	***Very Important*** 7
Online and blended offerings are pedagogically more beneficial.	☐	☐	☐	☐	☐	☐	☐
Addressing growing populations and limited space.	☐	☐	☐	☐	☐	☐	☐
Online and blended offerings are financially beneficial.	☐	☐	☐	☐	☐	☐	☐
Students prefer online course activities.	☐	☐	☐	☐	☐	☐	☐
Certified teachers are not available for traditional face-to-face instruction.	☐	☐	☐	☐	☐	☐	☐
Offering courses not otherwise available at the school.	☐	☐	☐	☐	☐	☐	☐
Offering Advanced Placement or college-level courses.	☐	☐	☐	☐	☐	☐	☐
Meeting the needs of specific groups of students.	☐	☐	☐	☐	☐	☐	☐
Reducing scheduling conflicts for students.	☐	☐	☐	☐	☐	☐	☐
Permitting students who failed a course to take it again.	☐	☐	☐	☐	☐	☐	☐

4. Please indicate **how much of a barrier** the following areas would be (or are) to [*Name of district*] in offering fully online or blended/hybrid learning courses.

	Not at all Important 1	2	3	*Neutral* 4	5	6	***Very Important*** 7
Course development and/or purchasing costs.	☐	☐	☐	☐	☐	☐	☐
Limited technological infrastructure to support distance education.	☐	☐	☐	☐	☐	☐	☐
Concerns about course quality.	☐	☐	☐	☐	☐	☐	☐
Restrictive federal, state, or local laws or policies.	☐	☐	☐	☐	☐	☐	☐
The need for teacher training.	☐	☐	☐	☐	☐	☐	☐
Concerns about receiving funding based on student attendance for online and/or blended/hybrid education courses.	☐	☐	☐	☐	☐	☐	☐

The following questions are for those schools districts that currently offer online or blended/hybrid courses. **If [*Name of district*] does not currently offer online or blended/hybrid courses**, click here to go to the final question (Number 11).

5. *(Districts with online and/or blended/hybrid offerings.)* Please **select the level** (1–7) at which you disagree/agree with the following statements with regard to online learning in [*Name of district*].

I believe that:	*Strongly* ***Disagree*** 1	2	3	*Neutral* 4	5	6	*Strongly* ***Agree*** 7
Fully online and blended/hybrid courses fulfill an important educational need for my students.							
Fully online and blended/hybrid course experiences are comparable in educational value to traditional face-to-face instruction.							
[*Name of district*] knows and maintains records on students taking fully online or blended courses.							
Fully online courses and blended/hybrid courses have allowed [*Name of district*] to build important relationships with other organizations.							
Students need more discipline to succeed in an online course than in a face-to-face course.							
Faculty at [*Name of district*] accept the value and legitimacy of online education.							

6. *(Districts with online and/or blended/hybrid offerings.)* Your best estimate of the **number of student enrollments** for [*Name of district*] in each of the following categories (a student enrolled in more than one course would be counted only once) during the 2005-2006 (12 month) school year?

	Student enrollments	
	Students taking at least one Fully Online Course	Students taking at least one Blended/Hybrid Course
Grades K-5		
Grades 6-8		
Grades 9-12		
Other		

7. *(Districts with online and/or blended/hybrid offerings.)* The **nature of the courses** that students are taking fully online or blended/hybrid at[*Name of district*] during the 2005-2006 (12 month) school year can be described as (check all that apply):

- ☐ Required courses.
- ☐ Elective courses.
- ☐ Other.

8. *(Districts with online offerings.)* Over the next two years, we expect **fully online course enrollments** for [*Name of district*] to:

- ○ Grow by about ____ percent.
- ○ Stay about the same.
- ○ Decrease.

9. *(Districts with blended/hybrid offerings.)* Over the next two years, we expect **blended/hybrid course enrollments** for [*Name of district*] to:

- ○ Grow by about ____ percent.
- ○ Stay about the same.
- ○ Decrease.

10. *(Districts with online and/or blended/hybrid offerings.)* The **provider(s)** for fully online and blended courses for [*Name of district*] are (check all that apply):

	Check all that apply	
Providers	Online Courses (80%+ course content delivered online)	Blended/Hybrid Courses (30% and 80% course content delivered online)
Your district (i.e., delivered centrally from the district)	☐	☐
Cyber (i.e., online) charter school in your district	☐	☐
Other schools in your district	☐	☐
Another local school district, or schools in another district, in your state	☐	☐
Education service agencies within your state (e.g., BOCES, COE, IU), not including the state education agency or local school districts	☐	☐
State virtual school in your state (i.e., state-centralized K-12K–12 courses available through Internet- or web-based methods	☐	☐
State virtual school in another state	☐	☐
Districts or schools in other states (other than state virtual schools)	☐	☐
Postsecondary institution	☐	☐

Independent vendor	☐	☐
Other: [ ]	☐	☐

11. *(All districts.)* In the space provided, feel free to make any other comments regarding the nature of online or blended learning at [*Name of district*]:

Thank you for completing this survey. Please provide your email address and so we can provide you with a link to a free download of the final survey report.

Email: [ ]

If you would like to participate in a follow-up telephone conversation to this survey, please provide your name and telephone number below. (Note: We value your privacy. The phone number you provide will be used **ONLY** for survey-related purposes, **not** for marketing, and will **not** be shared with any other organization.)

Name: [ ]

Telephone number: [ ]

Thank you for your time. Press **Submit** to record your responses.

[Submit] [Clear Form]

This study has been funded and supported by the Alfred P. Sloan Foundation and is conducted by researchers at Hunter and Babson Colleges. All responses will be held in strictest confidence and at no time will districts or respondents be identified by name. There are no known risks associated with participation, only the researchers will have access to the data, which will be stored at Babson College for a minimum of three years. Questions regarding the conduct of the survey can be directed to the Hunter College IRB at 212 650-3053.

IX. APPENDIX B

U.S. Dept of Education National Center for Education Statistics (NCES) Common Core of Data (CCD) Locale Code

Locale Code is a variable that NCES has created for general description, sampling, and other statistical purposes. It is based upon the location of school buildings, and in some cases may not reflect the entire attendance area or residences of enrolled students. The designation of each school's "locale" is based on its geographic location and population attributes such as density. School locale codes are coded by Census from school addresses in CCD files. The classifications are:

1. Large City: A central city of a Core Based Statistical Area (CBSA) or Consolidated Statistical Area (CSA), with the city having a population greater than or equal to 250,000.

2. Mid-size City: A central city of a CBSA or CSA, with the city having a population less than 250,000.

3. Urban Fringe of a Large City: Any incorporated place, Census designated place, or non-place territory within a CBSA or CSA of a Large City and defined as urban by the Census Bureau.

4. Urban Fringe of a Mid-size City: Any incorporated place, Census designated place, or non-place territory within a CBSA or CSA of a Mid-size City and defined as urban by the Census Bureau.

5. Large Town: An incorporated place or Census designated place with a population greater than or equal to 25,000 and located outside a CBSA or CSA.

6. Small Town: An incorporated place or Census designated place with population less than 25,000 and greater than or equal to 2,500 and located outside a CBSA or CSA.

7. Rural, outside CBSA: Any incorporated place, Census designated place, or non-place territory not within a CBSA or CSA of a Large or Mid-size City and defined as rural by the Census Bureau.

8. Rural, inside CBSA: Any incorporated place, Census designated place, or non-place territory within a CBSA or CSA of a Large or Mid-size City and defined as rural by the Census Bureau.

We thank Elaine Bowden and Kathryn M. Fife for their comments and suggestions for improving this report.

AN INTERPRETATIVE MODEL OF KEY HEURISTICS THAT PROMOTE COLLABORATIVE DIALOGUE AMONG ONLINE LEARNERS [1]

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ABSTRACT
One of the more challenging aspects of teaching online is promoting content-focused, collaborative dialogue among students. How do we move discussants beyond initial brainstorming toward more focused, deepened dialogue that clearly supports a course's instructional goals? Garrison and Anderson's framework for communities of inquiry illuminates the critical interplay among social presence, cognitive presence and teaching presence for learning in asynchronous, online courses [2]. This paper describes aspects of teaching presence in Virtual High School™ classes [3]: explicit teaching of how to engage in collaborative dialogue; collaborative activity designs and evaluation rubrics; and feedback that, supported by attention to maintaining social presence, helped to promote substantive, collaborative dialogue or cognitive presence.

KEYWORDS
Online Learning, Community of Inquiry, Discourse, Teaching Presence, Cognitive Presence, Discourse Analysis

I. INTRODUCTION

Learning to teach online is not a simple transition for instructors. We can no longer assume that what works in a classroom will work online. This challenge is evident in secondary online courses as well as in higher education. A visual scan of the threaded course discussion areas in the archives of the 112 spring 2003 classes taught in the Virtual High School (VHS) revealed just 22 classes (19%) that indicated some collaborative dialogue or extended peer review activity may have occurred, based on the presence of occasional thread depths of four or higher.

I sought incidents with thread depths of over three for two reasons. Thread depths of one or two, the predominant trend found in 51 (46%) of the class discussion areas that semester, appeared too minimal to be called "dialogue." Thread depths of three predominately represented a single exchange with the author of the initial post returning to add a "thank you" or "I agree." That also did not amount to "extended" dialogue. Once the thread depth passed three, at least a minimum of extended dialogue appeared to have occurred. I, therefore, set the standard for collaborative dialogue at a minimum thread depth of four postings, indicating that students were replying to one another.

The results of my survey suggested that VHS teachers might want to adopt new strategies that support usage of text-based dialogue to foster a classroom-like "community of inquiry in which students listen to one another with respect, build on one another's ideas, challenge one another to supply reasons for otherwise unsupported opinions, assist each other in drawing inferences from what has been said and seek to identify one another's assumptions" [4]. In their evaluation of VHS, Zucker and his associates at SRI [5] confirmed that fostering content-focused dialogue was one of the most significant challenges to secondary level online instructors. To pursue Lipman's vision, using collaborative dialogue online, exchanges among students must have sufficient depth and levels of engagement that enable discussants to build on one another's thinking and deepen their mastery of new material.

In just three of the 22 classes that contained some extended discussion threads, I found a regular pattern of extended threading involving thread depths of four or more, along with a low volume of instructor postings in content threads. These thread maps suggested dialogue occurred regularly across the full fifteen-week semester. Indications in each case included the presence of more than 25 occasions where thread depth was four or higher, spanning the 15 weeks. In addition, instructor postings in each of the three classes totaled less than 30 in content for across the semester, or two or fewer each week. The lower level of active instructor involvement in content-based dialogues suggested other types of scaffolding may have supported learner-to-learner collaboration in those discussions, such as clear rubrics, explicit teaching and/or assessment related to co-constructing understanding through dialogue. More instructor involvement would have suggested extended dialogue depended on an instructor actively pushing the discussion forward. A high level of teacher talk within content-related dialogues defeats or at least interrupts the process of engaging students in dialogue with one another—the outcome that I wanted to study. From a practitioner's viewpoint, intensive and ongoing teacher participation in student dialogue is simply too much work for the teacher, making teaching online more time consuming and challenging than necessary. A regular pattern of lower instructor activity in content-related dialogues was therefore a useful filter, along with the appearance of regular extended dialogue to identify the most interesting classes for further examination.

The analysis of the three classes that appeared on the threaded discussion surface to be highly collaborative could potentially reveal elements of teaching presence and social presence that lead to cognitive presence among the learners. In order for these courses to be instructive, the discourse analysis of collaborative events would need to show that learners were focusing their comments on new content and building on one another's responses, insights and questions.

This paper describes a preliminary study designed to begin addressing the challenge of fostering cognitive presence among secondary learners. It concludes with an emerging interpretative model that synthesizes key elements that support sustained collaborative dialogue found in all three classes. The resulting model combines three critical elements: the explicit teaching of how to engage in collaborative dialogue, collaborative activity designs, and evaluation rubrics or feedback directly linked to contributions to the forward movement of class discussions. Each of these elements is a facet of teaching presence according to Garrison [6]. These elements of teaching presence were supported by attention to maintaining social presence in the classes examined. They were found to be the most likely elements to have fostered such highly collaborative dialogues and cognitive presence in the context of VHS.

The paper is organized in the following way. First I describe the VHS context. Then I describe the theoretical framework that I used for understanding online collaborative dialogue. Third, I describe the methods employed for transcript analysis and the qualitative approach for identifying and analyzing other elements of teaching presence. Fourth, I present the findings leading to the emerging model of elements most likely needed for fostering collaborative dialogue. Finally, I discuss implications of the results and recommendations for practitioners.

II. THE VIRTUAL HIGH SCHOOL

The Virtual High School is a collaborative effort among public high schools in which teachers at participating schools develop and offer online classes that are open to secondary students from all participating districts. The VHS was first launched ten years ago with a 5-year, $7.4 million dollar Technology Challenge Grant from the U.S. Department of Education to the Hudson Massachusetts Public Schools in partnership with The Concord Consortium. The concept was that accredited high schools would enter into a collaborative relationship in which teachers from those schools would lead virtual classes in exchange for seats for local students in the VHS, twenty seats for each semester class taught.

In 2001, the success of the project enabled VHS to become a non-profit, independent organization. In 2006, over 7,500 students are enrolled in more than 200 VHS classes. Nearly 400 member schools include schools in 30 states. Twenty-five member schools are international schools from around the world. The student body is currently 57% female and 43% male. Additional demographics are not readily available. Course offerings include such titles as History of Pop Music to 101 Ways to Write a Short Story, Fractals, Introduction to Programming in Visual Basic, Advanced Placement Calculus, Biotechnology, the Holocaust and the Vietnam War [2]. VHS is considered an exemplary model for pre-college online learning [5].

I wanted to know what design and facilitation strategies VHS teachers who were highly successful at fostering and maintaining asynchronous online dialogue about course content used to promote collaborative dialogue focused on course learning objectives. In particular, I assessed the presence of content exploration evident in the collaborative exchanges in order to then be able to weigh the effectiveness of some strategies over others for promoting focused discussion on and deepened exploration of stated knowledge goals.

III. FRAMEWORK

Nearly all of the researchers studying online learning have focused on higher education. However, secondary level online course offerings have been increasing rapidly. Distance education opportunities existed in about 36% of US public school districts during the 2002–2003 year. The numbers are growing annually [7]. The community of inquiry model, and the delineation of the critical roles of social presence, cognitive presence and teaching presence in higher education courses, is useful for understanding collaborative constructivist approaches to teaching secondary-level virtual learners. At the secondary level, the content may be less complex. Yet, the inquiry-oriented processes of teaching and learning are equally appropriate, on- and off-line [8, 9, 10, 11]. Social presence, or the establishing and continued nurturing of a sense of community among learners must be fostered for people of any age to feel comfortable taking the risks needed to learn deeply [12]. Cognitive presence grows among learners as they co-construct their understanding of new content. Bransford and the National Research Council, in *How People Learn* [13], point out the value of such social interaction for cognitive engagement in the K–12 arena:

> Teachers must attend to designing classroom activities and helping students organize their work in ways that promote the kind of intellectual camaraderie and the attitudes toward learning that build a sense of community. In such a community, students might help one another solve problems by building on each other's knowledge, asking questions to clarify explanations, and suggesting avenues that would move the group toward its goal [14, p. 25].

The use of dialogue as a learning activity is also not new [15]. Harasim [16] identifies the emerging role for computer-mediated conversation described by Brown [3] as “the shift from seeing technology as a cognitive delivery system to using it as a means to support collaborative conversations about a topic and the ensuing construction of understanding." Online, asynchronous collaborative dialogue is a potent, new form of collaborative work. Bruffee [17] highlights the potential of conversation for deepened thinking. Aviv describes asynchronous learning networks as "cooperative learning enhanced by extended think time" [18] since the asynchronicity provides learners the opportunity to reflect and think through a response before responding. Bender suggests, "we can think of teaching and learning as being comprised and communicated by the words that flow between teacher and student, as well as student and student."[19]. Specifically, invitations to learners to post comments to discussions of class readings, science investigations, or math problems; to peer-review one another's assignments [20]; or to share questions and insights about a learning experience can prompt participants to collaborate, or "co-labor." That co-laboring online becomes *collaborative dialogue*. The researchers cited here focused on higher education. However, the same reflective advantages of the online text-based medium can likely be nurtured in younger learners, when appropriate teaching methods are used.

When describing the community of inquiry framework, Garrison points to design features, discussion facilitation, and pedagogic leadership that must blend social and cognitive issues and expectations in order to achieve an effective teaching presence in an asynchronous, text-based environment. He notes these considerations go "well beyond deciding what content will be covered" [6, p. 26]. The interplay among collaborative, constructive processes that effectively shape inquiry experiences can be revealed through case studies. Therefore, the goal for this study was to analyze case studies of potentially exemplary VHS classes.

IV. METHODOLOGY

A. Transcript Analysis

Before I could examine pedagogy, I needed to confirm that the thread depths of four or more appearing on the surface of thread maps in the three classes I had selected actually contained collaborative dialogue. My approach to transcript analysis was to conduct three passes through the transcript data of all the collaborative events, or threaded dialogue amounting to a thread depth of four or more, in each of the selected classes with the goal of establishing the overall quality of collaborative dialogue in each.

In the first pass I employed Harasim's [16] categories of collaborative postings: content-based idea generating, idea linking and convergence. According to Harasim, *idea generating* messages typically introduce ideas or understandings, offer an opinion, or provide an example to the discussion. In VHS discussions, initial postings to discussion assignments were generally idea generating in that they offered student thinking on an assignment question or task.

According to Harasim, postings characterized as *idea linking* referred directly to previous messages, perhaps referencing the name of the author. They included agreement, disagreement, a statement of enhanced understanding, elaboration, or a brief quote from a previous post with a comment. In the VHS postings, the reference was often implicit, as in "I agree that…" or "What do you mean by…".

Evidence of *intellectual convergence,* according to Harasim, is reflected in shared understandings, where ideas of a group of students are combined. She notes that convergence is most likely to appear in the context of participants "engaged in co-production, whether it be producing a report, a presentation, a point of view, a work of art or a scientific theory" (p. 195). None of the classes I selected for this study included these types of team assignments within discussion fora. In addition, I added two additional categories, social (e.g., "Thanks!") and evaluative (e.g., "I agree!"), to better fit the VHS data.

For the purposes of my study, I wanted to know whether the content of sustained, threaded conversation was collaborative dialogue. To answer that question, I needed to quantify the amount of dialogue that was on-topic and collaboratively linking or building on the ideas, questions or insights of others. I would then have comparable profiles of dialogue quality. Were participants engaging socially or were they constructing understanding together? Posts, or parts of posts, that offered simple positive evaluations or agreement without extending any ideas were discounted. It served my purpose to conduct a simple assessment of whether initial posts presented an initial response to the discussion topic or not, and whether linked posts extended that initial thought in some way as a linked idea, question, or insight. In other words, would discourse analysis bear out the surface perception that threaded posts represented collaborative, co-construction of understanding new content? Put another way, how much of these collaborative events signified cognitive presence among the learners in each class?

To find out, I first I color-coded all collaborative events with thread depths of four or more, according to Harasim's framework and my additional categories. In a second pass, I made visual assessments and assigned percentages to each portion of every post by category in order to quantify the content. I made a separate, new pass through the data to match stated learning goals from the three classes with each printed line of the contents of each posting. I chose the unit of a printed line in order to avoid subjective interpretations of "units of meaning" such as sentences, while at the same time gaining a more precise measure than paragraph or message units would provide. Tangential comments were separated out. I assigned a new set of percentages based on direct alignment of discourse with learning goals. In general, the VHS posts were concise and targeted making coding less difficult.

For example, the following post met the stated literature course objective, "Reflect on your life experience, applying the author's philosophies, in writing and discussion" by 100% (every line of text was directed toward stated learning goals) in one of the three classes. The discussants were asked to compare the meaning of love romantically and realistically, in the context of an analogy made to salt crystals on a branch conceived by the French philosopher Stendahl. This learner built on a previous discussant's comment stating,

> This theory was really interesting to me because it sounds so familiar! It really reminds me of the part in *Gone with the Wind* (if any of you have read that) where Scarlett discusses what she felt for Ashley as being "in love with a pretty suit of clothes."
>
> I think we've all been there before. It's so easy to fall "in like" with someone when all you know about them is what you yourself made up It's not so fun when the "crystals shake off" and you realized you just wasted so much time on someone who wasn't really worth it!

In an example from a class in nuclear physics, the topic was depleted uranium (called "DU" in the comment). The discussion explored the question, "What responsibility do we have to workers who are exposed to radiation or have been exposed to radiation in the past?" Again, the following post was made by a discussant building on the comment of previous participants. This post was also 100% on topic. Note the explicit linkage to a previous comment in the opening:

> [Name] mentioned that DU is a toxic element, which is the main reason why DU is dangerous. Think about the substances people consume everyday that are toxic…tobacco and alcohol are two prime examples of toxic substances (consumed daily by many) Can we blame the government for getting diseases from using these toxic elements? Sure, these are by choice—but DU has not shown strong evidence of illnesses directly from the substance.

Although 100% content-related postings predominated generally in VHS content forums I examined, more socially oriented exchanges did occasionally appear. For example, in the following set of three linked posts, the instructor first re-visited a discussant's comment, the learner responded, then the instructor followed-up. The instructor's first intervention was 100% on topic. The learner's response was about 50% social (apologetic) and the instructor's follow-up was 100% social in nature, essentially intended to be reassuring to the learner. At the same time, the dialogue has moved off-topic (albeit, not far) and no longer directly targeted the stated objective that "students will be able to solve half-life problems."

> *Rate of decay* (Instructor): Are you sure there is a direct relation? I'll agree the activity is higher for an isotope that decays faster, but if something decays faster, does it mean it has a long half-life or a short half-life? (100% on topic/2.5 lines)
>
> *My Mistake* (Learner): I feel pretty stupid contradicting myself.
>
> Obviously, as half-life gets smaller, activity increases: inversely proportional. Sorry. (50% social/1 line social; 1 line content-related)
>
> *Don't* (Instructor): Don't feel stupid. Your mistake was quite a common one. Many of my f2f students confuse inverse and direct relations (and I hate it when they use the term indirect instead of inverse). With these two quantities, it is even easier to get them mixed. (100% social/3 lines social)

The purpose of this additional analysis was to be sure the selected classes showed clear evidence that learning about the target goals was consistently and clearly supported by learner dialogue.

I trained a second individual to code a random sample of 10% of the full data set, in order to ascertain inter-coder reliability using the Cohen's kappa measurement. Following training, and an initial coding session, I revised my training to clarify what counted as substantive linking phrases, and what was simply social or evaluative. For example, in the training, I was thinking of "evaluative" as evaluating the previous participant's comment. In the first round of coding by my second coder, she coded all statements that evaluated the subject matter of the class (e.g., "I liked this story because…" or "I disagreed with this author since…") as "evaluative." Another correction I had to make was to clarify how a linking comment had to be substantive, in that it was directly related to course content. For example, a student had posted, "Okay, I'm not confused anymore. I figured out what was confusing me. Good story!" My partner coded that as a linking comment, however, according to my schema, it does not add anything to the co-construction of understanding new material; instead, it is a social response to a helpful clarification. With a follow-up post of "Great!" we would have a thread depth of four with only the first two posts being substantive. In a similar case, my partner labeled a comment as linking that stated, "Thanks for the heads up on the movie. I'm definitely going to rent it." The movie mentioned was a movie that had a plot similar to that of the story under discussion, used in order to make a connection. That connecting post contained a substantive, linking comment. However, it was not a substantive build to respond with plans on renting the video. That again was social, according to my schema. Postings were coded again. The final reliability measure was .8865 or a percentage agreement of 92.68% according to Cohen's kappa.

I also analyzed instructor postings to understand how discussion facilitation was conducted in each of the three classes and to determine the impact of instructor interventions into dialogue on collaborative discourse. Garrison and Anderson [2] highlight the importance of "cognitive presence" for online learning, defining it as:

> …the intellectual environment that supports sustained critical discourse and higher-order knowledge acquisition and application. More specifically… facilitating the analysis, construction, and confirmation of meaning and understanding within a community of learners through

sustained discourse and reflection largely supported by text-based communication. (p. 55)

The framework developed by Collison et al. in *Facilitating Online Learning: Effective Strategies for Moderators* [21] adds specificity to the general guidelines indicated by Garrison and Anderson. Taxonomies of voices and critical thinking strategies described by the authors are intended to both engage and probe student thinking to further collective exploration of content. Therefore, they were useful in analyzing the specific pedagogical moves at work in the VHS dialogues. Collison et al. identified six "voices" or roles and a set of critical thinking strategies that effective online instructors can use in combination to further collective thinking and learning. These instructor voices are presented in Table 1, below, followed by a brief description of the set of critical thinking strategies.

Voice	Role
Conceptual Facilitator	Identifies conceptual areas that need further attention.
Generative Guide	Lays out a spectrum of possible positions taken to indicate avenues of exploration that are not yet addressed.
Personal Muse	Models publicly the kind of internal dialogue one might have when critically examining beliefs.
Mediator	In support of the central goal—maintaining a dialogue's direction and open spirit—a moderator redirects away from hardened positions and toward goals that are central to the interests of all parties.
Reflective Guide	Restates the elements of a participant post or sequence of posts in order to highlight potential building blocks toward further insight. The voice carries a sense of non-directive interaction, as effected by a Rogerian counselor, though holding steady on the goal of the dialogue.
Role-play	Introduces alternative perspectives into a dialogue, alerting participants to unexamined considerations.

Table 1: Instructor Voices

The critical thinking strategies identified by Collison et al. included three that are useful for sharpening the focus of a dialogue. *Identifying a Direction* for dialogue points toward but does not reveal essential elements for improved understanding of a problem or a process. *Focusing on Key Points* posts draw from participant input related to specific learning goals to highlight essential comments and connections made to date and thus clearing the way forward toward additional learning goals. *Sorting Ideas for Relevance* posts identify candidates for further exploration that are suggested in initial postings.

Three additional strategies serve to deepen a developing dialogue. *Full-Spectrum Questioning* offers five general categories of questioning: "so what?"; clarification of meaning; exploration of assumptions; identification of causes and effects; and questions that consider appropriate action. By modeling these richer modes of probing discussants, the facilitator points toward new approaches for viewing or questioning current thinking. The *Making Connections* strategy challenges discussants to move away from contributing "more of the same" to explore inferences or tensions that will help participants shift to more systemic layers of content exploration and recognition. The *Honoring Multiple Perspectives* strategy suspends belief, holding up tensions in discussants' conceptual frameworks for further consideration.

Instructors foster collaborative content-related dialogue using one of the voices in conjunction with a critical thinking strategy. For example, in a VHS language arts assignment, students read a short story by Edgar Allen Poe, "paying close attention to how Poe introduces and carries out the conflict" and "support[ing their] interpretations with specifics from the text." The resulting discussion was off-target and the instructor intervened to re-focus the group more specifically on topic. In *Facilitating Online Learning* it states, "If your diagnosis is that plenty has been posted but little of value has been revealed…you can list current directions or contributions, and seek alternative ordering principles, extensions, or interpretations, with the goal of targeting likely conceptual blocks or assumptions" [21, pp. 106-7]. The instructor used a *Generative Guide* voice to *Identify a Direction* for more content-related dialogue:

> It's fine to exchange stories about revenge strategies in the lounge, but here I want you to focus on what happened in the story. How does Poe use innuendo? How does he reveal the conflict? What in the character's personality can we identify?

In this case, the instructor's initial directions were focused but open-ended ("paying close attention to how Poe introduces and carries out the conflict" and "support(ing) your interpretations with specifics from the text"). The intervention was intended to sharpen a dialogue that was active but not focused on targeted learning goals. She acknowledged their contributions, suggesting that their exchange to this point was acceptable in a social forum, but not for the assignment. She clarified the original assignment. The goal was to *generate* more focused discussion by *identifying* the more appropriate *direction* for students to explore.

In another example, students were discussing Shakespeare's *Anthony and Cleopatra*. They produced an active brainstorm and were ready to dig more deeply into their analysis. In *Facilitating Online Learning* it states,

> Most facilitators of online discussions read, sort and assign value to discussion entries and their components based on the context of the topic or the course goals. The sorting ideas for relevance critical-thinking strategy addresses a very different process: Crafting an entry that explicitly, but informally, makes public the sorting mechanism, leaving options open for collective input [21, p. 133].

In the following example, the instructor prodded the students to consider how the bits of evidence they had gathered as they described the relationship between the two main characters fit together into a consistent picture. He offered them a *Reflective Guide* post to help them *Sort for Relevance*:

> Hi all...
>
> I'm reading the analyses below, and we've come up with an impressive array of poetry readings...A caution about temptation? (Names Student 1)
>
> An author with an axe to grind against males? (As Student 2 notes) Male Goblins as a necessary evil for childbearing? (Did I get that right, Student 3?)
>
> (Student 4) suggests there's an inherent weakness in rationality and moral behavior—exposed in the poem. A tale of sibling love? (Names Student 5)
>
> Have we made progress? We've got a *wide* array of responses on the table... which should we take deeper? And those of you whom we haven't heard from... do get in soon so the rest of us can post our follow-ups!

This instructor *guided* by mirroring or *reflecting* back to learners an "array" of insights gleaned from the dialogue, naming contributors and citing their words. He avoided telling them where to focus and instead asked them to *sort* through their collective gems for *relevant* pathways worthy of more careful consideration by all. In this case, the instructor helped to sharpen the focus of discussants confronted with a barrage of postings and ideas by narrowing their consideration to the key ideas already on the table.

This type of intervention can leverage the group to a more reasoned level of deepened discourse on the important ideas already on the table without narrowing their focus down a single pathway or toward "the one right" answer.

For the VHS data, I first categorized all the public postings of the instructors in each class. I then looked at any moves instructors made in the content-related fora toward focusing or deepening dialogue and assessed alignment between such postings and the voices and strategies described above. I also found other types of instructor comments in public discussions, such as social comments, probes for clarification, public praise, or suggestions of resources. I categorized these to uncover other patterns that might explain the presence of collaborative dialogue. I conducted an open-coding approach to label each public posting made by the instructor. Table 2, below, organizes my final set of categories by the general instructional processes identified by Garrison and Anderson.

General Processes	Specific Indicators	Examples of Indicators
Fostering Cognitive Presence	Voice (e.g., conceptual facilitator, reflective guide) & Critical Thinking Strategy, according to Collison et al.	"Okay (Name) et al., (sic) Can you discuss why: 'it is a good example of how a short story should be written'? Go beyond saying it's creepy."
Other Forms of Teaching Presence	Public Praise	"Good job on your setting sketch. I can't wait to read your story."
	Negative Evaluations	"This is supposed to be a setting sketch – time, place, mood. You've gotten into the story. Please redo."
	Constructive Criticism	"Hi (Name), This reflection on "homeland" is so general, it could be about virtually any story. If this one didn't strike you as good, perhaps try a different one that would give you specifics to talk about."
	Direct Instruction	"We are well past animal testing for irradiated food. It is being consumed now, by people around the world, including some products in the U.S."
	Offering resources	"Another book you would probably enjoy is Bird by Bird by Anne Lamott. It will make you laugh out loud, and think hard about your writing, and writing habits."
	Probe	"Hey (Name), What are you saying here? Can you be more specific?"
	Collegial joining in as a participant	"Glad to hear other people love this book; I'm having fun reading it with my sophomores right now, and most are into it, but you know how some kids drag their feet…I just wish the first 100 pages weren't so slow. (I think that qualifies as a nasty run-on sentence!) My advice to students is usually, read faster!"

Table 2: Indicators of Teaching Processes in Content-based Fora.

Once again, to assess inter-rater reliability for this coding procedure I trained a second coder to code a random sample of 10% of instructor postings. Cohen's kappa agreement was .9415 after two rounds of training. Confusion was reduced for coding these postings with the use of Table 2, above. After a review of the categories, we achieved strong agreement.

After transcript analysis was completed, the quality of dialogue in the selected classes was assessed, and instructor postings were analyzed, I turned to additional elements of the course that may have influenced collaborative dialogue. I considered evaluation and feedback, instructional design features, participant influences, and comparable elements in equivalent courses where collaborative dialogue was low. The remainder of this section describes these methods.

B. Evaluation and Feedback

I compared private feedback in the three classes to assess the role of evaluation in fostering collaborative dialogue. The VHS instructors interacted in three ways with their virtual students. First, they posted in the public discussions. Second, they conversed privately with students in individualized discussions. Third, they posted private feedback to each student about their work, including formal grades. In these private discussions, the conversations were predominately of the "Where's your assignment?" and "Sorry I was late posting this week" genre. Formal feedback about performance in the class appeared in another area of the class designated for grading and evaluative comments. I examined patterns in instructors' private feedback to learners that directly supported student dialogue about new content. In order to compare the relative emphasis on and support for substantive interactivity, descriptive statistics such as how often an instructor addressed discussion participation or offered suggestions to students about how to collaborate with their peers more effectively were drawn from the archives.

C. Instructional Design Features

All the VHS classes shared similar design features that supported peer interactivity. For example, VHS instructors were required to start with "getting-to-know-you" icebreaking activities to foster a socially-connected community. Research has established social community as a necessary foundation for generating intellectual camaraderie [2, 22, 23, 24]. Most VHS classes, including those in this study, contained at least one social forum such as a student lounge that was active throughout the semester. VHS classes required discussion participation and final marks incorporated student participation. These common features of VHS classes were actively encouraged by VHS administrators and served as a baseline for fostering interaction. Though essential, they were not in themselves enough to assure substantive student dialogue, given the lack of student interactivity in most classes that semester.

To uncover additional supportive design features, I sought design elements that were likely to have contributed to the cognitive presence among discussants. I used the constant comparative method [25, 26, 27] and an open-coding procedure [27, 28]. I considered aspects of overall course design, specific activity designs, and discussion starter postings in order to assess the aspects of teaching presence that potentially played a role in achieving collaborative dialogue in these classes. I coded design features evident in introductory course documents that might have corresponded with increased or decreased numbers of collaborative events. For example, I documented such dimensions as small team discussions versus whole class discussions, detailed grading rubrics and posting requirements, and discussion activities where students were assigned specific roles. I sought out descriptions of grading practices, specifically related to student-to-student interaction. Were postings evaluated, and if so, what percentage of the final grade did they account for? Was the importance of building on one another's ideas or "active listening" mentioned or emphasized?

D. Cross-Case Comparisons

In order to develop a complete analysis across classes, I mixed case-oriented and variable-oriented approaches [28, 29]. I constructed descriptive cases [30] in order to have a holistic view of each instructor and class essential for contextualizing the complex interplay among variables. I displayed these variables in matrices that compared the relative prevalence of some variables over others. Carefully examining variables such as type of feedback or course design features (team work, emphasis on dialogue in discussion assignments, etc.) helped to isolate which approaches may have had the most impact, when looking across cases or across weeks in a single case.

E. Participant Influences

To check my assumption that collaborative dialogue was a result of course design or instructor facilitation and leadership, I also considered participant influences. This consideration served two roles in the study. First, the positive role that participants might play in furthering learner dialogue (asking their peers questions, engaging active listening, etc.) could be useful to instructors seeking to teach their students how to engage more collaboratively. Second, examining participant roles in extended dialogue made the model development process more robust, helping to avoid the pitfall of inaccurately attributing sustained student dialogue to instructor moves and design features. Did learners initiate or sustain continued peer dialogue? What online, text-based rhetorical behaviors could be encouraged by instructors and learned by discussants to support extended dialogue?

Research has shown that the gender roles may shift when a course moves from a face-to-face environment onto online discussion boards. In the face-to-face environment, where airtime is limited, research has shown men are more at ease with speaking out. However, online, where competition for airtime is removed, women may be more at ease with the collaborative, networking aspects of the environment that emphasize dialogue. A recent review of the literature by Hiltz and Shea [31] suggests that, though findings of new studies on gender and asynchronous learning networks have yet to be replicated, it appears that gender inequalities aren't great. However, it is intriguing that, as stated in the original proposal for the project, the intention of VHS was to admit an equal number of male and female participants, yet gradually over time the percentage of females over males has increased. Currently, 57% of VHS participants are female and 43% are male. Therefore, I sought out indications of gender imbalance in the collaborative participation of learners.

F. Comparison with Classes Showing Lower Levels of Collaborative Dialogue

In an earlier study [32], I considered two VHS classes from the same original set of spring 2003 archives that were comparable with matching sessions of the same two classes, but were taught by different instructors and hardly exhibited any linked dialogue at all. The purpose of that pilot study was to compare classes with higher levels of collaborative dialogue with equivalent sessions of the same class that appeared to have lower levels of collaborative dialogue. I considered the results of that study as I weighed the likely impacts of the approaches used in these three exemplary classes. If approaches in both types of classes, those with higher levels of collaborative dialogue and those with lower levels of collaborative dialogue were similar, those elements were less likely to be the factors that explained higher levels of collaborative dialogue.

G. Reliability, Validity and Generalizability

Archived online course data offer a unique opportunity for data collection. The researcher has no impact on class activities and can study them in their near totality without intruding. I made numerous passes, or "check-coding" [28] through the same discourse data for open-coding, and re-coding to assess personal reliability and to correct errors. This reduced reliability problems [29]. As described above, a second coder coded 10% of the discourse data in order to assess reliability and the results were strong. I also conducted "member-checks," sharing my findings with the VHS instructors who taught the three classes included in the study.

The validity of my analysis may seem at risk, as I selected just three classes from VHS to examine, and from which to draw preliminary conclusions. The strengths of the methodology were the completeness of the data set initially surveyed: one full semester archive of VHS classes, and the complete data set of three classes examined that had revealed over 25 collaborative events across the semester with a minimum of direct instructor intervention.

Now that this study is complete, the resulting interpretative model can be tested internally, by VHS instructors. A new study with an experimental design could compare two semesters of the same class taught by the same teacher: the semester in which he or she attempts to shift practice toward the design and teaching practices suggested by the research could be compared with the previous semester. Such a "pre-post" research design would test and strengthen the validity of the model.

The classes examined represented course disciplines, designs, and instructors who were most likely actively seeking a high level of learner dialogue in their courses. They did not represent all academic disciplines, nor did they represent an exhaustive list of possible approaches to increasing collaboration. For VHS instructors who have been frustrated in their attempts to increase student-to-student collaborative dialogue, referenced in Kozma and Zucker's account of the challenges VHS teachers face, the model developed in this study may be of interest and use.

The study may have internal generalizability within VHS where the format and general culture is constant. However, the constructed model is preliminary and untested. It must be tested for replicability before it can have significant external generalizability. Although not conclusive, this initial research established standards and methodologies that can be used in the future to further develop interpretative models that can improve online learning in a variety of settings.

V. FINDINGS

Sustained, collaborative dialogue among learners, evidenced by thread depths of more than four, and called "collaborative events," appeared regularly throughout only these three 15-week VHS courses offered in the spring of 2003. In addition, there was a minimum of instructor facilitation, implying that other factors of design, rubrics or assessment fostered sustained peer-to-peer conversation. One course was an honors language arts class open to grades 9–12, examining the theme of love in literature. The others were standard courses open to grades 10–12. One was a social studies course on the United Nations, and one was a course on nuclear physics and society. Examination of the three selected discussion areas revealed that the language arts course and the science course were the two classes with the most robust collaboration levels. Both had 29 collaborative events with thread depth of four or more that spanned the 15-week semester. The average thread depth for both was four, and the average thread length was 5 in the language arts class and 6 in the science class. The social studies class achieved all 26 of its collaborative events within just four weeks during the class when discussions were assigned. This high concentration of collaborative events was unique. The extent of collaborative dialogue, with an average thread depth of five and thread length of 13 within each of these events, was also notably high for VHS that semester.

Although the thread depth in each of the collaborative events varied, many were conversations involving just three linked replies building on an initial post, suggesting that even in these three classes, which may have represented the most robust levels of sustained, collaborative dialogue in VHS classes that semester, there was not much evidence of extended dialogue. These relatively low levels of interaction point to the importance of providing training to secondary instructors. Research in higher education has definitively shown the importance of interaction for learning online [2, 33, 34]. These collaborative learning processes are equally important for younger people [13].

A. Dialogue Quality

I also analyzed the quality of conversations in collaborative events using Harasim's taxonomy of online discourse [16], seeking posts that were idea generating, idea linking, and possibly reflecting a convergence of ideas. I found that these VHS learners conducted highly focused discussions of content in collaborative events. The middle column in Table 3 below shows the percentage of postings using Harasim's collaborative categories in all three classes. When I quantified the amount of dialogue within collaborative events (CEs) that was in support of explicitly stated learning goals, the third column shows that I also found the dialogue quality to be high.

Class	% idea generating, idea linking & convergence in CE postings	% of CE postings directly related to explicitly stated learning goals
LA	95%	95%
SSt	96%	94% or 99%*
Sci	90%	98%

Table 3: Collaboration and Learning Scores

***A major digression in the SSt class during March of 2003, a class about world conflict and the United Nations, focused on the controversial start of the war in Iraq. The dialogue was not directly related to course learning objectives. If that "digression" to a related current event is considered a digression from learning goals, only 94% of lines of discussion strictly adhered to stated objectives. If the discussion is considered at least indirectly related to the goals of the class, 99% of the lines of dialogue were directly linked to course goals.**

In fact, the three courses selected as a result of the initial visual scan of all the spring 2003 course discussion areas turned out to contain substantive collaborative dialogue about course content, focused on meeting course learning goals. I could, then, focus on my research question and delve into these three classes to determine what aspects of social and teaching presence led to sustained collaborative dialogue, or cognitive presence, in each case.

B. Social Presence

The online medium for learning poses inherent challenges to instructors seeking to foster collaborative dialogue. The social cues that support learner collaboration in a face-to-face classroom are easily taken for granted. These include the facility with which class members exchange eye contact, facial expressions, and body language. Before learners feel comfortable joining in a goal-directed dialogue, alternative methods of fostering a sense of social community and trust must be implemented in a text-based, asynchronous environment [2, 35]. A clear sense of community [22] or social presence [2] has been established as a key factor in measuring the success of learning online [12]. All three classes in this study showed evidence of social presence with fully-attended ice-breaking activities during the first weeks, as well as active social fora that were available and used by the students regularly throughout the semester to discuss non-course related topics. Students enthusiastically discussed new movies, music, college plans, and other matters in all of these classes. However, social bonds only support learning. To locate the elements of teaching presence that built on the established foundation of community bonds, I turned to such instructor moves as discussion facilitation, feedback, evaluation, course activity designs and discussion prompts.

C. Teaching Presence

Teaching presence is described by Garrison [6] as "the crucial process of constructing meaning through collaborative inquiry…the crucial integrating force that structures and leads the educational process in a constructive, collaborative and sustained manner" (p. 26). He described this leadership role in terms of four elements: design, discourse facilitation, direct instruction and assessment. In each of the three VHS classes I examined, the interplay of these elements was unique. In order to ascertain the elements of teaching presence that most likely contributed to collaborative dialogue among learners I took the following steps: 1) I coded instructor postings using the Collison et al. framework to single out facilitative interventions intended to focus or deepen dialogue; 2) I categorized and compared patterns in private feedback and evaluation rubrics related to dialogic participation by learners; 3) I examined and compared course documents such as those related to expectations for participation, specific discussion activity designs and instructions, and discussion prompts. Findings in each of these areas are described below.

1. Discourse Facilitation

Discourse facilitation can support cognitive engagement by helping discussants focus more sharply on content, or by moving them more deeply toward mastery of new concepts. The role of facilitator is inherently a coaching or supporting role that helps to guide inquiry. It differs from the role of expert, who might provide explanations, clarifications, or other forms of direct instruction within the context of dialogue. The Collison et al. framework of voices and critical thinking strategies identifies specific approaches a facilitator might use to focus or deepen dialogue.

The language arts instructor only interjected three posts into content-related dialogue all semester. They were all facilitative comments according to the Collison framework. For example, "Hi, (Name), What pieces suggest eros later in the play? This is an interesting point…is Shakespeare inconsistent in his characterization of their love?" Using the voice of a *reflective guide*, he mirrors the point a discussant is making in order to broaden the scope of the discussion, *making a connection* to the possibility that Shakespeare, the author, might be inconsistent. Two of these facilitative interventions were inserted into Week 3, when content-related discussions were first getting underway. The third appears in Week 6. This early modeling of deepened exploration for the group may have helped to foster collaborative dialogue among his students. It is hard to know, but useful to highlight the minimal active participation needed in this class to achieve collaborative dialogue among learners.

The social studies instructor interjected six comments into content-related dialogue. One served as a generative reminder, "I believe we are getting away from the intended topic of this week's discussion." The other five were probes such as, "Why should the same five nations in the (United Nations) Security Council have the only say in what gets a veto? Is this fair?" Again, perhaps these facilitative comments helped nurture collaborative dialogue, but it is likely other elements made more of a difference. It can be said that neither of these two instructors needed to be very actively supporting dialogue.

The science instructor posted more regularly into learner dialogues, with a total of 27 over the semester. Twelve of those delivered direct instruction on a science concept. Nine interjections were evaluations of student comments. Five suggested additional resources. One was public praise. The science instructor did not use focusing interventions as defined by the Collison framework at all. In fact, his approach contrasts in a number of ways with the language arts instructor. Some examples of direct instruction interjections into dialogue were:

> A few of you have mentioned accidental discoveries. I'll agree that they occur, but do they represent the bulk of scientific discoveries? Galileo is frequently given credit as the person who truly started the 'scientific method.' They point to his methodical experiments and careful

> documentation of data and results. When he came to his conclusions, he had the evidence to back it up. That doesn't sound 'accidental' to me.

and

> Rutherford was not using a cathode ray tube to separate the three types of radiation. He simply had the radiation, shooting from a pinhole in a lead container, pass through a magnetic field before striking a fluorescent screen.

The presence of direct instruction within the content dialogues may simply represent a difference between the roles of a science teacher to support accurate understanding of scientific facts, versus the role of a teacher of literature orchestrating dialogue where the meaning of literature is discussed. For literary analysis, more of a focus on interpretation drawn from life experiences or evidence drawn from a text is needed.

When comparing these three instructors, it may seem that 27 interventions into learner dialogues by the science instructor was relatively high, however, over a 15-week semester, his posts amounted to fewer than two per week. Therefore, although the other two instructors entered into learner dialogues very infrequently, all three of these instructors kept their active steering of learner dialogue to a minimum.

In summary, no clear pattern of instructor facilitation appeared to be related to promoting collaborative dialogue. The use of interventions that fit the model described in Collison et al.'s *Facilitating Online Learning* [21] was minimal in all these classes containing extensive, regular collaborative dialogue, and therefore the analysis of the effect of these interventions remained inconclusive. Other elements of teaching presence appeared to contribute more to overall effectiveness.

2. Evaluation and Feedback

Assessment of participation appeared to contribute to dialogue quality in all three of these cases. Each instructor presented rubrics or expectations for postings differently, yet collaborative dialogue was clearly supported in all three classes by feedback and/or evaluation rubrics.

The language arts instructor offered continuous private feedback that emphasized the importance of dialogue for group learning. It was the single most distinguishing element of teaching presence for that instructor. He offered feedback that was unique in its explicit urging of learners to discuss, not just post, to earn full credit, and he offered it every time he delivered private feedback (bi-weekly throughout the class), with the exception of his final comments in week 14. Here's an example from the grade book for a student who was not doing well. Dialogue was explicitly encouraged:

> I see 5 posts from you in those two weeks. This does not meet the minimum number of required posts for this two-week period. If you intend to stay in the class (and I sincerely hope you do) I need to see a dramatic turn around in the amount of work you are doing. This is going to require a lot of work from you--it is possible to catch up--but you must start sooner instead of later.
>
> I'm not seeing any of the required follow-ups from you *that we so urgently need to build momentum and depth in our discussions.*
>
> It is important that everyone checks in at least 3 times each week. Cramming assignments in at the end of a week or not doing them on time *has detrimental effects on the quality of our discussions, and it affects your participation mark. This class is about interacting, discussing,*

> *and engaging ideas with* other classmates throughout the week—not merely turning in assignments at the end of a week. Fair enough? So be sure to spread your participation out more so we can get your grade up. (Italics added.)

In the next example, the student was doing well, and the instructor emphasized what the learner was doing right, specifically pointing to the student's contributions toward sustained dialogue. The instructor cited specific phrases from the learner's postings to demonstrate exactly the type of contributions sought.

> I see 18 posts from you in two weeks. While you didn't make that minimum number, *you have posted a number of quality "builds" in our discussions. This is especially true when you wrote:*
>
> Had Goblin Market been written in present times, women would have been portrayed much differently. In those days, the only role women had in sexuality was fulfilling the man's needs and desires. Things have changed, in a society that both sexes are out to satisfy themselves. Their roles in public are no longer being silent and beautiful but having a voice, opinions and independence are looked highly upon. Christina Rossetti's poem would have portrayed the females as a little wiser in their actions, a little less dependant on the goblin's company and their fruit and they wouldn't have allowed for the mistreatment, swiftly calling a women's abuse hotline.
>
> *Do you see what this post has to offer to the group . . .you have taken the discussion to a new and interesting place and offered direction for others to take up in follow-up posts. This is exactly the type of post we are looking for. Hurrah!!*

Collaborative dialogue was most likely related to the frequent private feedback he provided in the case of this class. Therein, he emphasized the importance of dialogue, pointed to what students were doing that was interactive, and described specific ways learners might improve their efforts to discuss content with peers.

The science instructor offered numerical grades for discussion postings. The numerical grade was based on a detailed rubric for discussion participation:

> To earn five points, comments were expected to:
>
> - address a topic directly,
> - show evidence of higher-order thinking, and
> - contain no evidence of misconceptions.
>
> To earn three points, comments must be:
>
> - directed toward the issue,
> - could contain minor errors, but
> - generally had to demonstrate topical understanding.

Students earned only one point for postings that contained major errors, missed key points, or were too brief to be informative. Information related to enhancing collaborative dialogue was not discussed further.

The social studies instructor, similar to the other two, emphasized the importance of dialogue for maintaining a high grade point average. In this class, 66% of the total private feedback comments focused on class discussion participation including some interactive games, the class discussions, and a final, multiple-week UN simulation where students played roles as nations in the discussion area. Only 33% of private comments focused on written assignments. Dialogue was emphasized and expected in the games, the content-related discussion activities, and the final simulation. The course overview included statements such as the following two. The first clearly described how to interact; the second emphasized what happened to the student's grade if they did not post more than four times per week:

> Participation: For this course to be successful it is necessary for us to interact with each other. This means that you and I must interact as well as you interacting with your fellow students…When discussing, simply responding "I agree" does not constitute meaningful interaction as far as I am concerned. If you are participating in a discussion and you find yourself agreeing with another student *it would be better if you stated: I agree with Fred particularly when he stated* ________. This shows me that you are indeed paying attention to the discussion not just randomly responding to discussions in order to complete the assignment. [Expectations and Quality of Work in Start Here] (Italics added.)

In another introductory document, the grading policy for the course was described. Students were required to post a public acknowledgement of this document in the discussion area as an assignment. Dialogue was emphasized once again:

> Important Note Regarding Discussion Grades: One area of this class that prompts the most student questions to me is that of grading discussion. Students are graded on both the quantity and quality of their participation during discussion weeks. The minimum amount of student participation during a discussion week is four comments posted on different days. Some students in the past have been unsure about what "minimum" participation means. "Minimum" means the lowest possible passing grade will be given for four comments posted on different days during discussion weeks. A minimum passing grade is 60% or "D-" So in other words should a student post four comments on different days during a discussion week they will receive a 60% for that week. I do not anticipate this being a problem for the vast majority of you. However, in the past some students have had trouble understanding this policy and my goal here is to make it as clear as possible. [Grading Policy: Week 2]

Comparatively, the science class weighted participation most heavily, with discussion participation accounting for 40% of the final grade. The language arts class weighted discussion participation as 25% of the final grade, supporting that leverage with extensive private feedback. In contrast, in the social studies class no overall percentage of the course grade for discussion participation was given in the beginning of the class. However, the documents and level of feedback comments directed at participation regularly reinforced the importance of discussion. This analysis shows that one likely answer to the question of what made these classes engage in collaborative dialogue more than most was an explicit link between collaboration and evaluation. This finding is supported by research in higher education as well [24, 36]. The language arts teacher was unique in his use of private feedback to foster collaborative dialogue. It seems additional elements must explain the striking outcomes in the science class and the social studies class.

3. Collaborative Instructional Designs

All three of these higher-collaboration classes were designed with promoting dialogue as a goal. They shared key features for establishing social presence, including social networking activities in the first two weeks and active student lounge-like social forums. These are expected features in all VHS classes. Each of these classes also included discussion prompts that were open-ended and explicitly required students to post responses to the comments of their peers: "Post your initial response and reply to at least one or two of your peers." Such prompts were typical in many VHS classes I reviewed. However, as the findings in an initial comparative survey [32] indicated, these factors alone did not promote extended collaborative dialogue. The analysis of these higher collaboration classes provided an opportunity to examine which design differences most effectively supported collaborative dialogue among all the classes examined. Here I describe differences in discussion assignment design that may have affected the level of collaborative online dialogue. I begin with the general framework for discussions evident in the social studies class, the class that exhibited the highest concentration of collaborative dialogue with 26 events in just four weeks.

This class was constructed around a United Nations simulation that took place during weeks 11 to 14 of the class. Activities in previous weeks were designed in order to build to the level of collaboration required for the final role-play. For example, during the second and third week of class, students were asked to partner and introduce one another to the group in an activity called "Meet the Delegates." The theme of the activity adds a United Nations frame to a common ice breaking task.

During Week 3, a friendly competition called "Who Is That Man" was conducted. A black-and-white image of an unremarkable middle-aged gentleman in a suit at a desk is pictured with the directive,

> I would like all students to post a comment as to who you might think this man is. He has something to do with the United Nations. You can post questions and I will answer them. Check the postings of other students and we will see who is the first person to figure out who he is.

The design of this activity fostered interdependence, another facet of getting to know one another, and provided scaffolding for more extended collaborative interactivity later on.

In the fourth week, students were assigned their first collaborative discussion, "What is the United Nations?" Each discussant was required to post four comments to the dialogue on four different days of the week to earn credit. The stated goals of this first discussion were: 1) to demonstrate that students understood the information contained in the introductory reading about the UN; and 2) that students continued to get to know one another by exchanging questions and ideas. The seed post for this forum was:

> OK everyone now that you are all "experts" on how the UN is organized let's see what you think. In this discussion you can post answers to questions or ask questions. I would like to stress that for classroom discussion you should * not * only ask questions. Posting questions and not doing any more than that is easy. I want to know your ideas as well. I'll get things started with this: What do you think are positive aspects or strengths of the way the Security Council is organized?

Eighteen threads were initiated under this assignment, most of them starting with the question the instructor posed, but some shifting to other aspects of the reading. Seven of these (39%) moved to thread depths of more than four, with students building on the comments of others, asking further questions, or adding their views in the context of previous statements. The facilitative effects of both the grading structure for the week and the inherent interdependency of the activity appear to have been effective, along with the explicit preparation for working in an interdependent way.

In contrast to this open-ended, but interdependent, collaborative discussion design, during weeks eight, nine and ten the discussions were highly structured, yet retained emphasis on collaboration. Each student was assigned the role of discussion leader or expert for a nation-based discussion on such topics as the economy, people, geography, or government of the assigned nation. First, the leader posted a report s/he wrote about the topic. The rest of the class was expected to "critique the reports given on countries as to their usefulness for this course." The instructor included a standard caveat with these assignments:

> I must stress that those students not reporting on a country will be graded on the quality and frequency of their participation in the weekly discussions on the countries assigned last week. You must comment frequently and in a relevant manner on each report…I will be looking for a relevant comment/question from each student on each report listed. You must also check back to see what the reporters have responded to your comment…The person who reported on this country and topic is responsible for facilitating discussion and answering questions students may have.

Each of these assignment and discussion documents was augmented with images of formal and informal gatherings of delegates at meetings in the United Nations, reminding learners of the context about which they were learning and that they would soon be simulating themselves. These highly structured and task-oriented discussions were closely linked to weekly grades, helping to ensure students would jump in and offer their comments "frequently" and "in a relevant manner" as stated above.

Taken together, supporting activities such as "Meet the Delegates" (supporting community building) and "Who Is That Man? (fostering interdependence) provided a foundation for the first open-ended collaborative discussion, "What is the United Nations?" and the similarly collaborative nation report discussions. These nation-based discussions were the final pre-cursor to the United Nations simulation that followed. They included student moderators and roles for participants that generated and sustained particularly high collaborative dialogue.

The overall design of the class reflected a cooperative learning approach [18, 37] successfully enhanced by the affordances of an asynchronous learning network. Previous research on such an approach for online learning has confirmed its effectiveness. In Aviv's evaluation study, cooperation was also structured so that learners succeeded "if and only if all learners succeed(ed), so that they all must coordinate their efforts" (p. 58). Effective methods that were successful in the case evaluated by Aviv were to assign a deliverable produced by the whole group (in the UN class, such a task was the UN simulation itself); to design task interdependence or a division of labor (as in the nation reports and the more elementary "Who Is This Man" warm-up activity); to build in resource interdependence (for example, the nation reports and follow-up discussions prepared students to participate knowledgably in the final simulation); and to reward interdependence (for example, individual accountability was emphasized from the beginning of the UN class with the email "contract" and grading was explicitly tied to collaborative participation).

In the less successful classes, less structure was evident. One of the 22 higher collaboration classes identified in the initial survey focused on controversial topics related to science. However, it only achieved irregular collaborative dialogue. An example of a prompt in that class was,

> Think about the following questions and make a comment to the discussion called "Environmental Problems." What do you think is Earth's most serious environmental problem? What caused, or causes, the problem? How do you think this problem should be dealt with?

The limitation evident in this example is that there are no instructions about how (or whether) to build on one another's thinking, nor is there a generic "respond to the comments of your peers" statement. Collaboration is neither emphasized nor specifically graded (and, as indicated by the wording of the question itself, may not have been the intention in this case). Both explicit teaching about how to post collaboratively and direct linkages to expectations and grading appear to be essential if collaborative dialogue is a goal.

The language arts class and science class examined for this study offered similarly open-ended discussion seed posts with positive results. However, as with the social studies class, the instructors of the other two classes made participation more heavily weighted in the final grade and pro-actively orchestrated dialogue by discussion design (science) or provided individualized feedback on participation (language arts). For example, in the science class's Week 4 controversy of the week (COW) discussion on "Food Irradiation" prompted the most collaborative events of all the discussions assigned in the class: six in all involving 41 postings. A total of 92 postings, 51 not part of collaborative events, were submitted under the topic. Thus, collaborative dialogue engaged just under half (45%) of the attention given to this activity.

The question for dialogue was, "Should the U.S. allow greater use of irradiation to decrease food contamination?" Seventeen background facts were provided in a list form, such as, "Washing food does not remove all bacteria," "Irradiated food is given to medical patients with weakened immune systems," and "At least 40 developed countries use food irradiation although it is not extensively used in the United States today." The expectations for COW discussions beyond the basic discussion rubric were delineated on every COW assignment document, including the following procedural expectations:

> Remember, to complete this assignment you:
>
> - should comment on the topic based upon what you know now.
> - may respond to others at any time.
> - should do some research on your own.
> - check on the "facts" (Can you confirm or dispute information supplied?).
> - expand the "facts" (for example: How many people die each year due to food poisoning?
> - add to our knowledge (Did you find some relevant information that would help in our discussion?).
> - identify websites with related information.
> - should return to this thread a couple times before weeks' end to add comments.
>
> Assessment: Total Points Available=40
>
> 10 points for posting your initial comments in the CR (by Thursday)
>
> 10 points for adding something to the discussion…knowledge, a website, etc. (by Friday)
>
> 10 points for responding to at least two others (by Sunday)
>
> 10 points for your final thoughts about the topic (Monday or Tuesday)
>
> *Before making your final comment you should read all other comments posted. Your final comments may include something you learned, something that surprised you, a summary, a shared thought, what you consider important about the topic, what you still wonder about, etc.* (Italics added.)

This discussion question did not have a right answer or just a few possible avenues of exploration; the net of possible responses was cast widely. Evaluation in the class emphasized participation in such discussions, and collaboration was explicitly valued in the individual activity directive cited above. In particular, the instructions for the "final thoughts" posting involved the expectation postings would reflect that students had considered everything previously posted to the dialogue. By suggesting they highlight new learning, surprises, shared thoughts, or what remains less understood, the instructor re-opened inquiry through the final days of dialogue, holding out the possibility that additional extended discussion could still take place.

In the language arts class, the structure was more open-ended; yet, the private feedback, as was shown earlier, was more specific. For example, the discussion forum that prompted the most collaborative dialogue in that class was titled "Need Love and Gift Love in Anthony and Cleopatra." It stated,

> …This week, we're trying out a different theory, courtesy of *Narnia Chronicles* author, C.S. Lewis. What did you think of his theory and description of love and its four types? What impressed you or seems worth discussing further? Are there connections to this theory in the play we're reading right now (Shakespeare's *Anthony and Cleopatra*)?
>
> Post your initial comments to this discussion starter early in the week. Stop back later to read others' ideas, and post a follow-up that helps us unpack our ideas further.
>
> Assessment: Posting at least two well-developed, thoughtful comments that
>
> 1) Show your understanding of C.S. Lewis' theory in a timely manner and
>
> 2) *Demonstrate active listening and interaction with your classmates* will earn you credit for this required assignment. (Italics added.)

The discussants participated in a whole class discussion for this assignment. There were 38 postings, including one facilitating post (*Conceptual Facilitator Identifies Direction* according to Collison et al.) from the instructor. Twenty-eight of the posts (74%) were involved in five collaborative events. Nine of the fourteen students (64%) fulfilled the assignment, with eight (57%) students posting more than twice, beyond expectations. In the most sustained dialogue, the thread depth was five and the thread length was nine.

A different version of this assignment appeared in the equivalent class, examined for the earlier comparison study of higher and lower collaboration sessions of the same class taught by different instructors. In that class, the parallel activity was shifted to a structured question-and-answer format. Students were required to post initial thoughts and then respond to two peer submissions. The task stated:

> **Note: visit this thread a couple times during week six.
>
> Early in the week, post your initial responses to the web site reading, and then later in the week, stop back to *respond to a couple of your group members' ideas.* You need to post at least three well-developed comments for your participation grade.
>
> In your initial post, answer at least three of the questions from group A and answer the question in group B. Please cut and paste these questions in to your comment so we know what you're responding to.
>
> (Choose three)
>
> - If there are four types of love (Affection, Friendship, Eros, and Charity), how can need and gift love be considered broad categories to sort the four types?
> - Is an understanding of God and religion necessary to understand Lewis' concepts? Why or why not?
> - What is the difference between Need-Love and Gift-Love? Is one better than the other? Is this a helpful distinction?
> - In Lewis's Affection an adequate characterization of parent-child love? Is that the only thing it is good for?
> - Is Lewis's definition of Friendship adequate? Does it describe your own?

- How, exactly, is Eros different from sexuality?
- Describe what it would look like for a love to be transformed by charity. (This question is mandatory.)
- Choose a character from the play and explain the type(s) of love that they seem to be engaging in. Choose specific, textual examples to support your ideas. (Italics added.)

This class was divided into two small group discussions for this assignment, even though the class contained only seven active students. The full class participated in their assigned groups. Each posted at least twice with a total of 26 postings, including one probing question for clarification by the instructor. All but one of the students fulfilled the assignment with at least three comments. There was one collaborative event, though it was weak in that it contained just four posts, with the fourth linked post being a probe from the instructor that remained unanswered. Thread depth in all other cases was two: initiating posts with single responses.

It made sense that the conversation might be more stilted based on the version of the assignment provided. Students offered many intriguing ideas and raised a variety of topics. However, the assignment itself did not encourage conversation. Evaluation and feedback did not regularly focus on collaborative dialogue or co-construction of understanding in this class, as it did in its higher collaboration counterpart. The dialogue remained limited to the level of brainstorming thoughts and reactions. That is, in essence, what the instructor sought from the learning activity.

In contrast, the directions in the assignment version in the session with higher collaborative dialogue cast a wide net that encouraged extended discussion by asking, "What impressed you or seems worth *discussing further*?" Additionally, the instructor asked students to "read others' ideas, and post a follow-up that helps us *unpack our ideas further*." This instructor also clearly linked assessment to collaborative dialogue when he stated, "Demonstrate active listening and *interaction with your classmates* will earn you credit for this required assignment." (Italics added.) Feedback then directly supported these interactions with explicit teaching of how to participate in a co-constructive manner.

One of the science classes among the initial 22 classes selected for some evidence of collaboration dealt with ethical issues related to biology. Discussion focused on such controversial topics as organ donation, genetic screening, and cloning. The potential for engaging in collaborative dialogue about such content was high. Student postings could have demonstrated understanding of the facts, used evidence to support opinions, and engaged with the multiple perspectives presented by peers. Emphasis on interaction would have necessitated that they linked their comments by actively listening and thus sustaining conversation rather than just offering individual points of view. Yet the course design in this science class did not directly support that collaborative type of engagement. Typically, discussion prompts read as this one on euthanasia did:

> Using the article you found write a short summary of the article and post your summary. To post your summary in the Course Room…
>
> Click the "Comment" button above to enter your question.
>
> Fill in the subject field with a descriptive title that briefly summarizes your posting.
>
> Enter your comments in the large text box below that. Please use as much space as you need—don't be shy.
>
> When complete, click the "Save & Close' button, and you'll be returned to this document.
>
> Use the "Discussions" button to see you newly posted question listed in the view with the other subthreads. Yours should appear just below the subject of this document.

> Click back later today or tomorrow for your answer. There will be a twisty beside your original comment indicating that a comment has been made to it.

These directions were repeated regularly in this class. Not only did they not emphasize interaction and dialogue, they focused learners on looking only at their own postings for comments rather than viewing the discussion as a whole for a more collaborative learning experience. In contrast, the set of directives used in the science class selected for its high level of collaborative dialogue, shifted the focus to the collaborative effort of the group. There, directions for “Controversy of the Week” discussions (described earlier in this section) emphasized dialogue and focused on how to co-construct understanding of content by way of peer interactivity. The directions for posting encouraged collaboration.

As in the comparison between the two literature class discussions above, this comparable pair of directives for dialogue about science content contained inherent differences that appeared to affect the amount of collaborative dialogue as one might have expected. The euthanasia topic produced no exchanges with more than two or, at the most, three linked comments. The “Controversy of the Week” discussion activity design from the higher collaboration science class produced 21 of the 29 collaborative events in that classroom, including those contained in the discussion of the question “Should the U.S. allow greater use of irradiation to decrease food contamination?” that was described earlier. Directions for individual dialogues worked in concert with evaluation rubrics and grading to make a difference in the level of collaborative dialogue.

A theme that emerges in all three cases is the importance of explicit teaching about how to engage in collaborative dialogue. Both of these comparisons illustrate how collaboration needed to be clearly linked to evaluation and explicitly taught, either directly within the design of dialogue activities, as we saw here, or delivered individually in private feedback.

Thinking out loud with peers, quick exchanges, brainstorming, and the use of shared visual artifacts are automatic in a face-to-face environment. Online, these collaborative activities take place predominately with text [38]. Therefore, new skills must be developed, taught, and learned to achieve effective collaboration in this literary context [2, 39]. With the support of explicit teaching and direct evaluation of collaborative efforts, collaborative dialogue improved.

D. Comparison of Participant Moves

One final factor was considered to fully understand the elements that influenced collaborative dialogue and to test the validity of the conclusions that emerged from this analysis of the higher collaboration classes. I needed to examine whether patterns existed in the student-to-student interactions themselves that further promoted or discouraged interaction. To find out, I compared patterns across student postings in all three classes. I found participants’ postings did not appear to markedly affect the level of collaborative dialogue in VHS classes.

The participants in these classes were a mix of repeaters and first-time online course takers. Elements other than facility with conversing online with text were therefore considered in order to test the validity of the emerging interpretative model. I sought out patterns of learners engaging one another spontaneously with questions, name-referencing, dominating participants or any other learning community-building or reducing behaviors that might be present. Ascertaining participant involvement in enhancing collaborative dialogue would influence the findings as well as the final interpretative model.

However, no patterns in participant activity appeared to enhance or discourage dialogue in the higher collaboration VHS classes. Students used such strategies as questioning one another and name-referencing relatively infrequently in these classes; and, when they did, there did not seem to be a consistent effect.

VI. DISCUSSION

A. A Balanced Interplay Among Key Heuristics

Teaching presence, or instructor leadership, that leaves the responsibility for learning to the learners may be easily recognizable when we experience the challenge of it, yet the approach is somewhat unique in every case, depending on content, activities, and the individual learners in a given class.

In these three cases, a foundation of social community, or a social presence, provided scaffolding for fostering cognitive presence among the learners. Three unique approaches to instructional leadership, or teaching presence emerged. Common elements were involved in all three approaches. In the language arts case, cognitive presence was heavily scaffolded by individualized regular feedback that explicitly showed learners how to collaborate. Early facilitative interventions directly into student dialogue modeled collaborative dialogue. Activity designs were inherently collaborative. Discussion prompts clearly promoted exchange rather than required homework-style individual statements of views and opinions. Evaluation was directly tied to successfully participating in collaborative dialogue.

In the science case, extensive feedback was not used. Grading was numerical, but tied to successfully contributing to collaborative dialogue. Explicit teaching of how to collaborate was woven into the "controversy of the week" type discussion activity designs and rubrics in great detail. Discussion design features thus provided scaffolding upon which students could build dialogue.

In the social studies case, where collaborative dialogue was most densely concentrated during the four weeks in which discussion activities were assigned, the key was again instructional design. Learners explicitly agreed to a grading policy that linked collaboration (not just participation) with grading. Interactive, ice-breaking activities built a collaborative skill base in the early weeks. Structuring specific roles and activities for learners extended the length and depth of collaboration. The structure of the discussions required that students both ask and answer questions of one another. Students moderated their own discussions. A direct connection between that type of engagement and the learners' grades for the week assured collaborative dialogue would take place.

These three exemplary classes revealed a balanced interplay among the key heuristics for fostering collaborative dialogue. They were 1) social community, or social presence; 2) explicit teaching of how to collaborate; 3) collaborative activity designs; and 4) clear linkages between collaborative dialogue and evaluation. In each of the three cases, a socially-bonded community, design features such as rubrics that explicitly promoted collaborative dialogue, direct linkages in feedback or evaluation to meeting these expectations, and direct teaching of how to collaboratively engage in dialogue around content, were essential to enhance collaborative dialogue.

In comparable classes examined in an earlier study [32], collaborative dialogue was not achieved when instructors did not provide this interplay of stated collaborative expectations, related evaluation, and explicit scaffolding. In those classes, social presence was evident, but it was not enough. This finding echoes findings from higher education [40]. In the cases examined for this study, it was not just any rubric, discussion activity, or participation grade that worked to promote collaborative dialogue. Instead, the quality of these elements made a difference. They needed to be precise, targeted, and explicitly pointed at collaborative interaction to ensure success. To a lesser extent, these elements were also present in the comparison classes, where collaborative dialogue was less. Therefore, it appears that course design elements that emphasize collaboration ("post responses to the initial comments of one or two peers") must be accompanied by additional supporting elements to be effective. Other research suggests that simply tying grades to number of postings will also backfire [41]. A discussion rubric supported by explicit teaching of how to engage in collaborative dialogue, all clearly linked to evaluation worked in concert to shift interactivity from a regular thread depth of two to more extensively linked postings exhibiting collaborative dialogue focused on learning goals.

B. Next Steps

The examination of the interplay of instructor moves, course design, and participant moves in this study provided a useful research tool for understanding factors that likely promote collaborative dialogue online. However, there are numerous directions for future research that further extend our knowledge about collaborative dialogue and quality online instruction:

Test the Interpretative Model within the VHS or other secondary online classes.

VHS could train interested instructors in course design features, using interventions that promote dialogue, and setting expectations for participation that prompt extended, substantive exchange. Researchers can use an experimental design to perform a comparative analysis in order to ascertain whether collaborative dialogue and learning is enhanced and the findings from this study are replicated.

Test the Interpretative Model beyond secondary classes.

Will the findings of this study be replicable in other educational contexts? As a secondary school program, grades in VHS classes affect learners' class ranking and college acceptance. Thus, evaluation is a strong extrinsic motivator. Will the other significant factors – collaborative activities that involve interdependence to succeed, clear directives to collaborate, and explicit feedback regarding learners' effectiveness at collaborating with their peers – make a difference in contexts where evaluation is not a driving force, such as in a pass/fail environment or a program for lifelong learning? How much encouragement to interact is needed in graduate classes involving highly motivated learners who perhaps paid the tuition themselves, though a high GPA isn't as important? The interpretative model would provide a basis for examining the impact of these factors in other settings.

Test Focusing and Deepening Interventions.

This study found some evidence of instructors using focusing and deepening interventions into learner dialogue as described in Collison et al. [21]. More research is needed where instructors are first trained in the method and then resulting collaborative dialogue is compared with previous sessions of the same class or discussion.

Perform Social Network Analysis.

In this study, the analysis of participant moves was conducted with the goal of eliminating the possibility that higher or lower collaboration was not a clear, direct result of the actions of one or more dominant or particularly engaging participants. A rigorous analysis of the existing social networks in these classes (for example, who addresses whom and how often) was not conducted.

In my analysis, I found it intriguing that the science class examined had an equal number of males and females, and yet neither gender was clearly dominant. Gender is an important aspect of social network analysis. Some research has suggested potential gender issues [22] in online discussion activities. Are gender differences less evident in secondary level online classrooms than they appear to be in undergraduate and graduate contexts? Or did the structure of the discussions in this class overcome commonly observed gender inequalities? The methodology employed in this study could be productively applied to these research questions.

Extend the Analysis of Learning.

In this study, I examined the quality of dialogue content for the strength of its sustained connection to stated learning goals, without delving deeply into an analysis of levels of higher-order thinking reflected in collaborative events. My judgment was that these data were too preliminary for such an investment of time and effort. Future research is needed to examine evidence of higher-order thinking found in sustained collaborative dialogue.

Extend Research to Other Disciplines.

Evidence of cognitive engagement in online classes is recognizable in learners' cognitive presence in the class, namely in their comments posted to their instructor and peers. Collaborative dialogue is one type of activity that facilitates cognitive presence. Classes considered in this study include language arts, social studies, and science classes. What about mathematics, music, technology (programming, graphic design, or filmmaking, etc.), or foreign language classes? How might classes in other disciplines differ in their quantity and quality of interactive engagement? Instructor moves, collaborative activity designs, and inquiry-based participation in those classes have yet to be explored. Further research is needed to determine if these factors or additional factors are effective in promoting online collaborative dialogue in other curricular areas and if there are curricular specific strategies.

Test Asynchronous Dialogue Combined with Synchronous Dialogue Activities.

It is a policy of the VHS to avoid synchronous technologies in VHS classes, although administrators acknowledge instant messaging outside of the courseware platform is inevitable and widespread. The reasoning behind denying access to synchronous activities within VHS classes is that student participants span every time zone, making the scheduling of synchronous class meetings next to impossible. Primarily, VHS is concerned about maintaining equity among students who only have access to computers at school and those who can also log on at home.

Another issue unique to the secondary school context is the considerable level of overt control over learners' daily schedules. For example, a student cannot choose to skip a math class to attend a synchronous chat at the library computer, nor can a young learner from a distant nation easily join his predominately U.S. peers for a mid-day synchronous chat when the time in her country is 3:00 am. While a certain type of equity is gained with the policy, the potential for more collaborative learning opportunities is also lost.

Might there be effective approaches to weaving synchronous conversations with transcripts and asynchronous follow-up dialogue to deepen the cognitive presence and higher-order thinking reflected in class discussions? That way, all students can join in the conversation. While VHS and other international online programs may have greater difficulty integrating synchronous class meetings, state-based or local online programs may be able to accomplish this more easily. In those contexts, it would be valuable to examine whether particular strategies used during synchronous dialogue supports or detracts from collaborative content-based dialogue.

VII. CONCLUSION

The importance of interaction for learning is well established [11, 14, 42, 43]. Text-based, asynchronous online delivery requires that instructional design and teacher behavior shift to fit the new medium [44]. When learners can't see one another and may never meet each other or the instructor, moving a group from social communication and direct teacher-student exchanges to a more reflective level of peer interaction requires new approaches. If online learning is to serve as a major educational medium in the future, understanding the pedagogical strategies that foster content-based dialogue online is essential.

Kozma and Zucker [5] reviewed a variety of online secondary programs and found that even the exemplary Virtual High School lacked the level of student-to-student interaction sought by its instructors to support higher-order critical thinking in online dialogue. In their evaluation, Zucker and his associates at SRI found that fostering dialogue was one of the most significant challenges to secondary level online instruction. Parallel challenges have been documented in higher education [40]. They indicated that research on what approaches best support extended student dialogue was needed. The systematic analysis of online learner exchanges and instructor moves conducted in this study addressed that concern and added to recent research that analyzes discourse transcripts from online classes in higher education [16, 45, 46, 47, 48].

The findings from this project begin to reveal elements that support online collaborative dialogue on the secondary level. This study takes a step toward assessing the quality of online learning in achieving content-based collaborative dialogue. It draws insight directly from work of VHS practitioners, with the explicit intent of thereby enhancing the credibility and usefulness of the research for online instructors seeking realistic approaches to enhancing collaborative dialogue in their online classes. The methodology and strategies that were derived in this study can set the stage for the next level of work in improving online instruction and the professional development for secondary online instructors.

This paper mined three VHS classes for teaching elements that most likely influenced the nature of the dialogues among students. In each case, specific approaches to discussion facilitation, activity designs and evaluation rubrics were uncovered that promoted substantive, collaborative dialogue. Yet the interplay among those elements varied widely. Examining all three illuminated a practical model of heuristics useful to practitioners on both the secondary level and possibly also in higher education.

VIII. ABOUT THE AUTHOR

Dr. Haavind is an Assistant Professor at the School of Education, Lesley University. She co-authored one of the pioneering books in the field of online learning: *Facilitating Online Learning: Effective Strategies for Moderators* by George Collison, Bonnie Elbaum, Sarah Haavind & Robert Tinker [21]. Her doctoral thesis, *Tapping Online Dialogue for Learning: A Grounded Theory Approach to Identifying Key Heuristics that Promote Collaborative Dialogue Among Secondary Online Learners* [49] was a study of online teacher practice and instructional design in Virtual High School (www.govhs.org) classrooms where asynchronous collaborative dialogue is a core learning activity. Her professional interests include online instructional design and teaching practices that deepen and enrich learning.

IX. REFERENCES

1. **Haavind, S.** Tapping Online Dialogue for Learning: A Grounded Theory Approach to Identifying Key Heuristics that Promote Collaborative Dialogue Among Secondary Online Learners. Cambridge, MA, Harvard University: Harvard Graduate School of Education, 2006.

2. **Garrison, D. R. and T. Anderson.** *E-Learning in the 21st Century: A Framework for Research and Practice*. London and New York: RoutledgeFalmer, 2003.
3. **Brown, J. S.** Toward a New Epistemology for Learning. In C. Frasson and G. Gauthier (eds.),: *Intelligent Tutoring Systems: At the Crossroads of Artificial Intelligence and Education*. Norwood, New Jersey: Ablex Publishing Corporation, 1990.
4. **Lipman, M.** *Thinking in Education*. New York: Cambridge University Press, 2003.
5. **Zucker, A. and R. Kozma.** *The Virtual High School: Teaching Generation V*. New York: Teachers College Press, 2003.
6. **Garrison, D. R.** Online Collaboration Principles. *Journal of Asynchronous Learning Networks* 10(1): 25–33, 2006.
7. **Setzer, J. C. and L. Lewis.** Distance Education Courses for Public Elementary and Secondary School Students: 2002–2003. D. o. Education, Ed.: National Center for Education Statistics (NCES), 2005.
8. **Bielaczyc, K. and A. Collins.** Learning Communities: A Reconceptualization of Educational Practice. In C. M. Reigeluth (Ed.), *Instructional Design Theories and Models, Vol. II*, 269–292. Mahwah NJ: Lawrence Erlbaum Associates, 1999.
9. **Brown, A., S. Ellery and J. Campione.** Creating zones of proximal development electronically. In J. G. Greeno and S. V. Goldman (Eds.), *Thinking Practices in Mathematics and Science Learning*. Mahwah, NJ: Lawrence Erlbaum Associates, 1998.
10. **Cazden, C.** *Classroom Discourse: The Languages of Teaching and Learning*. Portsmouth, New Hampshire: Heinemann, 1988.
11. **Scardamalia, M. and C. Bereiter.** Computer support for knowledge-building communities. *Journal of the Learning Sciences* 3: 265–283, 1994.
12. **Swan, K. and P. Shea.** Development of Virtual Learning Communities. In S. R. Hiltz and R. Goldman (Eds.), *Learning Together Online: Research on Asynchronous Learning Network.*, Mahwah, NJ: Lawrence Earlbaum Associates, 2005.
13. **Bransford, J. D., A. L. Brown and R. R. Cocking.** *How People Learn: Bridging Research and Practice*. Washington, D. C.: National Academy Press, 2000.
14. **Brown, A. L. and J. C. Campione.** Guided discovery in a community of learners. In K. McGilly, (Ed.) *Classroom Lessons: Integrating Cognitive Theory and Classroom Practice*, 229–270. Cambridge: MIT Press/Bradford Books, 1994.
15. **Burbules, N. C.** Dialogue in teaching: Theory and practice. In J. F. Soltis. (Ed.), *Advances in Contemporary Educational Thought, Vol. 10*. New York: Teachers College, Columbia University, 1993.
16. **Harasim, L.** What makes online learning communities successful? The role of collaborative learning in social and intellectual development. In C. Vrasidas and G. V. Glass (Eds.), *Distance Education and Distributed Learning*. Greenwich, CT: Information Age Press, 2002.
17. **Bruffee, K. A.** *Collaborative Learning: Higher Education, Interdependence, and the Authority of Knowledge*. Baltimore: John Hopkins University Press, 1999.
18. **Aviv, R.** Educational Performance of ALN via Content Analysis. *Journal of Asynchronous Learning Networks* 4(2): September 2000.
19. **Bender, T.** *Discussion-Based Online Teaching to Enhance Student Learning*. Sterling, VA: Stylus Publishing, LLC, 2003.
20. **Riel, M., J. Rhodes and E. Ellis.** Culture of Critique: Online Learning Circles and Peer Review in Graduate Education. Presented at American Educational Research Association, Montreal CA, 2005.
21. **Collison, G., B. Elbaum, S. Haavind and R. Tinker.** *Facilitating Online Learning: Effective Strategies for Moderators*. Madison, WI: Atwood Publishing, 2000.
22. **Rovai, A. P.** Building classroom community at a distance: A case study. *Educational Technology Research and Development: ETR&D* 49: 33–48, 2001.
23. **Harasim, L., S. R. Hiltz, L. Teles and M. Turoff.** *Learning Networks: A Field Guide to Teaching and Learning Online*. Cambridge, MA: MIT Press, 1995.

24. **Swan, K., P. Shea, E. Fredericksen, A. Pickett, W. Pelz and G. Maher.** Building knowledge building communities: consistency, contact and communication in the virtual classroom. *Journal of Educational Computing Research* 23: 389–413, 2000.
25. **Bogdan, R. C. and S. K. Biklen.** *Qualitative Research for Education: An Introduction to Theory and Methods*. Boston: Allyn and Bacon, Inc., 1982.
26. **Glaser, B. G. and A. L. Strauss.** *The Discovery of Grounded Theory: Strategies for Qualitative Research*. New York: Aldine Publishing Company, 1967.
27. **Strauss, A. and J. Corbin.** *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks: SAGE Publications, 1998.
28. **Miles, M. B. and A. M. Huberman.** *Qualitative Data Analysis: An Expanded Sourcebook, 2nd Ed*. Thousand Oaks London New Delhi: SAGE Publications, 1994.
29. **Strauss, A. and J. Corbin.** Grounded Theory Methodology: An Overview. In N. K. Denzin and Y. S. Lincoln (Eds.), *Handbook of Qualitative Research*, 273–286. Thousand Oaks: SAGE Publications. 1994.
30. **Erikson, F.** Qualitative Methods in Research on Teaching. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching*. New York: MacMillan, 2001.
31. **Hiltz, S. R. and P. Shea.** The Student in the Online Classroom. In S. R. Hiltz and R. Goldman (Eds.), *Learning Online Together: Research on Asynchronous Learning Networks*. Mahwah, NJ: Lawrence Erlbaum Associates, 2005.
32. **Haavind, S.** A Study of Factors that Affect Student-to-Student Dialogue Online. Cambridge, MA, Harvard University: Harvard Graduate School of Education, 2004.
33. **Hiltz, S. R. and R. Goldman, R.** *Learning Together Online: Research on Asynchronous Learning Networks.* Mahwah, NJ: Lawrence Earlbaum Associates, 2005.
34. **Roberts, T. S.** *Online Collaborative Learning: Theory and Practice*. Hershey, PA: Information Science Publishing, 2004.
35. **Gunawardena, C. N.** Social presence as a predictor of satisfaction within a computer-mediated conferencing rnvironment. *American Journal of Distance Education* 11: 8–26, 1997.
36. **Swan, K.** Assessment and collaboration in online learning. *Journal of Asynchronous Learning Networks*10(2): 45–62, February 2006.
37. **Johnson, D. W., R. T. Johnson and E. J. Holubec.** *The New Circles of Learning: Cooperation in the Classroom and School*. Alexandria, VA.: Association of Supervision and Curriculum Development, 1994.
38. **Lankshear, C., M. Peters and M. Knobel.** Information, knowledge and learning: Some issues facing epistemology and education in a digital age. In M. R. Lea. and K. Nicoll (Eds.), *Distributed Learning: Social and Cultural Approaches to Practice*, 16–37. London and New York: RoutledgeFalmer, 2002.
39. **Bonk, C. J., R. A. Wisher and J. Lee.** Moderating learner-centered e-learning: Problems and solutions, benefits and implications. In T. S. Roberts (Ed.), *Online Collaborative Learning: Theory and Practice*, 54–85. Hershey, PA: Idea Group Publishing, 2003.
40. **Angeli, C., N. Valanides and C. J. Bonk.** Communication in a web-based conferencing system: the quality of computer-mediated interactions. *British Journal of Educational Technology* 34: 31–43, 2003.
41. **Oliver, M. and G. P. Shaw.** Asynchronous discussion in support of medical education. *Journal of Asynchronous Learning Networks* 7(1): 56–67, February 2003.
42. **Rogoff, B.** Developing understanding of the idea of communities of learners. *Mind, Culture and Activity* 1: 209–229, 1994.
43. **Lea, M. R. and K. Nicoll.** *Distributed Learning: Social and Cultural Approaches to Practice.* London and New York: RoutledgeFalmer, 2002.
44. **Harasim, L.** Shift happens: Online education as a new paradigm in learning. *Internet & Higher Education* 3: 41–61, 2000.

45. **Garrison, D. R., T. Anderson and W. Archer, W.** Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education* 15: 7–23, 2001.
46. **Meyer, K. A.** Face-to-face versus threaded discussions: The role of time and higher-order thinking. *Journal of Asynchronous Learning Networks* 7(3): 55–65, 2003.
47. **Moller, L.** Designing communities of learners for asynchronous distance education. *Educational Technology Research and Development* 46: 115–122, 1998.
48. **Sheingold, K.** *Conversations in Learning: Facilitating Online Science Courses*. Cambridge, MA: TERC, 2005.
49. **Haavind, S.** Tapping Online Dialogue for Learning: A Grounded Theory Approach to Identifying Key Heuristics that Promote Collaborative Dialogue Among Secondary Online Learners. Cambridge, MA, Harvard University: Harvard Graduate School of Education, 2006.

THE LOUISIANA ALGEBRA I ONLINE INITIATIVE AS A MODEL FOR TEACHER PROFESSIONAL DEVELOPMENT: EXAMINING TEACHER EXPERIENCES

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ABSTRACT

Over the past decade online learning initiatives have shown tremendous potential for broadening educational opportunities and for addressing local and regional shortages of highly qualified K–12 teachers. The Louisiana Algebra I Online initiative represents one type of online model than can address both the need for improving course offerings and for addressing teacher shortages. The goal of the model is to improve educational opportunities for students by providing them with a high-quality, standards-based curriculum delivered online by a certified mathematics teacher and to support the professional development of teachers in hard-to-staff schools by partnering them with a highly qualified teacher-mentor who is available online. The innovation of this model for online learning is that it integrates classroom-based learning with virtual learning thereby providing students with the structure and opportunities afforded by regular class meetings and supports the professional development of uncertified teachers through ongoing and embedded professional development opportunities.

This research suggests that the Louisiana Algebra I Online model is a viable online model for providing teachers with an effective model for authentic and embedded professional development that is relevant to their classroom experiences.

KEYWORDS

Online Learning, Algebra I, Virtual Learning, Distance Learning

I. INTRODUCTION

Online learning initiatives have shown tremendous potential for changing how teachers teach and how students learn and over the past decade, we have seen an enormous increase in the use of online teaching and learning environments at the K–12 level. Researchers estimate that student enrollment in K–12 online learning programs increased tenfold between 2002 and 2006; more than 600,000 students were enrolled in K–12 online learning programs during the 2005–2006 school year compared to only 40,000–50,000 students during the 2001–2002 school year [1]. In many cases, these online distance learning initiatives have been implemented to address critical local needs for (1) broadening the educational opportunities that are available for students by providing courses online that are not available locally and (2) addressing severe local and regional shortages of qualified teachers [2]. These advantages are particularly salient given the current mandates of The No Child Left Behind Act (NCLB) for improving student achievement and for providing students with highly qualified teachers in every classroom. According to NCLB, all teachers in core academic subjects are required to be highly qualified, including having an academic background in the subjects they teach, by the end of the 2005–06 school year [3].

Ever-increasing demands to improve student performance and teacher quality have led states to explore the potential of online learning programs. Within the umbrella term of "online learning program" there are myriad models through which coursework can be delivered. For example, during the 2002–2003 school year, many districts reported using two-way videoconferencing to teach classes (55%) while others described asynchronous computer-based instruction delivered via the Internet (47%) [4]. Other online models include pre-recorded video instruction, synchronous computer-based courses delivered via the Internet, or using other technologies such as teleconferencing or CD-ROM to provide instruction to students.

According to [4], hard-to-staff schools such as those in rural areas are leading the way in online course enrollment. This interest is fueled by the unique challenges faced by these districts and schools in recruiting and retaining highly qualified teachers that can provide a broad range of courses for students. For example, the National Educational Association reported that teachers in rural populations tend "to be less educated, slightly less experienced, younger," have limited access to professional development opportunities, and have a higher likelihood of teaching outside of their field [5]. According to [4], 46% of rural districts reported that their students were participating in distance education courses compared with only 28% in urban school districts and 23% in suburban districts.

With its large number of rural school districts in which teacher recruitment and retention remain problems, Louisiana faces a particular challenge in helping students gain proficiency in core subject areas, and in mathematics in particular. According to [6], approximately 26% of public school students in Louisiana were enrolled in rural school districts during 2003–2004. Of this percentage, about 32% were classified as minority students and 22% lived in poverty. Overall, 91% of Louisiana's teachers were classified as "highly qualified" during the 2003–2004 school year. However, when the data were disaggregated by school poverty level, it was evident that high poverty schools in Louisiana had lower percentages of highly qualified teachers. For example, during that school year, only 87% of teachers were considered highly qualified in the high poverty schools, compared to 93% of teachers in low poverty schools (2003–2004 Louisiana State Education Progress Report, http://www.doe.state.la.us).

In 2000, to broaden the course offerings taught by highly qualified teachers, Louisiana joined the ranks of several states offering online courses to students by launching Louisiana Virtual School (LVS). LVS uses the Internet, e-mail, technology tools, and other online and offline resources to enable Louisiana schools to provide students with access to a variety of courses that might not otherwise have been available. Starting with only 130 students during its pilot year in 2000, LVS grew to serve more than 2,300 students during the 2004–05 school year.

One particular program supported by the Louisiana Department of Education (LDE) and the State Board of Elementary and Secondary Education (SBESE), and offered through LVS is the Louisiana Algebra I Online initiative. This algebra course is delivered online via the Blackboard™ online learning platform and incorporates email, Internet tools such as Java Applets, and video into the lessons. Students also use graphing calculators and Graphire 2 Digital Tablets with a stylus and handwriting capture system. For students, the Louisiana Algebra I Online model integrates classroom-based learning with virtual learning, while also seeking to support the professional development of teachers in rural schools. In this way, the model not only provides instruction from a highly qualified teacher for students, but also provides local teachers with embedded professional development that is relevant to their classroom experiences.

Given the NCLB mandate for improving student achievement in core academic areas through the provision of highly qualified teachers in every classroom, it is not surprising that LVS would choose to focus some of their online learning resources on algebra instruction. The overarching skills acquired in the mastery of algebra include problem solving, being able to generalize from patterns, and applying mathematical reasoning to real-world problems [7] and its study is a vital step in students' education. A solid proficiency in Algebra is critical to success not only in more advanced mathematics [8], but also in students' education overall. Success or failure in this course has been found to be a major determinant of students' further work in mathematics and science and hence an important predictor of future educational attainment and employment opportunities [9].

II. THE LOUISIANA ALGEBRA I ONLINE PROJECT

Designed for schools in which a sufficient number of certified mathematics teachers are not available, the goal of the Louisiana Algebra I Online project is to improve educational opportunities for students by providing them with a high-quality, standards-based curriculum delivered online by a certified mathematics teacher. Additionally, this highly qualified teacher mentors a classroom teacher who is not certified to teach mathematics thereby providing an authentic and embedded professional development for local teachers that is relevant to their classroom experiences. The innovation of the Louisiana model is that it enables a school to have a certified teacher available when one is not locally present, while still providing students with the structure and opportunities afforded by regular class meetings.

A. Teacher Roles and Responsibilities

The online and in-class teachers are expected to play different instructional and management roles in the classroom. The online teacher serves as the teacher-of-record for students in the Algebra I Online classrooms and as a mentor and model for the in-class teacher. They are expected to respond to the students' questions and assignments, to provide feedback on homework, tests, and discussion board postings, to keep the students and the in-class teacher informed about student progress and status, maintain the schedule in the Blackboard™ course delivery system used for the online course, provide whole group and individual communications and instruction, and communicate with the in-class teacher. The online teachers report grades to LVS on a regular basis and maintain email backups to submit to LVS three times a year.

The in-class teachers, most of whom are either certified in other areas or are working towards certification in secondary mathematics, follow the curriculum guide to facilitate face-to-face learning activities and collaborate with the online teachers in guiding and supporting the students. The in-class teachers serve as collaborators with the online teacher and their responsibilities include creating an atmosphere conducive to learning in the classroom, assisting students with technology, supervising and instructing the Algebra I students, working with students when problems arise, communicating with the online teacher, keeping the online teacher informed about individual student issues and class activities, monitoring student grades, and providing feedback on activity days.

B. Formal Components of Teachers' Professional Development Opportunities

In addition to providing students with access to two teachers, this approach provides a unique professional development model for the in-class teachers since they work throughout the year with a highly qualified mathematics teacher who is available online. Both the in-class and online teachers participate in formal professional development workshops to prepare them for their participation in the Algebra I Online initiative. The formal professional development opportunities include the following activities:

1. Summer Orientation

This required, two-day session for the in-class and online teachers introduces them to each other and the course environment. It also provides an opportunity for the in-class and online teacher teams to begin planning the management of their collaboration throughout the year. The topics addressed included outlining the course organization and expectations, grading, review of teacher roles, classroom set-up and management, and technology tools. The in-class and online teacher also work together to create a schedule for at least the first semester of their collaboration, a plan for the daily routine for their classroom, a process on how grades will be reported, and a plan for how they will communicate with one another.

2. Orientation to Algebra I Online for In-class Teachers

This online, 11 module, four-week course is required for the in-class teachers and teachers are expected to spend two hours per week on the course. By the end of the course, the in-class teachers are expected to be able to (1) use Blackboard™ and email to communicate efficiently and effectively; (2) manage files in a Windows environment; (3) use the TI-83 graphing calculator and selected sensors; (4) use a digital tablet to capture handwritten work digitally; (5) identify and address major management issues in the secondary mathematics classroom; and (6) plan for daily activities in the algebra classroom.

3. Orientation to Algebra I Online for Online Teachers

This online, 17 module, four-week course is required for the online teachers and teachers are expected to spend two hours per week on the course. By the end of the course, the online teachers are expected to be able to (1) use Blackboard and email to communicate efficiently and effectively; (2) use Blackboard™ to manage an online classroom: make materials available, upload files, create announcements, create and manage discussion boards, use Blackboard's assessment feature, use the grade book tool; (3) manage files in a Windows environment; (4) use the TI-83 graphing calculator and selected sensors; (5) use specialized software to capture calculator screenshots and download calculator programs; (6) use a digital tablet to capture handwritten work digitally; (7) identify and address major management issues in the online mathematics classroom, including backups and documentation of work and communication; (8) help the in-class teacher plan for daily activities in the algebra classroom; and (9) develop a class schedule for each semester.

4. Topics for Algebra Leaders and Instructors (TALI)

This course is available to both in-class and online teachers through a regional state university. The course includes 11 online modules that parallel the Algebra I Online course and provides an overview of the administrative, instructional, technological, and pedagogical issues of the online Algebra I classroom.

These modules are presented online over a ten-month period and coincide with the modules the students are completing in the classroom. Participants are required to spend a minimum of two hours per week on course activities.

C. Curriculum and Textbooks

The Algebra I Online course uses a curriculum designed by the Louisiana Center for Educational Technology (LCET) and the Louisiana School for Math, Science, and the Arts (LSMSA). The course is aligned to the National Council of Teachers of Mathematics (NCTM) standards and the Louisiana state content standards, benchmarks, and Grade Level Expectations (GLEs) (http://lvs.doe.state.la.us). Students enrolled in the Louisiana Algebra I Online program participate in an algebra class that meets on a standard class schedule, with all students meeting together in a technology-equipped classroom. Each student has access to a multimedia, Internet-connected computer during class time where the course curriculum and materials may be accessed. Students with access to an Internet-connected computer at home or elsewhere can also access their course materials outside of the school day. Each student benefits by having two teachers: an experienced secondary certified mathematics teacher who is available online and a teacher available in the classroom who is not necessarily certified to teach secondary mathematics.

During the first year of the course delivery (2002–2003), the Southwest Educational Development Laboratory (SEDL) included the Algebra I Online course as part of a study to determine the quality and effectiveness of curriculum, instruction, and student assessment in online courses. The study found that the Algebra I Online program met the criteria for an effective and quality web-based course for middle and high school students based on (1) alignment with state standards, (2) providing resources that enrich course content, (3) providing opportunities for students to engage in abstract thinking and critical reasoning skills, (4) providing appropriate student-to-student, as well as teacher-to-student interactions [10].

III. PRIOR RESEARCH AND CURRENT INQUIRY

Despite the recent proliferation of online learning initiatives in K–12 education, very little high-quality, evidence-based research is currently available to inform the choice and implementation of online programs. For example, there has been very little research on the effectiveness of online learning in K–12 compared to traditional face-to-face learning, and almost no research on specific curriculum interventions. In a meta-analysis of 19 research studies that examined K–12 online programs, [11] found there to be preliminary evidence that students in online courses do as well as students who receive face-to-face instruction. However, only 10% of the studies examined by [11] employed an experimental or quasi-experimental approach. Similarly, another meta-analysis conducted by [12] found that only 2 of the 232 studies that focused on online learning at the K–12 level employed experimental or quasi-experimental methods, used appropriate data analyses, or made conclusions appropriate to the methodology used. A more recent meta-analysis conducted by [13] reported that “[M]any studies of K–12 distance education have been published, but a small proportion of them are controlled, systematic, empirical comparisons that fit the definition of ‘scientific,’ as it is defined by the U.S Department of Education and described at the What Works Clearinghouse website.”

Much of the research-to-date on online teaching and learning has been conducted in higher education settings. These studies have found that online learning programs provide students and teachers with quite different teaching and learning environments than those provided in traditional, face-to-face settings [14, 15, 16]. The distinguishing characteristics include class structure [17], the level and types of peer-to-peer and student-teacher interactions that take place [15, 18], and the lack of “social presence” during the learning process [19, 20, 21]. While many studies of learning outcomes in higher education have found no statistical differences in achievement for online courses compared to traditional, face-to-face courses, there remains concern that the quality and depth of learning may be affected in online courses [22, 23, 24 25]. Mediating variables that may promote or hinder learning success in an online environment have been isolated in several studies and these include attitudes towards the online environment [26] and beliefs about the efficacy of online learning [25, 27, 28, 29, 30].

The 2004–2005 school year implementation of the Louisiana Algebra I Online project provided a unique opportunity to use a quasi-experimental design to explore potential differences between students' experiences in online and traditional classrooms. Under this design, students participating in the initiative (treatment classrooms) were compared with students in matched comparison classrooms that received the traditional face-to-face or "business as usual" approach to instruction (comparison classrooms). During the 2004–2005 school year, the Louisiana Algebra I Online project was implemented in 18 intact classrooms in six school districts and two private schools. In total, 257 students participated in the Algebra I Online course and their survey responses and algebra achievement scores were compared with 232 students from 15 matched, comparison classrooms [31].

Using a hierarchical linear regression modeling approach in which 463 treatment and comparison group students were nested within 33 classrooms, examination of student achievement from the Louisiana Algebra I Online initiative found that after controlling for initial pre-intervention measures of mathematics ability, students who participated in the initiative scored as well on the posttest as students in traditional face-to-face Algebra I courses [31]. This finding is similar to those reported in other studies and meta-analyses which compared learning outcomes for online and face-to-face courses [13, 25, 27]. Since many online learning initiatives are implemented to fulfill critical local needs, this finding was very important as it showed that the Algebra I Online program was as effective as the traditional, face-to-face algebra classroom in improving student pre-to-post program learning outcomes.

Using survey data collected from students in the treatment and comparison classrooms, students' learning experiences were also compared. The data showed that students in the Algebra I Online classrooms responded positively to the online learning environment. They reported that they enjoyed the new learning experience and in particular, using technology to learn algebra. Interestingly, students in the Algebra I Online classrooms reported spending more time interacting with their peers to talk about the content of the course and working together on course activities than students in the traditional, face-to-face classrooms. The amount of time that students spent socializing, interacting to understand assignment directions, and working together on both in-class assignments and homework were approximately the same in the traditional and online environments [31].

Despite having similar post-intervention algebra scores, the survey data showed that students in the Algebra I Online classrooms reported lower levels of confidence in their algebra skills than students in the traditional, face-to-face algebra courses [31]. This finding supports those from studies described by Bernard et al. [15] in their meta-analysis on how online and traditional classroom experiences may vary. It may be that the model of delayed feedback and dispersed authority in the online course lead to a "lost" feeling where students were unable to gauge "how they are doing."

A. Focus of the Current Inquiry

While our prior work examined student learning outcomes and student experiences, the focus of the current inquiry is on teachers' experiences in the Algebra I Online program and how these relate to student learning outcomes. Again, the 2004–2005 implementation of the Algebra I Online program provided us with the opportunity to examine the effectiveness of the initiative as a professional development opportunity for local teachers and to examine teacher practices and behaviors. Note that teacher data were not available from the comparison classrooms as the data collected were specific to the characteristics of the Algebra I Online program.

While the Algebra I Online model integrates classroom-based and virtual learning for students, it also supports the professional development of teachers by partnering local classroom teachers (who may not be certified to teach algebra) with highly qualified teachers who act as mentors throughout the implementation of the program. By providing classroom teachers with an individual mentor, albeit an online mentor, this model of professional development avoids the one-shot, one size fits all professional development approach that may not provide teachers with the opportunity to master new strategies for meeting the day-to-day veracity of their classrooms [32, 33]. The design of the Algebra I Online program dovetails with the current literature on professional development as it provides for the “joint construction of knowledge through conversation and other forms of collaborative analysis and interpretation” [34]. According to [33], online models for teacher professional development have the potential to provide teachers with the “needed support and time which may currently not be available given the conventional school professional development frameworks (e.g., set hours or a number of days).”

Given these current thoughts on effective teacher professional development and the important professional development components of the Algebra I Online model, it is important to examine the initiative as a professional development model. Specifically, this research examines the online and in-class teachers’ experiences in the program through the examination of teacher survey responses and the association between teachers’ beliefs and practices and student learning outcomes. The current lack of sound empirical evidence about the impacts of online learning in K–12 settings is troublesome given the widespread and growing use of online models for teaching, learning and teacher professional development and the costs incurred from limited school budgets to support its use.

IV. STUDY DESIGN AND SAMPLE CHARACTERISTICS

In this section we describe the district and teacher characteristics, the instrumentation used to collect data and the steps taken to assess the fidelity of the implementation of the program. To participate in the Louisiana Algebra I Online program, districts were required to demonstrate a need for certified mathematics teachers and a desire to provide professional development to teachers interested in obtaining certification in secondary mathematics. District leaders were asked to identify the schools in which the program was to be implemented and the teachers who would serve as in-class teachers for the Algebra I program. In addition, participating schools were required to provide the hardware, computer access, and an email account for each student. They also agreed to provide release time for the participating teachers to attend the required professional development sessions and to identify a district coordinator who would oversee the registration process for the students.

A. Sample Characteristics

A total of six school districts and two private schools participated the Algebra I Online program during the 2004–2005 school year. According to the NCES 2001–02 School District Locator, four of the participating districts qualified as Rural or Small Town districts and the remaining two were classified as Urban Fringe of Mid-Size City districts. All six districts had previously participated in the Algebra I Online program during the 2003–2004 school year, and two had participated in the pilot year in 2002–03.

A total of 26 teachers participated in the Louisiana Algebra I Online program as either online or in-class teachers; 10 teachers taught online and 16 teachers acted as in-class teachers. The online teachers were selected on the basis of their outstanding teaching credentials and were identified by the Louisiana Department of Education to be at the level of "mentor teachers." These were master teachers who were certified to teach secondary mathematics and were experienced with technology. According to the data collected as part of the study, this group of teachers had an average of 11 years teaching experience with an average of 9.4 years in their current position, they taught an average of 4.9 classes per semester with an average class size of 17 students.

In the selection of in-class teachers, first priority was given to those teachers who were actively working toward their certification in secondary mathematics. Thirteen of the 16 in-class teachers were certified to teach elementary education and the remainder held certifications in middle school mathematics, special education, or health and physical education. The average number of years teaching for the in-class teachers was 8.5, and they taught an average of 5 classes per semester with an average class size of 21 students.

The Algebra I Online course was available to students in Grades 8 and 9 and there were no academic pre-requisites for enrolling in the course. The course was not intended for those students who had previously failed algebra, so regardless of grade, students were taking Algebra I for the first time. Since online learning makes certain demands upon students beyond those in face-to-face algebra courses, the districts and schools were asked to avoid selecting students for participation on the basis of prior mathematics achievement. They were asked instead to consider students' ability to work independently, communicate effectively, and their ability to manage their time effectively. District coordinators were given instructions on how to identify students who would benefit from learning mathematics in a non-traditional setting. In total, 257 eighth and ninth grade students participated in the Louisiana Algebra I Online project during the 2004–2005 school year implementation.

B. Instrumentation

Survey instruments were administered to the in-class and online teachers to gather data about their practices and experiences in the Algebra I Online program. Prior to the implementation of the program, students were administered an achievement test to assess their general mathematics ability and at the end of the course, an aligned post-test was administered. In addition to these data sources, observational data were collected in a random sample of 9 classrooms to assess the fidelity of the implementation across the classrooms. Each data source will be discussed in turn.

1. Teacher Surveys

A 19 item survey was administered to both the in-class and online teachers. The in-class teacher survey was designed to collect information on teacher activities during the implementation of the Algebra I Online program, to gauge the teachers' satisfaction with the professional development opportunities and their mentee experiences, and to get a sense of their overall satisfaction with the program.

Similarly, the online teachers' survey was used to collect data on teacher activities during the implementation of the Algebra I Online program and on teachers' satisfaction with the professional development opportunities. In addition, this survey was used to assess the online teachers' experience working with the in-class teacher, and their satisfaction with the program overall. The online and in-class surveys were comprised of several groups of overlapping items but since some teacher survey items were only administered to one of the groups, comparisons across in-class and online teachers were not possible for all survey items.

2. Student Achievement Measures

Administered in September 2004, the pretest was comprised of 25 multiple-choice items that assessed students' general mathematics ability and mathematics comprehension. The Cronbach's alpha estimate of reliability for the pretest was 0.70. The posttest, administered in June 2005, was also a 25 item multiple choice test but was aligned with the Algebra I Online course objectives and Louisiana's GLEs outlined by the Louisiana Department of Education. The Cronbach's alpha estimate of reliability for the posttest was 0.81. Evidence of the content validity of the assessments was established by having two mathematics educators with experience developing curriculum and assessments map the items on the test to the Louisiana GLE and Algebra standards [31]. Evidence of criterion validity was gathered by correlating scores on the assessments with students' standardized test scores. Despite being unable to separate the algebra strand from the complete standardized test scores, the correlations between the Grade 8 Louisiana Educational Assessment Program (LEAP) assessment scores and the Grade 9 Iowa Test of Educational Development (Iowa) assessment and the pre- and posttest scores were moderately strong and positive; 0.55 and 0.67 for the pre- and posttest scores, respectively with the LEAP assessment and 0.50 and 0.55, respectively for the pre- and posttest measures with the Iowa assessment [31].

For the treatment group, pretest achievement data were gathered from 261 students and posttest data were collected from 231 students. Since students in the treatment group and comparison groups were taking Algebra I for the first time regardless of grade, data from both grades were combined for analysis.

D. Fidelity of Program Implementation

To assess the fidelity of the implementation of the Algebra I Online program, classroom observations were conducted in a sample of the treatment group classrooms; nine of the eighteen classrooms. The classroom observations documented the types of instructional phases (i.e., transition, whole group instruction/discussion, student individual work, etc.), the roles fulfilled by the in-class teacher, and types of student interactions across the treatment classrooms. Additional observational data recorded how the technologies were used and how the classrooms were set-up. Two trained researchers observed one class period in each of nine classrooms, working together and observing the same classes at the same time. During the class period observation, both researchers recorded the length and description of the instructional phases independently. Their observations of the instructional phases were entirely consistent with an inter-rater reliability of 100%. Within each phase, observers took descriptive notes on the student to student interaction, teacher to student interaction, student engagement with the task, technology use, and a general description of the activity. Additionally, both observers recorded the instructional roles the in-class teacher fulfilled and the classroom organization (i.e., lecture, lecture with discussion, small group instruction, individual work, teacher demonstration, etc.). Again, their observations were entirely consistent within each classroom. Immediately after each class, the researchers came to a consensus on the post-class checklist that includes items about the observations of students' mathematical thinking, discipline incidents, uses of technology, and students' levels of comfort with technology. With two trained observers in each of the nine classrooms, the classroom observation data showed high levels of similarity among the activities being conducted across the treatment classrooms, and in each case these activities were directly linked with how the course content was presented. For example, in each of the treatment classrooms, students used technology to "analyze information," "evaluate information," and "self-assess or assess" their own work or work from classmates [35].

V. RESULTS

In total, 26 Algebra I Online teachers completed the teacher surveys; 16 in-class teachers and 10 online teachers. To examine the Louisiana Algebra I program as a professional development model, online and in-class teachers' survey responses are compared under several headings relating to their experience with the program. Where variability in teachers' responses permitted comparisons, students' posttest scores were compared across groups of teachers. For these comparisons, individual student posttest scores were used rather than classroom mean scores. Note that although some online teachers taught more than one online class, they only completed the one survey.

A. Resources and Support

Table 1 shows that in general, the online and in-class teachers were positive about the formal professional development opportunities that were available as part of the Algebra I Online model. More than 90% of the online and in-class teachers either agreed or strongly agreed that the two-day summer orientation and the ongoing professional development opportunities were beneficial and applicable to their teaching experiences. Similarly, in terms of technical resources and support in their classrooms, schools and districts, the in-class and online teachers were very positive. Recalling that local schools and districts had to provide the technology hardware and computer and email access for students, and agreed to provide release time for the participating teachers to attend the required professional development sessions, this finding is encouraging. Prior research on technology use has found that local support for educational technology is a significant positive predictor of teachers' integration technology into their teaching practices [36] and has been found to be positively related to teachers' satisfaction with their technology experiences. Since adequate access to educational technology is a necessary but insufficient condition for technology use and integration into classroom instruction and learning, these findings are encouraging. Without local support and adequate resources, the tenability of Louisiana Algebra I Online program would certainly be jeopardized.

Beyond their local schools and districts, the teachers were also very positive about the support they received from the Algebra I Online staff; each of the in-class and online teachers either strongly agreed or agreed that they received adequate support from the trained Algebra I Online staff. The lack of variability in teacher responses did not permit the examination of student learning outcomes.

Table 1: Resources and Support

		Strongly Agree or Agree	Strongly Disagree or Disagree
The two-day summer orientation for the Algebra I Online Project was beneficial and applicable to my teaching experiences.	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	15 (94%)	1 (6%)
The ongoing professional development for the Algebra I Online Project was beneficial and applicable to my teaching experiences.	Online Teachers	9 (90%)	1 (10%)
	In-class Teachers	15 (94%)	1 (6%)
The technical resources in my classroom are adequate.	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	15 (94%)	1 (6%)
The school and district provided adequate support.	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	15 (94%)	1 (6%)
The Algebra I Project staff provided adequate support.	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	16 (100%)	0 (0%)

B. Levels of Interest in the Online Environment

Since teaching an online course is likely to present teachers with quite a different teaching environment than that in a traditional, face-to-face setting [14, 15, 16], it is interesting to examine how teachers rate their level of interest in the online classroom environment. Table 2 shows that compared to their level of interest in a regular classroom environment, the majority of in-class and online teachers said that their interest was either somewhat or much higher. A greater percentage of the online teachers (90%) reported higher levels of interest than the in-class teachers (75%). This is not surprising since the online teacher-leaders were more experienced with the online environment than their in-class mentees (recall that a prerequisite for being selected as an online teacher was that of being experienced with technology).

Prior research has found that students' success in an online learning environment has been found to be associated with more positive attitudes towards the online environment [26] and more positive beliefs about the efficacy of online learning [25, 27, 28, 29, 30]. Table 2 shows that when the in-class and online teachers were asked to rate their students' level of interest in the online course compared to a regular course, the in-class teachers reported lower levels of interest for their students; 4 of the 16 in-class teachers indicated that their students' level of interest was somewhat or much lower than for a traditional course. All 10 of the online teachers said that their students' level of interest was either the same, somewhat higher or much higher; in speculating about the difference between the two ratings, it may be that the online teachers were less familiar with the students' interest levels because they were not physically present in the classroom.

This finding raises some important issues about online learning environments in general and the Algebra I Online program in particular. For online teachers, their physical absence in the classroom may lead to the under or over-estimation of students' progress or motivation, while for students', the delayed feedback and the absence of their teacher-of-record in the online classroom may make it difficult for students to gauge their progress in the course. This hypothesis is somewhat supported by the finding reported in [31] that despite having similar post-intervention algebra scores, the students in the Algebra I Online classrooms reported lower levels of confidence in their algebra skills than students in the traditional, face-to-face algebra courses.

Table 2: Level of Interest in the Online Classroom Environment

		Much or Somewhat Higher	About the Same	Much or Somewhat Lower
How would you describe your own level of interest in the online classroom environment in comparison to a regular classroom environment?	Online Teachers	9 (90%)	1 (10%)	0 (0%)
	In-class Teachers	12 (75%)	2 (13%)	2 (13%)
How would you describe the students' level of interest in the online course in comparison to a regular course?	Online Teachers	8 (80%)	2 (20%)	0 (0%)
	In-class Teachers	9 (56%)	3 (19%)	4 (25%)

To examine whether teachers' level of interest in the online classroom environment was associated with students' posttest scores, the mean student posttest scores were calculated for the groups of teachers who expressed different levels of interest in the online classroom environment. The significance of the difference between the means was then examined using either an independent means t-test or the one-way

ANOVA. Note that for the independent means t-tests, an adjusted alpha-level is used to adjust for multiple comparisons within a single data set.

For the online teacher responses, an independent means t-test was used to examine whether students' posttest scores differed according to teachers' self-reported level of interest in the online classroom environment. The results in Table 3 show that there was no significant difference between posttest scores for teachers who reported having a much or somewhat higher level of interest (15.24) and the posttest scores for teachers who reported interest levels about the same as those for a regular classroom environment (16.41) ($t = -1.08$, $df = 110$, $p = 0.284$). To examine the same question for three groups of in-class teachers, a one-way ANOVA was used. Similar to the results for the online teachers, the ANOVA showed that there were no significant differences between students' posttest scores for teachers who said that their level of interest was much or somewhat higher (14.68), about the same (15.79), or much or somewhat lower (16.23) ($F(2,210) = 1.85$, $p = .160$). These results suggest that teachers' level of interest in the online environment was not associated with higher or lower posttest scores for students.

Looking at how students' posttest scores differed across teachers' perceptions of students' level of interest in the online environment, similar analyses were conducted. Table 3 shows that students whose online teacher perceived them to have a much or somewhat higher level of interest (16.55) scored significantly higher than students whose online teacher said that their level of interest was about the same (10.81) ($t = -5.97$, $df = 110$, $p < .001$). Examining the in-class teachers' perceptions of student interest, the data show that students' whose teachers perceived them to have much or somewhat lower levels of interest scored lower on the posttest (11.86). The ANOVA conducted to examine the difference was significant ($F(2, 210) = 19.20$, $p < .001$) and post hoc Bonferroni tests showed that these students scored significantly lower than students whose in-class teachers perceived their interested level to be about the same ($p < .001$) or whose in-class teachers perceived their interested level to be much or somewhat higher ($p < .001$) in comparison to a regular classroom environment. Recognizing that these are not direct measures of students' level of interest in the online environment, but rather teachers' perceptions of student interest, the results remain interesting.

Table 3: Student Posttest Means and Level of Interest in the Online Classroom Environment

		Much or Somewhat Higher	About the Same	Much or Somewhat Lower
How would you describe your own level of interest in the online classroom environment in comparison to a regular classroom environment?	Students' Posttest Mean for Online Teachers (s.e.)	15.24 (.50)	16.41 (.71)	N/A
	Students' Posttest Mean for In-class Teachers (s.e.)	14.68 (1.07)	15.79 (.58)	16.23 (.38)
How would you describe the students' level of interest in the online course in comparison to a regular course?	Students' Posttest Mean for Online Teachers (s.e.)	16.55 (.41)	10.81 (.90)	N/A
	Students' Posttest Mean for In-class Teachers (s.e.)	15.99 (.39)	16.31 (.66)	11.86 (.56)

Note: The alpha level was adjusted separately for online teacher comparisons. Significance was established using $\alpha/2 = .025$ for the online teachers.

C. Challenges in Teaching the Algebra I Online Course

When the in-class and online teachers were asked to identify the biggest challenges they faced in facilitating and teaching the Algebra I Online course, the in-class teachers reported facing more challenges than the online teachers. Table 4 shows that these challenges included lack of teaching experience and lack of familiarity with technology, as well as having technical problems in the classroom. Also, half the in-class teachers reported that substantiating student participation was a challenge. A smaller number of the online teachers reported technical problems and having difficulties substantiating student participation as challenges. None of the teachers in either group reported that insufficient professional development opportunities or lack of support were obstacles to teaching the Algebra I Online course. These findings triangulate with the data reported in Table 1 where in-class and online teachers were generally positive about the available professional development opportunities and the support and resources they received.

To explore whether the challenges reported by the teachers were related to student achievement, the difference between the mean posttest scores for students in classrooms where teachers reported challenges and the mean posttest scores for students in classrooms where challenges were not reported were examined using independent means t-tests. Note that due to the lack of variability on some of the challenges reported, only the challenges of lack of teaching experience, lack of familiarity with technology, facing technical problems and substantiating student participation were examined in this way. Similar to the previous analyses, disaggregated student data were used for these analyses. Again, an adjusted alpha-level used to adjust for multiple comparisons within a single data set.

The mean posttest score for students whose in-class teachers reported their lack of teaching experience as a challenge (11.81) was statistically significantly lower than the mean for students whose in-class teachers did not report such a challenge (15.73) ($t = 4.67$, $df = 221$, $p < .001$). Similarly, the mean posttest scores for students whose in-class teachers reported that their lack of familiarity with technology was a challenge (10.56) was statistically significantly lower than the mean for students whose teachers did not report a lack of familiarity with technology (16.14) ($t = 7.75$, $df = 221$, $p < .001$).

In looking at the difference between the mean posttest scores for students whose in-class teacher reported facing technical difficulties (14.51) and the mean for those whose teachers did not report such a challenge (15.59), the data show that while the students whose in-class teachers reported this as a challenge scored lower, the difference was not statistically significant ($t = 1.73$, $df = 221$, $p = .086$).

However, the mean posttest scores for students in the classrooms where the in-class teacher reported having difficulty substantiating student participation (13.47) was statistically significantly lower than the mean for classrooms in which the in-class teachers did not report these difficulties (16.81) ($t = 5.82$, $df = 205$, $p < .001$).

For the online teachers, students’ posttest scores were slightly lower for those teachers who reported technical problems as a challenge (14.87) when compared to the online teachers who did not (15.70). However, the difference was not statistically significant ($t = 0.87$, $df = 110$, $p = .389$). In classrooms where the online teachers reported having difficulty substantiating student participation (16.76), students’ posttest scores were statistically significantly higher than for students whose online teacher did not report this as a challenge (14.23) ($t = -3.06$, $df = 110$, $p < .01$). This finding is somewhat unusual and would warrant future research.

Table 4: Challenges in Teaching the Algebra I Online Course

	Number of in-class teachers identifying this as challenge (total N = 16)	Number of online teachers identifying this as challenge (Total N = 10)
Insufficient professional development opportunities	0 (0%)	0 (0%)
Lack of support	0 (0%)	0 (0%)
Lack of materials/resources	1 (6%)	0 (0%)
Lack of teaching experience	3 (19%)	0 (0%)
Lack of familiarity with technology	3 (19%)	1 (10%)
Technical problems	6 (38%)	3 (30%)
Substantiating student participation	8 (50%)	3 (30%)

Note: The alpha level was adjusted separately for online and in-class teacher comparisons. Significance was established using $\alpha/2 = .025$ for the online teachers and $\alpha/4 = .013$ for the in-class teachers.

D. Teaching in the Algebra I Online Program

In addition to reporting on the challenges they faced in teaching the Algebra I Online classes, the in-class and online teachers were asked to respond to several questions about the benefits they perceived from their participation. These benefits related to increasing their comfort with technology, their knowledge of algebra content, increasing their understanding of students' learning and thinking, and increasing their classroom teaching skills. As Table 5 shows, the in-class and online teachers were very positive about the benefits of the Algebra I Online program. The one exception to this was that 5 of the 16 in-class teachers reported that they perceived no benefit from the program for increasing their classroom teaching skills.

Though it is encouraging to see that all 16 of the in-class teachers reported that the program increased their knowledge of algebra, the lack of perceived benefit for their classroom teaching skills is not entirely surprising. When serving as in-class teachers for the Algebra I Online program, teachers served as collaborators with the online teacher and their responsibilities included creating an atmosphere conducive to learning, assisting students with technology, supervising and instructing the Algebra I students, working with students when problems arise, keeping the online teacher informed about individual student issues and class activities, monitoring student grades, and providing feedback on activity days. In many ways, these roles are quite different from the typical role fulfilled by a classroom teacher in the traditional face-to-face environment. The data suggest that while the Algebra I Online model provides for improving content knowledge in algebra, the mentor-mentee relationship does not necessarily result in a model for changing general teaching practices.

Table 5: Benefits of Teaching in the Algebra I Online Program

My experience as an Algebra I Online teacher contributed to…		Strongly Agree or Agree	Strongly Disagree or Disagree
…an increase in my comfort with using technology	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	16 (100%)	0 (0%)
…an increase in my knowledge of algebra	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	16 (100%)	0 (0%)
…an increase in my understanding of students' learning and thinking	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	15 (94%)	1 (6%)
…an increase in my classroom teaching skills	Online Teachers	10 (100%)	0 (0%)
	In-class Teachers	11 (69%)	5 (31%)

E. Communication Between In-class and Online Teachers

The online and in-class teachers fulfilled different and complementary roles during the teaching process and so the model required the in-class and online teachers to communicate about a variety of classroom issues. Recall that the online teachers served as the teacher-of-record for students in the Algebra I Online classrooms and were expected to respond to the students' questions and assignments, to provide feedback on homework, tests, and discussion board postings, to keep the students and the in-class teacher informed about student progress and status, to provide whole group and individual communications and instruction.

To develop an understanding of the implementation of the Algebra I Online program, it was necessary to examine the frequency with which the pairs of teachers communicated with each other for a variety of purposes. The in-class teachers were asked how frequently they communicated with the online teacher for each purpose, and the online teachers were asked how frequently they communicated with the in-class teachers for each purpose. As Table 6 shows, the teachers communicated most frequently (about once per week or daily/almost daily) for planning lessons and for discussing individual students' work. More than half the online and in-class teachers reported communicating with each other at least once per week, almost daily or daily for planning lessons and discussing individual student's work. The teachers communicated less frequently for planning and grading assignments, and for assisting with the use of technology.

Table 6: Communication Between In-class and Online Teachers

How often do you communicate with the in-class/online teacher for…		Never or rarely	About once per month	About once per week	Daily/almost daily
Planning lessons	Online Teachers	0 (0%)	1 (10%)	8 (80%)	1 (10%)
	In-class Teachers	3 (19%)	0 (0%)	8 (50%)	5 (31%)
Planning assignments	Online Teachers	0 (0%)	3 (30%)	7 (70%)	0 (0%)
	In-class Teachers	3 (19%)	8 (50%)	4 (25%)	1 (6%)
Grading assignments	Online Teachers	1 (10%)	4 (40%)	4 (40%)	1 (10%)
	In-class Teachers	10 (63%)	5 (31%)	1 (6%)	0 (0%)
Discussing individual student's work	Online Teachers	0 (0%)	4 (40%)	6 (60%)	0 (0%)
	In-class Teachers	3 (19%)	3 (19%)	6 (38%)	4 (25%)
Assisting with the use of technology	Online Teachers	3 (30%)	4 (40%)	3 (30%)	0 (0%)
	In-class Teachers	0 (0%)	10 (63%)	5 (31%)	1 (6%)

To look at whether patterns of communication were associated with student achievement, we dichotomized the frequency of communication variable resulting in a measure that allowed us to compare student outcomes for teachers who seldom communicated (those who communicated "never or rarely" or "about once per month") to those who frequently communicated (those who communicated "about once per week" or "daily/almost daily"). Independent means t-tests were then used to compare posttest mean scores for the students of teachers in each group. Again, an adjusted alpha-level was used to adjust for multiple comparisons within a single data set.

The results in Table 7 show there are differences in students' posttest scores according to whether teachers seldom or frequently communicate, and the differences vary according to the purpose of the communication. For example, students' posttest mean scores were statistically significantly higher for online teachers who communicated frequently with the in-class teacher for planning lessons (16.04) and for discussing individual student's work (16.91) than online teachers who seldom communicated about these issues (11.15, 12.44, respectively). Similarly, the mean posttest score for students whose in-class teachers communicated frequently with them online for planning assignments (16.63) was statistically significantly higher than that for in-class teachers who seldom communicated for assignment planning (14.41).

For in-class teachers who communicated frequently with the online teacher around technology issues (11.11), the student mean posttest scores were statistically significantly lower than for those teachers who seldom communicated for this purpose (15.25). There was no significant difference in student mean posttest scores according to how frequently in-class and online teachers reported communicating for grading assignments.

Table 7: Student Posttest Means and Communication Between In-class and Online Teachers

How often do you communicate with the in-class/online teacher for…		Seldom Communicate	Frequently Communicate	t	df	p-value
Planning lessons	Students' Posttest Mean for Online Teachers (s.e.)	11.15 (1.04)	16.04 (.44)	-3.86	110	.000*
	Students' Posttest Mean for In-class Teachers (s.e.)	15.72 (.73)	14.89 (.35)	1.09	211	.275
Planning assignments	Students' Posttest Mean for Online Teachers (s.e.)	14.77 (.54)	17.09 (.59)	-2.54	110	.013
	Students' Posttest Mean for In-class Teachers (s.e.)	14.41 (.39)	16.63 (.47)	-3.29	211	.000*
Grading assignments	Students' Posttest Mean for Online Teachers (s.e.)	15.96 (.57)	14.76 (.65)	1.37	110	.173
	Students' Posttest Mean for In-class Teachers (s.e.)	15.06 (.32)	15.50 (1.31)	-0.39	211	.819
Discussing individual student's work	Students' Posttest Mean for Online Teachers (s.e.)	12.44 (.73)	16.91 (.45)	-5.43	110	.000*
	Students' Posttest Mean for In-class Teachers (s.e.)	13.96 (.43)	16.28 (.43)	3.79	211	.000*
Assisting with the use of technology	Students' Posttest Mean for Online Teachers (s.e.)	15.92 (.61)	14.83 (.57)	1.26	110	.221
	Students' Posttest Mean for In-class Teachers (s.e.)	15.25 (.32)	11.11 (.92)	-2.68	211	.008*

Note: The alpha level was adjusted separately for online and in-class teacher comparisons. Significance was established using $\alpha/5 = .01$.

*** Signifies statistical significance for $\alpha = .01$**

F. Time Spent During Algebra I Sessions

In view of the different roles that the in-class and online teachers were expected to fulfill in the implementation of the Algebra I Online classrooms, it was important to explore how the teachers spent their time in class. The online and in-class teachers were each asked to share information about the amount of time they spent on a variety of activities during a typical Algebra I class. Due to the nature of their day-to-day work and often different roles, the prompts for the online and in-class teachers varied.

Table 8 shows that 5 of the 10 online teachers reported spending more than 50% of their time communicating with students via email or grading students' assignments and homework. The most variability in the time spent during the typical Algebra I Online classroom was spent communicating with the in-class teacher; 5 of the 10 online teachers said that they spent less than 25% of their time on this activity.

Fourteen of the 16 in-class teachers reported spending less than 25% of their time reviewing assignments and homework with their class or getting students started. Only one in-class teacher reported spending more than 50% of his/her time presenting new math content to whole class. Although 15 of the 16 in-class teachers said that they spent less than 25% of their time working with small groups of students, 10 of the 16 in-class teachers reported spending time (> 26%) working with individual students.

Table 8: Teacher Time Spent During Typical Algebra I Session

How much time do you devote to each of the following types of activities for a typical Algebra 1 session?	Little (<10%)	Some (11-25%)	A lot (26-50%)	Most of the time (>50%)
Online Teachers (N = 10)				
Communicating with the in-class teacher (via e-mail, phone, or other)	2 (20%)	3 (30%)	4 (40%)	1 (10%)
Communicating with students via e-mail	0 (0%)	3 (30%)	2 (20%)	5 (50%)
Grading students' assignments and homework	0 (0%)	1 (10%)	4 (40%)	5 (50%)
In-class Teachers (N = 16)				
Presenting new math content to whole class	8 (50%)	3 (19%)	4 (25%)	1 (6%)
Reviewing assignments and homework with their class	7 (44%)	7 (44%)	2 (13%)	0 (0%)
Getting students started	7 (44%)	7 (44%)	2 (13%)	0 (0%)
Working with individual students	0 (0%)	6 (38%)	9 (56%)	1 (6%)
Working with small groups of students	3 (19%)	12 (75%)	1 (6%)	0 (0%)

To further examine how teachers spent their time during a typical Algebra I session, the variable representing the amount of time spent was dichotomized. This allowed us to compare student posttest scores for teachers who spent relatively small amounts of time (< 25% of their time) to the student posttest scores for teachers who reported spending larger amounts of time (> 25% of their time) on these activities. Again, independent means t-tests were used to examine the significance of the differences between the means and an adjusted alpha-level used to adjust for multiple comparisons within a single data set.

The data in Table 9 show that students' whose online teachers reported spending more time grading assignments and homework (15.85) had statistically significantly higher posttest scores than students whose online teachers reported spending less time on this activity (11.11). Similarly, students whose in-class teachers reported spending more time working with small groups of students (18.27) had statistically significantly higher posttest scores than students whose teachers spent less time working with small groups of students (14.71). Students whose in-class teachers spent more time getting students started during the typical Algebra I session (10.00) had statistically significantly lower posttest scores than students whose in-class teachers spent less time on this (15.75). These findings are not surprising since these activities indicate a greater engagement between the teacher and the student around Algebra content.

Table 9: Student Posttest Means and Teacher Time Spent During Typical Algebra I Session

How much time do you devote to each of the following types of activities for a typical Algebra 1 session?	Little or Some of the Time (<10% to 25%)	A lot or Most of the time (26% to >50%)	t	df	p-value
	Students' Posttest Mean (s.e.)				
Online Teachers					
Communicating with the in-class teacher (via e-mail, phone, or other)	14.54 (.88)	15.97 (.46)	-1.60	110	.113
Communicating with students via e-mail	15.64 (.92)	15.41 (.48)	0.25	110	.806
Grading students' assignments and homework	11.11 (.92)	15.85 (.44)	-3.11	110	.002*
In-class Teachers					
Presenting new math content to whole class	15.52 (.38)	14.31 (.54)	1.86	211	.064
Reviewing assignments and homework with their class	15.17 (.33)	14.68 (.87)	0.61	211	.543
Getting students started	15.75 (.32)	10.00 (.68)	6.39	211	.000**
Working with individual students	14.89 (.49)	15.17 (.41)	-0.42	211	.674
Working with small groups of students	14.71 (.33)	18.27 (.85)	-3.53	211	.001**

Note: The alpha level was adjusted separately for online and in-class teacher comparisons. Significance was established using $\alpha/3 = .017$ for the online teachers and $\alpha/5 = .01$ for the in-class teachers.

*** Signifies statistical significance for $\alpha = .017$**

**** Signifies statistical significance for $\alpha = .01$**

In-class teachers were also asked to identify the amount of time during a typical Algebra I Online class that their students spend on a variety of activities. Table 10 shows that more than half the in-class teachers said that their students spent less than 25% of their time in class listening to presentations of new materials, working in small groups, reading/doing problems from the text, or interestingly, discussing mathematics. Recall that prior analysis of the student survey data that compared students in the Algebra I Online classrooms to match traditional, face-to-face classrooms [31] found that students in the Algebra I Online classrooms reported spending more time interacting with their peers to talk about the content of the course and working together on course activities than students in the comparison classrooms. According to more than half the in-class teachers, their students spent a lot or most of the time working individually or working online.

Table 10: In-class Teacher Reports on How Students Spent Time During Typical Algebra I Session

How much time did your students spend engaging in each of the following types of activities?	Little (<10%)	Some (11-25%)	A lot (26-50%)	Most of the time (>50%)
Listening to presentations of new content	9 (56%)	2 (13%)	4 (25%)	1 (6%)
Working individually	1 (6%)	4 (25%)	3 (19%)	8 (50%)
Working in small groups	1 (6%)	9 (56%)	6 (38%)	0 (0%)
Reading/doing problems from the text	4 (25%)	7 (44%)	5 (31%)	0 (0%)
Working online	2 (13%)	0 (0%)	9 (56%)	5 (31%)
Discussing mathematics	2 (13%)	8 (50%)	5 (31%)	1 (6%)

Similar to the previous analyses, the variable representing the amount of time spent was dichotomized. This allowed us to compare student posttest scores for teachers who reported that their students spent relatively small amounts of time (< 25% of their time) to the scores for teachers who reported that their students spent larger amounts of time (> 25% of their time) on these activities. Again, independent means t-tests were used to examine the significance of the differences between the means and an adjusted alpha-level used to adjust for multiple comparisons within a single data set.

The results in Table 11 show only small differences between the mean posttest scores for students whose teachers report varying amounts of time spent. Using the conservative significance level ($\alpha/7 = .007$), the results indicate that none of the differences between the mean posttest scores were statistically significant.

Table 11: Student Posttest Means and In-class Teacher Reports on How Students Spent Time During Typical Algebra I Session

How much time did your students spend engaging in each of the following types of activities?	Little or Some of the Time (<10% to 25%)	A lot or Most of the time (26% to >50%)	t	df	p-value
	Students' Posttest Mean for In-class Teachers (s.e.)				
Listening to presentations of new content	15.17 (.38)	14.87 (.58)	0.45	211	.654
Working individually	14.14 (.61)	15.50 (.36)	-2.00	211	.046
Working in small groups	15.16 (.38)	14.92 (.57)	0.36	211	.717

Reading/doing problems from the text	15.21 (.38)	14.85 (.56)	0.55	211	.581
Working online	13.07 (.78)	15.38 (.34)	-2.50	211	.013
Discussing mathematics	15.64 (.37)	14.05 (.56)	2.44	211	.015

Note: The alpha level was adjusted for the in-class teacher comparisons. Significance was established using $\alpha/6 = .008$.

G. Narrative Responses

In addition to the forced-choice survey questions, the in-class and online teachers were invited to respond to several open-ended questions about their experiences in the Louisiana Algebra I Online program. The questions asked teachers to reflect on their mentor/mentee partnership, the positive and negative aspects of the initiative for students, as well the positive and negative aspects of the initiative for them as either in-class or online teachers.

For the in-class teachers, the most rewarding aspect of the mentor/mentee relationship was having the online teacher available as a resource for content-related questions. The in-class teachers also said that the partnership with the online teacher provided them with the opportunity to collaborate on ways to help students understand difficult concepts and also helped them to “use a different approach to teaching some of the concepts.” For the online teachers, the benefits of the partnership were around teamwork and the benefit of having two teachers providing help, support, and assistance to the students. A theme that emerged frequently was that the in-class teacher served as the online teachers’ “eyes and ears” in the classroom to help monitor the students and provide extra instruction. Given the online teachers’ lack of physical presence in the classroom, in-class teachers’ fulfillment of this role is particularly salient.

When asked about the positive aspects of the Algebra I Online course for students, the in-class and online teachers overwhelmingly said that exposure to technology and the high quality of the curriculum provided by Algebra I Online were the most positive aspects of the course. One online teacher said that the most positive aspect for students was “having an opportunity to master technology and mathematics concepts at the same time.” Some in-class and online teachers viewed the course as a useful opportunity for students to develop their skills to work and learn independently. Having said this, several in-class and online teachers also raised the independent nature of the learning as a challenge for students. Teachers, particularly the in-class teachers, recognized that the delayed feedback and being unable to “ask questions and get an answer during class time” was difficult for students. Half of the online teachers felt that students’ lack of technical skills was the most challenging aspect for their students.

The in-class teachers reported that an increase in their algebra content knowledge and an increase in their technology skills was were the most positive aspects of their own participation in the program. For the online teachers, the benefit of the program was in using the technology to support their teaching activities. One online teacher said that she “enjoyed the technology and the fact that it provides me with a way to do something I love” while another said “I enjoy using technology and I love teaching, so this is a great combination for me.” Interestingly, the asynchronous nature of the feedback that was mentioned by the in-class teachers as a challenge for the students was mentioned as a benefit for the online teachers themselves. For example, a teacher said that “having an opportunity to really think about my responses to student questions and provide them with the best answer possible” was very beneficial. When asked what was most challenging about their role, in-class teachers reported “not having sufficient time” to complete the lessons and some felt that they did not understand their students’ progress because they weren’t responsible for student assessments or grading. Not surprisingly, the online teachers reported that the lack of face-to-face contact with their students was the most challenging aspect for them as professionals.

The in-class and online teachers' responses to these open-ended prompts provided a useful insight into their experiences. While themes similar to those raised in the forced-choice questions emerged from teachers' narratives, some interesting differences arose between the in-class and online teachers' experiences and the perceived experiences for their students. In addition to the changes to teaching and learning that we have to expect in the online environment (e.g., changes in class structure [17], the level and types of peer-to-peer and student-teacher interactions that take place [15, 18], and the lack of "social presence" during the learning process [19, 20, 21]), the very nature of Algebra I Online program places a new emphasis on collaboration and shared classroom "space."

VI. CONCLUSIONS AND DISCUSSION

Facing demands to meet the current mandates of the NCLB Act for improving student achievement and for providing students with highly qualified teachers in every classroom, several states have turned to online learning programs for increasing student achievement and for providing effective teacher professional development in core academic areas. The Louisiana Algebra I Online initiative for eighth and ninth grade students in Louisiana is one such model. The program was designed and implemented to bring highly qualified mathematics teachers to students in places where they would not be otherwise available, to provide students with the structure of a regular class period, and to provide a unique professional development model for local teachers.

Previous research examining student data from the implementation of the Algebra I Online model found that after controlling for initial pre-intervention measures of mathematics ability, students who participated in the initiative scored as well on the posttest as students in traditional face-to-face Algebra I courses [31]. While the students in the online Algebra I course scored as well as students in the matched comparison classrooms, there were differences in their learning experiences. Though the student responded positively to the online environment, they reported lower levels of confidence in their algebra skills than students in the traditional, face-to-face algebra courses. This finding may be the result of students being unable to gauge their progress in the course because of delayed feedback and dispersed authority in the online environment. Other differences were found in the level and type of student interactions between the online and traditional instructional models. What these findings suggest is that the characteristics of the learning environment appear to alter when content is delivered online, either fully or as part of a hybrid model similar to the Algebra I Online approach.

As an extension of the investigation of student measures and their relationship between student learning outcomes, this paper examined the experiences of teachers working within the Algebra I Online model frameworks. In addition, this research explored the important question of whether teacher practices were related to student learning outcomes. Just as we saw student experiences differ, the findings presented in this paper show that teachers participated in useful professional development opportunities, experienced interesting benefits and faced new challenges through their participation in the Louisiana Algebra I Online initiative.

According to recent research and writings, some key components of effective professional development include individualizing development approaches to allow teachers to master new strategies for meeting the day-to-day challenges in their classrooms [32, 33], providing for "collaborative analysis and interpretation" of classroom experiences [34], and embedding professional development opportunities for teachers in their everyday professional lives [33]. Through its formal professional development workshops and ongoing model of mentor/mentee partnership and collaboration throughout the school year, the Louisiana Algebra I Online model espouses these key components.

The in-class and online teachers responded very positively about their experiences in the formal professional development components of the model and the in-class teachers were very positive about the year-long partnership with their mentor. Local teachers reported that the most rewarding aspect of the professional development model was having the online teacher available as a resource for content-related questions and being able to collaborate on ways to help students understand difficult concepts.

An important component for the success of educational technology initiatives, particularly one that requires substantial investments in terms of time and resources, is the level of school and district support [36]. While successful implementation of an initiative might not always lead to improved outcomes, without local support for program implementation the impact of an initiative might be jeopardized. Given the large investments in resources and support for the Algebra I Online program, it was very encouraging to see that teachers felt very positive about the resources and support available to them during the course.

It was interesting to see the ways in which the in-class and online teachers' experiences differed. For example, the two groups of teachers rated their students' interest in the online course quite differently. More in-class teachers said that the students' interest in the course was about the same, somewhat or much lower than for a traditional course than the online teachers. By way of another example, more in-class teachers reported facing challenges in the program than the online teachers. Also, the types of challenges faced differed across the two groups of teachers; the in-class teachers were more likely to report their lack of teaching experience and lack of familiarity with technology as a challenge than the online teachers. These findings are not entirely surprising since the online teachers were master teachers selected because of their excellent teaching record and their experience with technology.

Another important finding was that while each of the in-class teachers said that the program increased their algebra-related content knowledge, about one-third of the teacher perceived no benefit for their classroom teaching skills. While we can only speculate the reasons for this pattern, this finding suggests that the type of activities which the in-class teachers were required to engage in (creating an atmosphere conducive to learning, assisting students with technology, supervising and instructing the Algebra I students, working with students when problems arose, keeping the online teacher informed about individual student issues and class activities, monitoring student grades, and providing feedback on activity days) were quite different to the typical role fulfilled by a classroom teacher in the traditional face-to-face environment and so did not necessarily provide an adequate professional development model for improving general classroom teaching skills.

Since models for professional development are generally directed towards improving student outcomes and in particular, student learning outcomes, it was noteworthy that achievement was generally lower for students in classrooms where the in-class teachers reported challenges such as a lack of teaching experience or experience with technology, or reported having difficulty substantiating student participation. There were also differences in students' posttest scores according to whether teachers seldom or frequently communicated, and the differences varied according to the purpose of the communication. For example, students' posttest mean scores were higher for teachers who communicated frequently with the in-class teacher for planning lessons and for discussing individual student's work. The data also showed that students whose in-class teachers reported spending more time working with small groups of students had higher posttest scores than students whose teachers spent less time working with small groups of students.

Recognizing the limitations of the small number of teachers included in this study and the limitations of self-reported observational data, in particular for making causal inferences, the research presented here provides us with important insights into the particular characteristics of the online teaching environment and how such an environment might be used to support the professional development of teachers in regions where teacher recruitment and retention are programs. Given the vast expenditures for online programs in K–12 in recent years, we are facing a critical need for evidence-based research to inform the proliferation of online distance learning initiatives. With more than half a million elementary, middle and high school students and their teachers impacted by some form of online learning initiative during the 2004–2005 school year, it is vital that the educational community and in particular state and local decision-makers have access to high-quality research they can use to inform their ongoing investments in online learning initiatives.

Since its pilot year in 2002–2003, 57 teachers have taken part in the Algebra I Online initiative as in-class teachers. From the pool of previously uncertified local teachers, 5 earned certification in secondary mathematics, 3 earned middle school mathematics certification, and 1 earned National Board Certification in Mathematics/Early Adolescence (grades 11–15). Of the 16 in-class teachers that participated during the 2004–2005 implementation, 2 earned certification in secondary mathematics. Although there are many types of online and distance learning models available for schools and districts, the findings from this research suggest that the Louisiana Algebra I Online model may be a viable approach for providing local teachers with effective professional development opportunities that are embedded within their day-to-day teaching activities and individualized to allow them to master new strategies for meeting the challenges in their classrooms.

VII. ABOUT THE AUTHOR

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VIII. REFERENCES

1. **Smith, R., T. Clark and R. L. Blomeyer.** *A Synthesis of New Research on K–12 Online Learning.* 2005. Retrieved December 12, 2006 from http://www.ncrel.org/tech/synthesis/.
2. **Perreault, H., L. Waldman and M. A. J. Zhao.** Overcoming barriers to successful delivery of distance learning courses. *Journal of Education for Business* 77(6): 313–318, 2002.
3. No Child Left Behind Act of 2001. Pub. L. 107-110, §1606, 115 Stat. 1425, 2002.

4. **Setzer, J. C. and L. Lewis.** *Distance Education Courses for Public Elementary and Secondary School Students: 2002–03* (NCES 2005–010). U.S. Department of Education. Washington, DC: National Center for Education Statistics, 2005.
5. National Education Association. *Status of Public Education in Rural Areas and Small Towns: A Comparative Analysis.* September 1998.
6. **Beeson, E. and M. Strange.** *Why Rural Matters 2003: The Continuing Need for Every State to Take Action on Rural Education.* Washington, DC: Poverty & Race Research Action Council, 2003. Retrieved September 13, 2005 from http://www.ruraledu.org/streport/streport.html.
7. **Loomis, S. C. and M. L. Bourque (Eds.).** National Assessment of Educational Progress Achievement Levels, 1992–1998 for Mathematics. Washington, D.C.: National Assessment Governing Board, 2001.
8. **Kilpatrick, J., J. Swafford and B. Findell (Eds.).** *Adding it Up: Helping Children Learn Mathematics*. Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education, Washington, D.C.: National Academy Press, 2001.
9. **National Center for Education Statistics.** *Distance Education Course for Public Education and Secondary School Students: 2002.* Washington, D.C.: Institute of Education Sciences, National Center for Education Statistics, 2002. Retrieved September 13, 2005 from http://nces.ed.gov/surveys/frss/publications/2005010/.
10. **Southwest Educational Development Laboratory (SEDL).** Evaluation of the Algebra I Online Pilot Project: 2002–2003, 2004.
11. **Cavanaugh, C.** The effectiveness of interactive distance education technologies in K–12 learning: A meta-analysis. *International Journal of Educational Telecommunications* 17(1): 73–88, 2001. Retrieved September 13, 2005 from http://www.unf.edu/~ccavanau/CavanaughIJET01.pdf.
12. **Ungerleider, C. S. and T. C. Burns.** *Information and communication technologies in elementary and secondary education: A state of the art review.* Paper presented at the Pan-Canadian Education Research Agenda Symposium, Montreal, Quebec, 2002. Retrieved September 12, 2005 from http://www.cesc.ca/pceradocs/2002/papers/CUngerleider_OEN.pdf.
13. **Cavanaugh, C., K. J. Gillan, J. Kromrey, M. Hess and R. Blomeyer.** *The Effects of Distance Education on K–12 Student Outcomes: A Meta-Analysis.* Naperville, IL: Learning Point Associates, 2004. Retrieved December 12, 2006 from http://www.ncrel.org/tech/distance/k12distance.pdf.
14. **Stodel, E. J., T. L. Thompson and C. J. MacDonald.** Learners' perspectives on what is missing from online learning: Interpretations through the community of inquiry framework. *The International Review of Research in Open and Distance Learning* 7(3): 2006. Retrieved on January 16, 2007 from http://www.irrodl.org/index.php/irrodl/article/view/325/743.
15. **Bernard, R. M., P. C. Abrami, Y. Lou, E. Borokhovski, A. Wade, L. Wozney, P. A. Wallet, M. Fiset and B. Huang.** How does distance education compare to classroom instruction? A meta-analysis of the empirical literature. *Review of Educational Research* 74(3): 379–439, 2004.
16. **Peters, O.** Learning with new media in distance education. In M. G. Moore and W. G. Anderson (Eds.), *Handbook of Distance Education,* 87–112. Mahwah, NJ: Erlbaum, 2003.
17. **Paloff, R. M. and K. Pratt.** *Lessons From the Cyberspace Classroom: The Realities of Online Teaching.* San Francisco: Jossey-Bass, 2001.
18. **Lally, V. and E. Barrett.** Building a learning community online: Towards socio-academic interaction. *Research Papers in Education* 14(2): 147–163, 1999.
19. **Bibeau, S.** Social presence, isolation, and connectedness in online teaching and learning. From the literature to real life. *Journal of Instruction Delivery Systems* 15(3): 35–39, 2001.
20. **Aragon, S. R.** Creating social presence in online environments. *New Directions for Adult and Continuing Education* 100: 57–68, 2003.
21. **Garrison, D. R. and M. Cleveland-Innes.** Facilitating cognitive presence in online learning: Interaction is not enough. *American Journal of Distance Education* 19(3): 133–148, 2005.
22. **Lockyer, L., J. Patterson and B. Harper.** ICT in higher education: Evaluating outcomes for health education. *Journal of Computer Assisted Learning* 17: 275–283, 2001.

23. **Neuhauser, C.** Learning style and effectiveness of online and face-to-face instruction. *American Journal of Distance Education* 16(2): 99–113, 2002.
24. **Thirunarayanan, M. O. and A. Peres-Prado.** Comparing web-based and classroom based learning: A quantitative study. *Journal of Research on Technology in Education* 34(2): 131–137, Winter 2001–2002.
25. **Allen, M., J. Bourhis, N. Burrell and E. Mabry.** Comparing student satisfaction with distance education to traditional classrooms in higher education: A meta-analysis. *American Journal of Distance Education* 16(2): 83–97, 2002.
26. **Sherry, A. C., C. P. Fulford and S. Zhang.** Assessing distance learners' satisfaction with instruction: A quantitative and qualitative measure. *American Journal of Distance Education* 12(3): 4–28, 1998.
27. **Navarro, P. and J. Shoemaker.** Performance and perceptions of distance learners in cyberspace. *American Journal of Distance Education* 14(2): 15–35, 2000.
28. **Muilenburg, L. and Z. L. Berge.** Barriers to distance education: A factor-analytic study. *American Journal of Distance Education* 15(2): 7–22, 2001.
29. **Smith, P. L. and C. L. Dillion.** Comparing distance learning and classroom learning: Conceptual considerations. *American Journal of Distance Education* 13(2): 6–23, 1999.
30. **Cooper, L.W.** A comparison of online and traditional computer applications classes. *Technological Horizons in Education* 28(8): 52–58, 2001.
31. **O'Dwyer, L. M., R. Carey and G. Kleiman.** A study of the effectiveness of the Louisiana Algebra I Online Course. *Journal of Research on Technology in Education* 39(3): 2007.
32. **Sparks, D. and S. Hirsh.** *A National Plan for Improving Professional Development*. National Staff Development Council, 2000. Retrieved April 19, 2006 from http://www.nsdc.org/library/authors/NSDCPlan.cfm.
33. **Lock, J. V.** A new image: Online communities to facilitate teacher professional development. *Journal of Technology and Teacher Education* 14(4): 663–678, p.669, 2006.
34. **Cochran-Smith, M. and S. L. Lytle.** Beyond certainty: Taking an inquiry stance on practice. In A. Lieberman and L. Miller (Eds.), *Teachers Caught in the Action: Professional Development that Matters*, 45–58. New York, NY: Teachers College Press, 2001.
35. **Kleiman, G., R. Carey, E. Halsted and L. M. O'Dwyer.** *A Study of the Effectiveness of the Louisiana Algebra I Online Project Final Report.* Boston, MA: Center for Online Professional Education, Educational Development Center, 2005.
36. **O'Dwyer, L.M., M. Russell and D. J. Bebell.** Identifying teacher, school and district characteristics associated with elementary teachers' use of technology: A multilevel perspective. *Education Policy Analysis Archives* 12(48): September 14, 2004. Retrieved September 14, 2004 from http://epaa.asu.edu/epaa/v12n48/.

LEARNING SCIENCE ONLINE: A DESCRIPTIVE STUDY OF ONLINE SCIENCE COURSES FOR TEACHERS

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TERC

ABSTRACT

Online education is a rapidly growing phenomenon for science teachers. Using a sample of 40 online science courses for teachers offered during the 2004–2005 academic year, the Learning Science Online (LSO) study examines the nature and variety of instructional methods and activities as well as communication, and students' perceptions of supports within the course. This research is unique in that it is the first aggregate study of online science courses offered by a wide variety of educational programs. Descriptive analyses suggest the instructional methods employed in online science courses for teachers include frequent use of online discussions and students participated in minds-on activities, including articulation and reflection on their scientific ideas, posing questions, analyzing data, and drawing conclusions from evidence. Hands-on instructional activities were rarely used, and pen-and-paper and collaborative instructional activities were occasionally used. Technology was used primarily for communications such as discussion boards, email, and chat, but there were very few other computer-based tools used within the courses. Students felt supported by instructors, other students, and the course design.

KEYWORDS

Science Education, Online Learning, Asynchronous Learning, Teacher Professional Development

I. INTRODUCTION

Online education is a rapidly growing industry [1, 2, 3] that suits the needs of many teachers by addressing issues of geographical remoteness, limited offerings by institutions, and their complex lives [4]. The teacher professional development community discovered early that online programs could offer "anytime, anywhere" education for working science teachers [5], and today there are entire master's degree programs online for science teachers. Teachers take these courses not only to improve their content knowledge, but also for professional certification and advancement. There are relatively few studies examining online science learning [6] and none to date that have examined more than a few courses.

Beginning in 2004, the Learning Science Online project has studied 40 online science courses designed for teachers to ask questions about (a) who takes online courses for teachers, (b) who teaches them, (c) who delivers them, and (d) what does teaching and learning look like in these courses as well as (e) what characteristics of these courses correlate with student performance. This paper focuses on the nature of teaching and learning in these courses.

II. REVIEW OF RELEVANT LITERATURE

LSO builds upon research in science education, teacher professional development, and online learning. At the intersection of these fields lies a wealth of interesting questions about instructional methods, communication, and supports for students.

A. Instructional Methods

As education moves to an online environment, some traditional methods of instruction may be jeopardized by lack of immediacy with the instructor and students. Faculty may begin online science education with the idea that if they place their notes online and have a mechanism to exchange problem sets and exams with students that students will learn effectively [7]. Alternatively, a large body of literature describes online learning environments as conducive to different types of learning strategies such as critical thinking, reflection, and active participation [8, 9, 10, 11] and typically rooted in social constructivist learning theories [12]. Social constructivism also is the premise of many of the core principles for science teacher professional development outlined in the national standards [13] and driving research on science teacher professional development [14]. These learning principles promote science teacher professional development that immerses teachers as students within a community of scientific inquiry where they actively investigate phenomena that can be studied scientifically, interpreting results and making sense of findings consistent with currently accepted scientific understanding. They state that these experiences should also incorporate ongoing reflection on the process and outcomes of understanding science through inquiry, and encourage and support teachers in efforts to collaborate [13].

As learners of science engage in a community of scientific inquiry, students must articulate their ideas, defend them with evidence, and provide reasoning for the ongoing changes in their mental models [15]. Asynchronous discussion boards may provide unique opportunities for scientific inquiry due to their text-based, asynchronous, and archivable nature. Written discussion forces students to make their thinking visible to themselves, as well as others, which raises students' level of interaction with the content at hand. In addition, students' writing is typically available for review long after the time of posting, so it becomes a source of reflection or referral for the learner and others. The asynchronous nature of discussion boards builds in natural "wait-time". Learners can respond to questions or comments whenever they are comfortable in doing so and can pace themselves as they read other students' ideas before articulating their own. This built in wait time has been suggested as a benefit of online learning that allows participants the opportunity to provide a thoughtful response to questions [16].

Laboratory instruction has been a particular question for online science education. America's Lab Report [17] explains that the effectiveness of even face-to-face laboratory instruction on learning is not well known because of lack of meta-studies of any significance, so they strongly call for more research including the use of emerging technologies in this area. A study of a virtual chemistry laboratory program [18] used with undergraduates show that a majority of the students felt that an online lab in organic chemistry allowed them to focus on the "why" of the actual chemistry rather than the instructions to perform techniques. In this same study, however, a majority of students reported that they did not learn any chemistry from completing the assignments used in the online lab environment, reporting instead that all of their chemistry knowledge came from in-person laboratory experiences. A study of an online master's program in science education [19] compared an online course to an analogous face-to-face course to study the frequency of students' reflections on their own learning process, teaching strategies, and the nature of the science content learned. These students frequently partook in hands-on "kitchen" experiments, before which they made predictions and then asked to articulate, reflect, and revise their theories as they gathered evidence through their experimentation. The analysis of online asynchronous discussions and videotape of analogous classroom discussions showed that the online participants demonstrated more reflection and articulation about their own science learning and the process of inquiry than did their on-campus counterparts. This study also found a greater change in science understanding (as measured through pre- and post- thought experiments) in the online participants, and they were shown to have more confidence in teaching inquiry than the on-campus participants did.

B. Communication

The nature of communication in online learning environments may be very different than face to face environments, as has been shown in many settings as computer mediated communication (CMC) has replaced face-to-face contact. The lack of social context cues in e-mail in some settings has been shown to lead to uninhibited communication such as hostile and intense language (i.e., flaming), greater self-absorption, and a resistance to defer speaking turns to higher-status participants [20]. In other CMC studies, users rated text-based media, including e-mail and computer conferencing, as equally rich or richer than telephone conversations and face-to-face conversations [21]. The asynchronicity of discussion boards is argued to be an important factor in metacognition for learners in online environments. Because a student may take their time to digest a question and formulate a response, and those responses are archived for later viewing, it is believed that this may promote reflection and thus deepen the learning [22].

Communication plays a key role in many online learning theories that tend toward social constructivism, where emphasis is placed on student interactions within a group rather than an instructor-led learning experience. The lack of visual cues such as seating arrangements and eye-contact provide a different quality to the social and teaching presence [23, 24] within a class, which may encourage students to take more or less of a lead in their own learning. Evidence of such a shift in roles might be found in online discussions, if students have more of a role in choosing topics for discussion and participate frequently in the discussions themselves. The participation of many students in communication may be an indicator of a learning environment where students take an active role in their learning, while discussions which are dominated by the instructor or only a few students may indicate that there are many passive students in the course who may or may not be engaged in learning. The amount of interactivity, or quantity and quality of interactions, in online discussions has been shown to correlate positively with performance on written assignments for the course [25]. The same study cautions that students' perceptions of their level of interactivity was not a good predictor of students actual participation.

C. Perceived Support

Students' perceptions about the support they receive from the instructor, other students, and the course environment itself may affect their participation in the course and thus potentially affect their learning. Within rich learning environments, students may benefit from many levels of support, particularly if there is coherence among the supports from course materials, instructor facilitation, and a peer group or learning community.

Course design takes on a whole new meaning in online education. As opposed to a face-to-face instructor, who has the option of waiting until the night before to prepare lecture notes or possibly "winging it" once they arrive at class, an online instructor typically must design and develop materials all in advance so that they are available from the beginning of the course. This may, as a fortunate by-product, force some overall course coherence and structure into the course design. Online courses may also distinguish the role of instructional designer from that of facilitator and have two (or more) different people do the two tasks. Online course design involves designing instructional methods and organizing materials to help students make meaning from the course content, allowing sufficient time for and placing high priority on online discussions and interactions, building a sense of community among students, and generally setting a climate for learning [26, 27].

The course designer and/or instructor also typically choose the types of learning tools used in the course. The very existence of many online science courses for teachers is a testament to the rapid adoption of many new technologies, some of which may provide new ways to enhance students' construction of conceptual knowledge. Tools often associated with online course environments include email, asynchronous discussion boards, synchronous chat rooms, assignment dropboxes (sometimes with feedback areas), grading books, calendars, and sometimes whiteboards or other graphic sharing tools. Generally speaking, web-based courses also may easily link to external web learning objects such as computer simulations, visualization software, and interactives. Some of these tools have been unexploited because of high-speed connectivity issues for many users, but as broadband Internet usage soars [28], designers will have a suite of tools to choose from, in order to make the most appropriate learning environment for the task at hand.

The role of the instructor has always been of question in distance education. Early models that adopted traditional designs for learning had students working on their own with instructors responding only when they were asked for help [29]. Most current online learning models are based upon a strong belief that the presence of an instructor is tremendously important to the learning experience, either face-to-face or online, but with different roles. In online learning, an instructor is seen as more of a facilitator who guides student learning using strategies such as open-ended questions and summarizing comments from messages posted in a discussion [8]. Instructors are seen as vital to synthesizing distributed knowledge and guiding groups toward deeper insights [30] as well as knowing when to push individuals and groups further and when to step in to offer help to participants in constructing new knowledge [31]. An increasing number of studies show that instructors' behaviors of immediacy, such as using humor to break the ice, providing and inviting feedback from students, and addressing students directly by name, all help to provide a presence that is positively associated with student learning and satisfaction [32, 33]. It has also been noted [34] that faculty who choose to teach asynchronously tend to value their students as lifelong learners and value learning as an active, constructive process that depends on teamwork and cooperation. In a model of a community of inquiry often used in online settings, direct instruction is also stated to play a role [35]. This model describes teaching presence as a combination of course design, facilitation, and direct instruction. The skilled online instructor not only knows how do each of these well, but provides a sense of balance and coherence among them.

A number of studies have shown the perception of interpersonal connections with peers to be an important factor in the success of online learning [36-40]. Social interaction provides opportunities to make internal thought processes public, or *make thinking visible*, which is seen as a prerequisite for knowledge building [41]. In a social learning environment, where knowledge is constructed as part of a group, the support of other students in the group is vital to encourage learners to take risks, pose questions, ask for clarification, and share their ideas with the group. In studies of online professional development seminars for math teachers, a sense of community was found to be important to participants, as participants appreciated being part of a group of colleagues with similar interests, having a support system, and reading other students' ideas [42]. Some have suggested a sense of "hyperpersonalness" of online discussion [21]. Students enrolled in an online graduate course in education were asked about their perceived social presence, or sense of belonging, and those data were compared with their performance on tests and written assignments. While there were no significant differences between groups with different levels of social presence on test scores, the group reporting higher social presence scored higher on written assignments than those in the lower social presence group [25].

III. RESEARCH QUESTIONS

There is a large body of literature that suggests online learning environments are well-suited to social constructivist learning environments, or communities of scientific inquiry, as called for by the national standards in professional development for science teachers. Research shows, however, that many novice online course developers have major misconceptions about the pedagogy that produces effective online learning [43]. This is not surprising since so little is known about online practices on a large scale, and in particular in science learning online.

Some instructors still believe that delivering an online course just means replicated course notes and exams online [7]. The developers of online learning software, on the other hand, advertise many features within their products such as data sharing tools and whiteboards, libraries of learning modules, and even immersion experiences within virtual worlds. As online learning becomes a stronger presence in the educational arena, more research is needed to understand the nature of how the technology is being used and which tools are more or less conducive to learning. The communication and supports within an online course become central to the climate of the course. When students perceive a safe and friendly environment, they will become more active participants in their own learning [8]. Understanding the extent to which students perceived support from their instructors, other students, and the course design will provide a picture of the climate within each course and how it describes a model that may be conducive to the social construction of knowledge. Examining the dynamics and nature of the communication within the course will enable us to search for evidence of changing (or unchanging) roles between students and instructors as well as look for conditions believed to be conducive to social construction of knowledge.

In order to understand how online environments are actually being used to deliver science courses for teachers, LSO has asked:

- *What types of instructional methods are used in online science courses for teachers?*
- *What is the nature of communication between students and instructors in online science courses for teachers?*
- *What is the extent of support perceived by students from their instructors, other students, and the course environment?*

IV. METHODOLOGY

Learning Science Online (LSO) is a mixed-method longitudinal study of 40 online science courses for K–12 teachers offered during the 2004–2005 academic year. LSO collected data from three types of participants: program coordinators at institutions offering courses, course instructors, and students. Participants at all levels were informed that the purpose of this study was to learn about the nature of all online science courses for teachers rather than the evaluation of their specific course.

A. Courses

To ensure a sufficient level of uniformity, courses were sought that met the following criteria:

- At least one graduate credit is offered for the course;
- Science content is the primary focus of the course (as opposed to instructional methods);
- Course requires some interaction among students and between instructor and students, which occurs primarily, but not necessarily exclusively, online via discussion boards, e-mail, chat

rooms, or other electronic media (excluding TV monitors).

Of the 60 courses we found meeting these criteria, 45 participated in the study and 40 of those were unique course (five were courses that were re-offered for a second time within the study period), giving an overall participation rate of 75 percent.

Six programs hosted the online courses in this study. Three programs were administered by educational nonprofit institutions and the other three were administered by universities—either within an academic department or through a continuing education or distance education program. Courses in any of these programs may have contributed to a master’s degree, but only two programs offered online master’s degrees themselves. Courses are described in terms of their duration, credits offered, content areas, affiliation with a master’s degree program, and audience for the course in Table 1. The typical course in this study was a biology/life sciences course of 12–14 weeks in duration, offered for 3 graduate credits, affiliated with a master’s degree program and designed specifically for high school science teachers. All except one course in this study was offered through a pre-existing online course platform—WebCT, Blackboard, or eCollege.

Two programs, one university and one nonprofit, are no longer offering the courses in this study. The remaining four programs vary in their level of self-sustainability. The online programs at the nonprofit institutions depend upon the support of their parent organization. At the universities, one online program is completely self-sustainable and profitable while the other is still supported through grants.

Course Characteristics	**Number of Courses**	**Percentage of Courses**
Maximum Number of Credits		
1 credits	1	3%
2 credits	9	23%
3 credits	26	65%
4 credits	4	10%
Affiliation with Masters program		
Part of a Masters program	26	65%
Independent of a Masters program	14	35%
Content areas of course		
Astronomy	5	13%
Biology/Life Science	28	70%
Chemistry	5	13%
Earth/Space Science	14	35%
Environmental Science	13	33%
Physics	7	18%
Science Education	13	33%
Other	9	23%
Audience of course		
Elementary school	9	23%
Middle school	18	45%
High School	30	75%
Unidentified level	7	18%
Duration		
5 weeks	11	28%
6 weeks	2	5%
12 weeks	16	40%
14 weeks	9	23%
16 weeks	1	3%
17 weeks	1	3%

NOTE: Percentages may not sum to 100 because participants were instructed to select all that apply. "Content areas of course" refers to any content area the instructor identified as being included in the course. "Level of course" refers to the grade level focused on as identified by the host institution. "Duration" calculations are based on the start and end dates provided by the host institution.

Table 1. Number and Percentage of Courses by Number of Credits, Affiliation with a Masters Program, Content Area, Grade Level, and Duration

B. Instructors

Program coordinators identified the following criteria when selecting instructors for their courses: strong science background; K–12 teaching experience; teacher professional development experience; university teaching experience; and, to a lesser extent, publication record, schedule flexibility, and online teaching experience. Many instructors were selected from a pool of current and retired colleagues. None of the programs reported a formal recruitment process, although most said they had turned away unsolicited requests to teach online courses.

A total of 35 unique instructors participated in this study. Table 2 describes these instructors in terms of their gender, age, their highest degree earned, whether they taught the online course through a university or nonprofit institution, and their appointment at that institution. The typical instructor in this study was a 50–59 year old white male with a science Ph.D. teaching the online course through a university science department *without* a regular faculty appointment in that department. Over two-thirds of the instructors had earned a doctorate, with 88 percent of those degrees in a science field. The majority of the instructors with a bachelor's or master's degree as their highest degree were graduate students working toward higher degrees. More than twice as many instructors do *not* have regular faculty appointments (assistant, associate, full, or emeritus professor) as do have them, with instructors at universities more likely to hold regular faculty appointments than instructors at nonprofit institutions ($t=-4.71$, 24 d.f., $p<0.001$). Programs varied in how instructors are compensated and, in universities, whether online courses are considered part of their teaching load or as overload.

Instructors' experience specifically teaching online could influence the design and implementation of their courses. Most instructors had taught online prior to teaching their current courses, although a third of the instructors had taught only their current course online. Half of the instructors reported some type of formal facilitation training, with all of the nonprofit instructors (n=10) and a third of the university instructors (n=7) reporting such training ($t=-7.14$, 24 d.f., $p<0.0001$).

Instructor Characteristics	Percentage of: All Instructors (n=35)	Nonprofit Instructors (n=10)	University Instructors (n=25)
Male Instructors	63%	40%	72%
Caucasian	97%	90%	100%
Age			
Less than 30 years old	3%	0%	4%
30-39 years old	14%	30%	8%
40-49 years old	11%	10%	12%
50-59 years old	40%	20%	48%
60-69 years old	23%	20%	24%
70-79 years old	9%	20%	4%
Highest Degree Earned			
Bachelor's	9%	10%	8%
Master's	23%	60%	8%
Doctorate	69%	30%	84%
Type of appointment			
No appointment at this institution	23%	50%	12%
Instructor/Lecturer	26%	40%	20%
Adjunct professor	11%	10%	12%
Assistant professor	0%	0%	0%
Associate professor	17%	0%	24%
Full professor	9%	0%	12%
Professor emeritus	9%	0%	12%
Other appointment	6%	0%	8%
Have regular faculty appointment	26%	0%	36%

NOTE: Regular faculty appointments are the assistant, associate, full, and emeritus positions.

Table 2. Percentage of Instructors by Gender, Race, Age, Highest Degree Earned, Type of Appointment Overall and by Program Type

Instructors were asked to identify which of the following content areas were included in their course: (a) Astronomy; (b) Biological/Life Sciences; (c) Earth/Space Science; (d) Environmental Science; (e) Physics; (f) Science Education; and (g) Other science or education. Of interest here is the match between the educational background of the instructors and the science content of the courses they are teaching (see Table 3).

Content areas included in course	**Number of Courses**	**Percentage of courses taught by instructors with the following degrees in that content area**			
		Bachelors	**Masters**	**Doctorate**	**No Degree in Content Area**
Biology/Life Science	31	65%	45%	45%	19%
Earth/Space Science	15	20%	7%	20%	73%
Physics	7	14%	14%	0%	86%

NOTE: Percentages may not sum to 100 because participants were instructed to select all that apply. Biology/Life Science includes courses with content in biology/life science and environmental sciences. Earth/Space Science includes courses with content in astronomy and Earth/space science.

Table 3. Number and Percentage of Instructor Fields of Study by Content Area of the Course(s) they are Teaching in the Study

Out-of-field teaching was least common in the biological/life sciences and more common in earth/space sciences and physics. Eighty-one percent of the instructors teaching biology/life sciences courses had a degree in the biological sciences. The remaining 19% of instructors of biology/life science courses had degrees in chemistry, Earth/space sciences, or science education. Only four of the courses with Earth/space science content were taught by an instructor with a degree in that content area. Instructors with degrees in biological and life sciences taught seven of those other eleven courses. Seven courses with physics content were offered, with one instructor reporting a bachelor's and master's degree in physics. Half of the instructors of these courses had degrees in other science fields and half had degrees in science education.

C. Students

Of the almost 800 students enrolled in the 40 online science courses in this study, 90% completed their courses. Instructors reported 735 students were enrolled in these 40 courses at the end of the add-drop period—two-thirds of whom were female. Forty percent of the students in these courses (n=296) completed the pre- and post-questionnaires as part of this study. While this student response rate is not ideal, it exceeds the response rate of other studies of online education [2]. Of the 296 students in this study, 46 students were taking more than one courses in this study. Student demographics are reported for the 250 unique students while course-specific data include all students.

The low student response rate suggests the perspectives of these students may be selective in unknown ways. One third of those students completing the pre- and post-questionnaires were male and two thirds were female. There was no difference in the student participation rates by gender in the study. Students who performed better in their courses were more likely to have participated in this study—45% of those who received As completed pre- and post-questionnaires versus 39% of those receiving Bs, 17% receiving Cs, and 7% of those who failed, received an incomplete, or withdrew from the course. This suggests the data from students are more representative of those who performed well in their course than of those who did not.

Reflecting the institutions delivering these 40 online courses, almost two-thirds of the students (n=156) took their online course through a university program and one-third took their course through a nonprofit program (n=94). Table 4 describes demographic characteristics of these students.

Student Characteristics	Percentage of All Students (n=250)	Students in nonprofit courses (n=94)	Students in university courses (n=156)
Female Students	64%	71%	60%
Race			
Asian	1%	0%	2%
Black or African-American	4%	4%	4%
Hispanic or Latino	1%	2%	1%
White	91%	90%	91%
Not reported	2%	2%	1%
Age			
25-35 years	25%	20%	28%
36-45 years	32%	34%	31%
46-55 years	24%	21%	26%
56-65 years	17%	21%	14%
65+ years	1%	3%	0%
Bachelor's Degree in Science	66%	57%	71%
10+ Years Science Teaching Experience			
Yes	21%	22%	20%
No	62%	63%	62%
Never taught	17%	15%	18%

NOTE: Students who took more than one course are included once in this table with one exception--four students who took courses in two programs are counted twice.

Table 4. Percentage of Students by Gender, Race, Age, Whether or not they have a Bachelor's Degree in Science, and Whether or not they have more than 10 Years of Science Teaching Experience

The typical student in these online courses were white females with a bachelor's degree in a science field who were middle or high school science teachers with 10 or fewer years teaching experience. Students in university courses were significantly more likely to have earned a bachelor's degree in a science field than were students in nonprofit courses (X^2=4.91, 1 d.f., p=0.0267). Among the 296 students participating in this study, this was the first online course for a quarter of them (n=72).

In summary, a total of 35 instructors and 250 unique students from 40 unique courses delivered by 6 institutions participated in this study.

D. Data Sources

Instructors' and students' pre- and post-course questionnaires were developed and tested with focus groups and piloted in four online courses during the summer of 2004. All questionnaires were administered online. Instructor and student pre-questionnaires collected demographic information such as their highest degree earned, fields of study, teaching experience, experience with online courses, and their expectations about the course.

To measure instructional methods employed in online science courses for teachers, we developed a set of survey items based on the measure of reform-based instruction in K–12 science classrooms developed by Borko and her colleagues [44]. Although Borko's constructs were developed to examine children's learning, many of their principles are compatible with the call for new methods of professional development for teachers. This framework has many parallels to NSES standards [13]; it utilized detailed rubrics in classroom observations with moderate to high levels of inter-rater agreement. Constructs particularly relevant for measuring reform-based science instruction in online courses for teachers include:

- **Hands-On:** The extent to which learners are interacting with physical materials or models to learn science.
- **Minds-On:** The extent to which learners participate in activities that engage them in wrestling with scientific issues and developing their own understanding of scientific ideas.
- **Collaborative Grouping:** The extent to which a series of lessons uses learner groups to promote learning.

Questions about the use of common instructional methods for science (e.g., completing problem sets, reading textbooks) as well as those unique to online courses (e.g., online discussion boards, simulations) were also included so as to cover the potential range of instructional methods used in these courses. Instructors were asked about the frequency with which students were expected to participate in each instructional activity and their expected usage of specific instructional materials (e.g., books, web readings, calculators, images). In addition to questions about instructional methods and materials, instructor and student post-questionnaires focused on overall course characteristics such as:

- the perceived level of **intellectual difficulty** of course materials,
- the frequency and nature of **assessment;**

as well as the nature of communication and dynamics in the course, including:

- frequency and nature of **communication between instructor and students,**
- frequency and nature of **communication among students,**
- control and dynamics within **online discussions,**
- perceived level of **support** from instructor, other students, and course design.

These pre- and post-questionnaires are the primary data sources for this study. Interviews were also conducted with program coordinators to understand how instructors were recruited, hired, and compensated and to understand the position of the programs within the larger institutions in terms of support provided and self-sustainability.

E. Data Analysis

The descriptive analyses presented in this paper require comparisons of means and distributions of responses. Standard statistical tests such as t-tests and chi-square tests were used. In cases when a large number of statistical tests were used on the same variables, a Scheffe test was employed to control the amount of Type I error across the t-tests. Cronbach's alpha, a measure of internal consistency of a set of items, are reported for each of the instructional method's scales.

V. RESULTS/FINDINGS

The findings are organized around the central research questions about the nature of teaching and learning in these online science courses for teachers:

- *What types of instructional methods are used in online science courses for teachers?*
- *What is the nature of communication between students and instructors in online science courses for teachers?*
- *What is the extent of support perceived by students from their instructors, other students, and the course environment?*

A. What Types of Instructional Methods are Used in Online Science Courses for Teachers?

Instructors were asked how frequently they expected students to engage in 23 types of instructional activities and 11 types of instructional materials likely to be found in online science learning environments. Half of these items clustered into four constructs—(1) Pen-and-paper, (2) Hands-on, (3) Minds-on, and (4) Collaborative activities (see Tables 5–8 for specific items). The internal consistencies of all constructs ranged from alphas of 0.62 (pen and paper) to 0.87 (collaborative activities). The remaining 17 instructional activities did not cohere with any one of these constructs (see Table 9).

1. Pen-and-Paper Instructional Methods

Pen-and-paper methods, typical of direct instruction, were not absent from online courses, nor did they dominate the pedagogy. Table 5 shows that most instructors expected their students to occasionally engage with pen-and-paper instructional activities. The most common instructional materials used were hard-copy books, with half of the instructors expecting students to use them at least once a week. The least common pen-and-paper instructional material was calculator usage, with only 20 percent of instructors expecting students to use them at any time during the course.

Pen & Paper Activities & Materials	Percentage and Number of Instructors Expecting Students to Engage in the Activity or With Course Materials					
	Not at All	**Once or Twice During the Course**	**Once or Twice a Month**	**Once or Twice a Week**	**Three Times a Week or More**	**Mean**
Books	33% (13)	10% (4)	3% (1)	35% (14)	20% (8)	**3.0**
Worked with pen and paper problem sets (e.g., problems from a textbook or worksheet)	53% (21)	23% (9)	10% (4)	15% (6)	3% (1)	**2.0**
Calculators	80% (32)	13% (5)	5% (2)	3% (1)	0% (0)	**1.3**

N=40 instructors.

NOTE: Scale goes from 1=not at all to 5=three times a week or more in this course.

Table 5. Percentage and Number of Instructors Reporting on their Expectations for Student Engagement with Pen-and-paper Instructional Methods

2. Hands-on Instructional Methods

Perhaps because of the amount of instructional time each hands-on activity requires or because they are typically done in group settings, most instructors rarely expected students to engage with hands-on instructional activities or materials in these online courses (see Table 6). Mean frequencies ranged from 1.6 to 1.9, suggesting that most students engaged with these activities at most once or twice during the course, if at all.

Hands-on Activities & Materials	Percentage and Number of Instructors Expecting Students to Engage in the Activity or With Course Materials					
	Not at All	**Once or Twice During the Course**	**Once or Twice a Month**	**Once or Twice a Week**	**Three Times a Week or More**	**Mean**
Designed their own scientific investigation(s) (e.g., developed hypothesis or question and procedure	45% (18)	33% (13)	13% (5)	10% (4)	0% (0)	**1.9**
Carried out procedures of scientific investigations designed by instructors or course developers (e.g., lab exercises, kitchen experiments)	60% (24)	15% (6)	10% (4)	10% (4)	5% (2)	**1.9**
Interacted with physical materials or models (e.g., mixing solutions, building circuits, scale models)	63% (25)	15% (6)	10% (4)	13% (5)	0% (0)	**1.7**
Carried out procedures of scientific investigations they designed (e.g., collected data, made observations)	63% (25)	25% (10)	8% (3)	5% (2)	0% (0)	**1.6**

N=40 instructors.

NOTE: Scale goes from 1=not at all to 5=three times a week or more in this course.

Table 6. Percentage and Number of Instructors Reporting on their Expectations for Student Engagement with Hands-on Instructional Activities and Materials

3. Minds-on Instructional Methods

As Table 7 reveals, these online science courses for teachers made frequent use of minds-on instructional activities, with the most common activity being articulating their scientific ideas in an online discussion (95 percent of instructors expecting this at least once a week). The least common minds-on activity was analyzing and drawing conclusions from data and observations, with an average frequency of once or twice a month.

Minds-on Activities & Materials	Percentage and Number of Instructors Expecting Students to Engage in the Activity or With Course Materials					
	Not at All	Once or Twice During the Course	Once or Twice a Month	Once or Twice a Week	Three Times a Week or More	Mean
Articulated their scientific ideas in an online discussion.	0% (0)	5% (2)	0% (0)	40% (16)	55% (22)	**4.5**
Reflected upon the scientific ideas of other students.	0% (0)	3% (1)	10% (4)	53% (21)	35% (14)	**4.2**
Raised questions with other students about their scientific ideas.	0% (0)	8% (3)	15% (6)	53% (21)	25% (10)	**4.0**
Reflected upon their earlier scientific ideas	0% (0)	10% (4)	33% (13)	43% (17)	15% (6)	**3.6**
Provided evidence to support their scientific ideas.	8% (3)	10% (4)	20% (8)	50% (20)	13% (5)	**3.5**
Analyzed and drew conclusions from data, observations, and other forms of scientific evidence	13% (5)	25% (10)	25% (10)	25% (10)	13% (5)	**3.0**

N=40 instructors.

NOTE: Scale goes from 1=not at all to 5=three times a week or more in this course.

Table 7. Percentage and Number of Instructors Reporting on their Expectations for Student Participation in Minds-on Instructional Methods

4. Collaborative Instructional Methods

Students were occasionally expected to engage in collaborative instructional activities (see Table 8). The most common collaborative activity was participating in student groups created to discuss course content, which instructors expected students to participate in an average of once or twice a month. The least common collaborative activity, perhaps because of the amount of time it takes to complete, was group work on projects or assignments that occur an average of once or twice during the course. Participating in students groups to complete group or individual assignments or to review each other's work occurred once or twice a month.

Collaborative Activities & Materials	Percentage and Number of Instructors Expecting Students to Engage in the Activity or With Course Materials					
	Not at All	Once or Twice During the Course	Once or Twice a Month	Once or Twice a Week	Three Times a Week or More	Mean
Participated in student groups created to discuss course content	33% (13)	13% (5)	3% (1)	23% (9)	30% (12)	**3.1**
Participated in student groups created to complete assignments or activities	38% (15)	18% (7)	18% (7)	10% (4)	18% (7)	**2.5**
Participated in student groups created to review each otherÕs work	58% (23)	13% (5)	13% (5)	10% (4)	8% (3)	**2.0**
Worked as part of a team on group projects or assignment	43% (17)	13% (5)	13% (5)	15% (6)	18% (7)	**1.5**

N=40 instructors.

NOTE: Scale goes from 1=not at all to 5=three times a week or more in this course.

Table 8. Percentage and Number of Instructors Reporting on their Expectations for Student Participation in Collaborative Instructional Methods

5. Other Instructional Methods

Nearly all of the remaining 17 instructional activities or materials were initially included in one of the four constructs (e.g., pen-and-paper, hands-on, etc.), but were dropped. They did not enhance the internal consistency of the scale because they were either (a) virtually non-existent in the courses or (b) so prevalent that they could have been used to support more than one instructional methodology (and did not cohere with just one). Instructors in at least half of the courses reported that at least once a week students were expected to:

- Read/listen to other students' posts
- Respond to other students' posts
- Use web-based readings
- Read/listen to instructor posts
- Use web-based images
- Respond to instructor posts

On the opposite end of the frequency continuum, at least half of the instructors reported that their students were never expected to:

- Use video files
- Use computer-based animations, games, or simulations (e.g., virtual dissection, SimEarth, flash interactives)
- Use presentation software
- Use physical materials
- Use interactive computer modules

- Use graphing and data analysis tools
- Articulate their scientific ideas in a journal
- Participate in on-site fieldwork (e.g., water testing, species counting in a natural setting, astronomical observations of the night sky)
- Use spreadsheets
- Use audio files
- Interact with professional scientists (e.g., site visits)
- Participate in student groups created to prepare for tests
- Visit professional scientific environments (e.g., labs)

Instructional activities that varied in their use across courses include:

- Read professional scientific publications (e.g., journals, periodicals)
- Worked on problems based in contexts from their daily life

Combined, these other instructional activities and materials paint a picture of courses that made frequent use of online discussion boards (with participation in discussions accounting for more than 20% of the final course grade in 64% of the courses), but not many other online technologies. The use of other science education methods, such as pen-and-paper problems, collaborative activities, use of authentic contexts, and review of scientific literature, varied among the courses. Students were expected to participate frequently in minds-on activities such as articulating and reflecting on their scientific ideas and those of others, but rarely in hands-on activities. The use of pen and paper activities and collaboration varied among courses.

Other activities and materials	Percentage and Number of Instructors Expecting Students to Engage in the Activity					
	Not at All	Once or Twice During the Course	Once or Twice a Month	Once or Twice a Week	Three Times a Week or More	Mean
Read/listened to other studentsÕ posts	0% (0)	3% (1)	0% (0)	40% (16)	58% (23)	**4.5**
Responded to other studentsÕ posts	0% (0)	3% (1)	5% (2)	50% (20)	43% (17)	**4.3**
Web-based readings	0% (0)	3% (1)	8% (3)	33% (13)	58% (23)	**4.5**
Read/listened to instructor posts	0% (0)	3% (1)	3% (1)	63% (25)	33% (13)	**4.3**
Images	5% (2)	8% (3)	5% (2)	38% (15)	45% (18)	**4.1**
Responded to instructor posts	3% (1)	5% (2)	13% (5)	63% (25)	18% (7)	**3.9**
Read professional scientific publications (e.g., journals, periodicals)	15% (6)	18% (7)	23% (9)	35% (14)	10% (4)	**3.1**
Worked on problems based in contexts from their daily life	20% (8)	28% (11)	33% (13)	13% (5)	8% (3)	**2.6**
Video files	50% (20)	20% (8)	10% (4)	10% (4)	10% (4)	**2.1**
Used computer-based animations, games, or simulations (e.g., virtual dissection, SimEarth, flash interactives)	53% (21)	23% (9)	5% (2)	13% (5)	8% (3)	**2.0**
Presentation software	50% (20)	35% (14)	13% (5)	3% (1)	0% (0)	**1.7**
Physical materials	63% (25)	23% (9)	3% (1)	13% (5)	0% (0)	**1.7**
Interactive computer modules	68% (27)	15% (6)	13% (5)	3% (1)	3% (1)	**1.6**
Graphing and data analysis tools	70% (28)	20% (8)	8% (3)	3% (1)	0% (0)	**1.4**
Articulated their scientific ideas in a journal.	85% (34)	5% (2)	3% (1)	3% (1)	5% (2)	**1.4**
Participated in on-site fieldwork (e.g., water testing, species counting in a natural setting, astronomical observations of the night sky)	83% (33)	13% (5)	13% (2)	0% (0)	0% (0)	**1.2**
Spreadsheets	80% (32)	18% (7)	3% (1)	0% (0)	0% (0)	**1.2**
Audio files	88% (35)	5% (2)	5% (2)	3% (1)	0% (0)	**1.2**
Interacted with professional scientists (site visits)	88% (35)	10% (4)	3% (1)	0% (0)	0% (0)	**1.2**
Participated in student groups created to prepare for tests	93% (37)	3% (1)	5% (2)	0% (0)	0% (0)	**1.1**
Visited professional scientific environments (e.g., labs)	100% (40)	0% (0)	0% (0)	0% (0)	0% (0)	**1.0**

N=40 instructors.

NOTE: Scale goes from 1=not at all to 5=three times a week or more in this course.

Table 9. Percentage and Number of Instructors Reporting on their Expectations for Student Engagement with Other Instructional Activities and Materials

B. What is the Nature of Communication Between Students and Instructors in Online Science Courses for Teachers?

None of the courses in this study met face-to-face. If they aren't communicating in person, what technologies are the students using to communicate with instructors and each other? More important than the technologies used is the content of this communication and the climate it creates in the course. Students and instructors were asked about their perceptions of this climate. Specifically of interest was: (a) who initiated topics during online discussions; (b) who contributed to the online discussions; and (c) the frequency and perceived helpfulness of instructor and student feedback.

To understand the media used for communication in these courses, instructors were asked how often they expected students to communicate with them and each other via eight communication media. Instructors expected students to use one of three media to communicate in these courses: (1) e-mail, (2) discussion boards, and (3) synchronous chat. No instructors expected students to communicate with them or each other via paper mail, telephone, video conferencing, or white board. Discussion boards were the sites of the most frequent instructor-student and student-student communication, with 60% of instructors expecting students to use discussion boards to contact them at least once a week and 58% of the instructors expecting students to contact each other via discussion boards three times a week or more.

Instructors and students were asked who chose new discussion topics—students or instructors (see Table 10). In most courses, instructors and students reported instructors chose most if not all of the topics in the online discussions (53% of instructors, 63% of students). Most instructors and students reported that nearly all students contributed to these discussions, with some students contributing more than others.

In addition to discussing science content, another potential role of communication is providing feedback. Students were asked about the frequency with which they received feedback from instructors and other students on their science learning in the course. Almost seven out of ten students (n=203) reported receiving feedback from instructors and students at least once a week, but they reported the feedback from instructors as significantly more helpful than feedback from other students ($t=5.40$, 288 d.f., $p<0.001$).

Overall, communication is a large part of these online courses. Discussion boards are used as the primary communication tool in these courses, with expectations of use 3 times or more per week typically, and nearly all students reported contributing to discussion. The instructor, however, is still reported to be choosing most of the topics for discussion. Students reported receiving frequent feedback from the instructor, and finding it helpful.

Aspects of Online Discussion	Percentage of Students (n=289)	Percentage of Instructors (n=40)
Who chose new topics within the online discussions		
Students chose nearly all of the new topics in the online discussions.	8%	3%
Students chose most of the new topics in the online discussions. Instructors chose a few of the new topics in the online discussions.	14%	25%
Students and instructors were equally likely to have chosen new topics in the online discussions.	15%	20%
Instructors chose most new topics in the online discussions. Students chose a few of the new topics in the online discussions.	24%	20%
Instructors chose nearly all new topics in the online discussions.	39%	33%
No response	0%	0%
Who contributed to online discussions		
A small group of students were the main contributors to discussions in this course. Most students did not contribute to discussions.	7%	0%
Over half of the students contributed to discussions, but some students contributed more than others.	15%	18%
Over half of the students contributed equally to discussions.	3%	3%
Nearly all students contributed to discussions, but some students contributed more than others.	63%	68%
Nearly all students contributed equally to discussions.	12%	13%
No response	0%	0%

Table 10. Percentage of Students and Instructors Who Initiated and Contributed to Online Discussions

C. What is the Extent of Support Perceived by Students from their Instructors, Other Students, and the Course Environment?

Students were asked their perceptions about the support they received from instructors, students, and course environment. The internal consistency of these support scales ranged from alphas of 0.77 (course supports) to 0.88 (instructor supports). Overall, there was a high level of perceived support from all sources.

1. Perceived Instructor Support

Student perceptions of instructor support are presented in Table 11. Students perceived a high level of support from their instructors, with 90 percent of the students agreeing that 'The instructor was accessible to me.' Three-quarters of the students agreed that 'Interactions with the instructor helped me understand the course material better.'

Dimension of Instructor Support	**Percentage and Number of Students:**					**Mean (S.D.)**
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	
The instructor was accessible to me.	1% (3)	1% (3)	5% (14)	47% (140)	46% (136)	4.4 (0.71)
I felt supported by the instructor(s) as I developed my understanding of the course material.	2% (6)	5% (15)	10% (29)	50% (148)	33% (98)	4.1 (0.90)
I was encouraged to provide feedback to the instructors about my questions and concerns about the course.	1% (3)	4% (13)	14% (40)	49% (146)	32% (94)	4.1 (0.85)
I felt my contributions to the online discussions were valued by the instructor.	1% (4)	3% (9)	16% (48)	55% (162)	25% (73)	4.0 (0.81)
Interactions with the instructor helped me understand the course material better.	2% (7)	7% (21)	16% (47)	47% (140)	27% (81)	3.9 (0.96)

N=296 students who completed pre- and post-questionnaires.

NOTE: Scale goes from 1=strongly disagree to 5=strongly agree.

Table 11. Percentage and Number of Students Reporting their Level of Agreement with Specific Statements about Perceived Support from the Instructor

2. Perceived Student Support

Students' perceptions of dimensions of student support are reported in Table 12. Students most strongly agreed that 'the class environment encouraged me to participate in discussions,' with 79% of the students agreeing or strongly agreeing with that statement. Slightly smaller percentages of students agreed that interactions with other students helped them better understand the course content, that they felt their contributions were valued by other students, or that they felt supported in their learning by other students.

Dimension of Student Support	**Percentage and Number of Students:**					**Mean (S.D.)**
	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	
The class atmosphere encouraged me to make contributions to the online discussions.	0% (0)	5% (16)	15% (45)	54% (160)	25% (75)	4.0 (0.79)
Interactions with the other students helped me understand the course material better.	1% (4)	6% (18)	18% (54)	49% (145)	25% (75)	3.9 (0.89)
I felt my contributions to the online discussions were valued by other students.	0% (0)	4% (13)	21% (63)	56% (165)	19% (55)	3.9 (0.75)
I felt supported by other students as I developed my understanding of the course content.	0% (1)	6% (17)	24% (70)	50% (147)	21% (61)	3.8 (0.83)

N=296 students who completed pre- and post-questionnaires.

NOTE: Scale goes from 1=strongly disagree to 5=strongly agree.

Table 12. Percentage and Number of Students Reporting their Level of Agreement with Specific Statements about Perceived Support from Students

3. Perceived Course Support

Student perceptions of support from the course environment displayed the greatest diversity (see Table 13). Students reported the highest level of agreement that they 'usually understood the content being taught in the course.' Interestingly, mean levels of agreement were significantly lower when asked about the course being designed for multiple learning styles (mean=3.4) despite higher levels of agreement that their own learning style was well suited for their course (mean=4.0). Students generally agreed that the course materials made connections between concepts clear.

Dimension of Course Support	Percentage and Number of Students:					Mean (S.D.)
	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree	
I usually understood the content being taught in the course.	1% (2)	3% (8)	4% (12)	57% (169)	35% (105)	4.2 (0.71)
I felt my learning style was well suited for this course.	1% (2)	5% (14)	15% (43)	54% (159)	26% (78)	4.0 (0.81)
Course materials were organized so it was clear how different concepts covered in this course fit together.	1% (2)	4% (12)	12% (35)	62% (184)	21% (63)	4.0 (0.75)
Course materials were organized so that each new concept built upon previous learning.	1% (2)	5% (16)	14% (41)	60% (178)	20% (59)	3.9 (0.78)
The course seemed to be designed to address multiple learning styles.	2% (6)	20% (60)	29% (86)	36% (106)	13% (38)	3.4 (1.01)

N=296 students who completed pre- and post-questionnaires.
NOTE: Scale goes from 1=strongly disagree to 5=strongly agree.

Table 13. Percentage and Number of Students Reporting their Level of Agreement with Specific Statements about Perceived Support from the Course Environment

Overall, students felt very high levels of supports from their instructors, other students, and for the most part, course design. The one slight exception to this is on the question of whether or not this course meets multiple learning styles, where students were less likely to agree. Interestingly, however, they did believe that the course was a good match for their own learning style. Students report participating frequently in mind-on activities, such as articulating and reflecting upon scientific ideas.

D. Limitations of the Study

When interpreting these findings, there are two limitations of this study that should be borne in mind. First, the students who completed all components of the study, and thus were counted in our sample, were more likely to earn higher final course grades than students not participating in the study. The sample also does not include, naturally, students who chose not to take an online science course or students who dropped out during the course. Thus, these findings reflect those who "made it" and may be biased towards those who have proficiency in either the content or in online modes of learning. These findings cannot be generalized to all learners seeking science professional development. In particular, students who did not perceive high levels of support from the instructor, other students, or the course design may not have completed the course, or may not have participated in the study. Those students who were at risk may have also reported a different dynamic in communication within the course, and we may be seeing a "best-case" scenario in these findings. Student and instructor reports of instructional methods were strongly correlated, however, so there is no reason to believe those findings would be biased by the selectivity of the student sample.

The second source of selectivity—the emphasis on courses designed for high school teachers—could influence the instructional methods as well as communication and perceived supports reported here. High school teachers are generally better prepared in science than elementary school teachers, and indeed, most teachers in our sample have a bachelor's degree in science. The lack of hands-on activities found in these courses may reflect this emphasis towards high-school science that is typically thought of as having more direct instruction and pen-and-paper problem sets than elementary science. It could be argued, however, that elementary teachers are more aware and educated about students' individual and social needs as learners and one might expect that instructional methods associated with social learning and inquiry-based science are found to be less prevalent with high school teachers than elementary teachers. If so, then the prevalence of social instructional methods, such as discussion and collaboration, which occurred frequently in these courses, may be underestimated in this study.

VI. IMPLICATIONS

Many of the findings from LSO are encouraging, in that they show innovative uses of new technologies that appear to foster learning in ways advocated for by relevant research and national standards for professional development for science teachers. There are also many areas in which online developers have room for growth in imaginative design of courses. Students report feeling a high sense of support and communicate frequently with their instructor and other students, debunking myths of isolation and alienation in online education.

A primary instructional method in virtually all of the courses studied is the use of asynchronous discussion boards. Instructors reported frequent student participation in minds-on activities, such as articulation and reflection of their scientific ideas and the ideas of others, which one might expect when the discussion is such a central focus of the course. Further research is needed to assess the cognitive depth of these discussions and the relevance of the discussion to students' scientific inquiry and their construction of knowledge.

Interestingly, the use of other online technologies such as simulations, visualizations, and interactives are relatively absent from these courses. The promise of re-usable learning objects does not seem to have become a reality in this setting, and also notably missing are frequent hands-on activities. In many face-to-face science teacher professional development courses, hands-on investigation is rampant. It appears to have been replaced by more minds-on work and discussion in these online courses. While the potential of online discussions for knowledge construction is certainly a fascinating area for future research and development, there may be even more value added when visualization tools and hands-on activity are integrated with discussions for an even richer learning environment.

The communication in online science courses for teachers is dominated by the use of asynchronous discussion boards. While instructors chose most of the topics for discussion, suggesting that a structure was designed by the instructor for learning as opposed to a purely open-ended conversation, students also reported that most students participated. This begins to portray a vision of a community of learners having possibly found their legitimate roles of participation [45]. The instructor still plays an important role for these students—they see the feedback from their instructor as more useful than feedback from their peers, and they receive their instructors' feedback frequently. The dynamics of communication found in these courses is encouraging and suggests that these environments would be ripe for research on the extent of knowledge construction measurable in these highly social learning communities.

The support perceived by students from these online courses was high in nearly all aspects. Students certainly reported feeling support from their instructors with high levels of agreement that their instructor was accessible and made them feel them feel like a valued contributor to the learning experience. Students rated their support from their fellow students slightly lower than that from their instructor, but still felt valued and supported by their peers. They reported that interactions with their instructor helped them understand the material better, and so did interactions with other students, but again to a slightly lesser extent. The organization of the course materials and chosen level of instruction were also perceived to be supportive to students, though students were less likely to agree that the materials would suit many different learning styles. Together these findings suggest that online science courses for teachers have reached a level of maturity where designers and instructors are crafting supportive course climates.

VII. CONCLUSION

Online professional development for teachers is a growing phenomenon that presents unique and rich opportunities for research and the LSO study of 40 online courses for science teachers is just a beginning. Students participating in these courses report feeling supported by their instructors, peers, and course design. Asynchronous discussion boards are used as a primary instructional tool in nearly all of the courses. The textual, archivable, and asynchronous properties of online discussion boards provide rich potential for the social construction of knowledge when students take time to articulate their thoughts and questions, gain perspective from the ideas and questions of others, and reflect upon their previous ideas. Students in LSO courses report participating frequently in mind-on activities such as articulating and reflecting upon scientific ideas. This type of online discussions may promote metacognition and other ways of learning different from what happens in conventional, face-to-face settings. As their use becomes more and more prevalent in the educational community, online discussions and online courses in general merit further research to both examine their effectiveness and also to utilize the new lens they may offer into the learning process, in particular the social construction of knowledge.

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Elizabeth Rowe, Ph.D. (co-PI), a senior researcher at TERC, is co-principal investigator of the *Learning Science Online* study. Dr. Rowe has led the formative and summative evaluations of several teacher professional development programs including TERC's *Foundational Tools for Data Literacy* project, *Massachusetts Technology Leadership Consortium*; the PALMS-Alliance *Mathematics Learning Community* project; the Harvard University Programs in Professional Education's *Media and American Democracy* program; and TERC's *Using Data Project*. Prior to joining TERC, Dr. Rowe was a research analyst at the American Institutes for Research. Dr. Rowe has extensive quantitative research experience and studies ways technology can support mathematics and science learning. She holds a bachelor's degree in mathematics from the University of the Pacific and a Ph.D. in human development and family studies from Cornell University.

X. REFERENCES

1. **National Center for Education Statistics.** *Digest of Education Statistics, 2005*. U.S. Department of Education, (NCES 2006-005), 2005. http://nces.ed.gov/programs/digest/d05/.
2. **Allen, I. E. and J. Seaman.** *Entering the Mainstream: The Quality and Extent of Online Education in the United States, 2003 and 2004*. Needham, MA: Sloan Consortium, 2004. http://www.sloan-c.org/publications/survey/pdf/entering_mainstream.pdf.
3. **Allen, I. E. and J. Seaman**. *Making the Grade: Online Education in the United States, 2006.* Needham, MA: Sloan Consortium, 2006. http://www.sloan-c.org/publications/survey/pdf/making_the_grade.pdf.
4. **Scarafiotti, C. and M. Cleveland-Innis.** The times they are a-changing. *Journal of Asynchronous Learning Networks* 10(2): 2006.
5. **Obbink, K. and G. Wheeler.** Teaching and learning via the network: National Teacher Enhancement Network. *Network Coalition for Networked Information,* Project Number 33, 1993. http://www.cni.org/projects/netteach/1993/prop33.html.
6. **Scanlon, E., C. Colwell, M. Cooper and T. Di Paolo.** Remote experiments, re-versioning and re-thinking science learning. *Computers and Education* 43(1–2): 153–163, 2004.
7. **Seiber, J. E.** Misconceptions and realities about teaching online. *Science and Engineering Ethics* 11: 329–340, 2005.
8. **Paloff, R. and K. Platt.** *Building Learning Communities in Cyberspace: Effective Strategies for the Online Classroom*: 21–32, 73–86, 167. San Francisco, Jossey-Bass, 1999.
9. **Allen, I. E. and J. Seaman.** *Growing by Degrees: Online Education in the United States, 2005.* Needham, MA: Sloan Consortium, 2005. http://www.sloan-c.org/publications/survey/pdf/growing_by_degrees.pdf.
10. **Garrison, D., T. Anderson and W. Archer.** Critical inquiry in a text based environment; Computer conferencing in higher education. *The Internet and Higher Education* 2(2–3): 1–19, 2000.
11. **Dede, C., P. Whitehouse and T. Brown-L'Bahy.** Designing and studying learning experiences that use multiple interactive media to bridge distance and time. *Current Perspectives on Applied Information Technologies* 1: Distance Education, 2002.
12. **Vygotsky, L. S.** *Mind and Society: The Development of Higher Mental Processes*. Cambridge, MA: Harvard University Press, 1978.
13. **National Research Council.** *National Science Education Standards.* Washington, D.C., National Academy Press, 1996.

14. **Loucks-Horsley, S.** The role of teaching and learning in systemic reform: A focus on professional development. *Science Educator* 7(1): 1–6, 1998.
15. **Kuhn, D.** Theory of mind, metacognition, and reasoning: a life-span perspective. In P. Mitchell and K. J. Riggs (Eds.), *Children's Reasoning and the Mind*. Hove, UK: Psychology Press, 2000.
16. **Blanchette, J.** Textual interactions handbook: Computer-mediated conferencing. In D. Collett (Ed.), *Learning Technologies in Distance Education*, HB65–HB96. Edmonton, AB: University of Alberta, 1999.
17. **Singer, S.R., M. L. Hilton and H. A. Schweingruber.** (Eds.) *America's Lab Report: Investigations in High School Science*. Committee on High School Science Laboratories: Role and Vision, National Research Council, 2005.
18. **Woodfield, B. F., M. B. Andrus, T. Andersen, J. Miller, B. Simons, R. Stanger, G. L. Waddoups, M. S. Moore, R. Swan, R. Allen and G. Bodily.** The Virtual ChemLab Project: A realistic and sophisticated simulation of organic synthesis and organic qualitative analysis. *J. Chem. Ed*, 82: 1728–1735, 2005.
19. **Harlen, W. and C. Altobello.** *An Investigation of "Try Science" Studied On-Line and Face-to-Face*. Cambridge, MA: TERC, 2003.
20. **Sproull, L. and S. Keisler.** Reducing social context cues: Electronic mail in organizational communication. *Management Science* 32: 1492–1513, 1986.
21. **Walther, J.** Interpersonal effects in computer mediated interaction. *Communication Research* 21(4): 460–487, 1994.
22. **Garrison, D. R.** Cognitive presence for effective asynchronous online learning: the role of reflective inquiry, self-direction and metacognition. In J. Bourne and J. C. Moore (Eds.), *Elements of Quality Online Education: Practice and Direction*, 47–58. Needham, MA: Sloan-C, 2003.
23. **Garrison, D. R., T. Anderson and W. Archer.** Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education* 11(2): 1–14, 2000. http://communitiesofinquiry.com/documents/CTinTextEnvFinal.pdf.
24. **Short, J., E. Williams and B. Christie.** *The Social Psychology of Telecommunications*. Toronto: Wiley, 1976.
25. **Picciano, A. G.** Beyond student perceptions: Issues of interaction, presence and performance in an online course. *Journal of Asynchronous Learning Networks* 6(1): 2002.
26. **Brown, R.** The process of community building in distance learning classes. *Journal of Asynchronous Learning Networks* 5(2): 18–35, 2001.
27. **Anderson, T., L. Rourke, D. R. Garrison and W. Archer.** Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks* 5(2): 1–17, 2001.
28. **Madden, M.** *Internet Penetration and Impact*. Pew Internet & American Life Project, Pew/Internet, Washington DC, 2006.
29. **Wallace, R.** Online learning in higher education: A review of research on interactions among teachers and students. *Education, Communication & Information* 3(2): 241–280, 2003.
30. **Collison, G., B. Elbaum, S. Haavind and R. Tinker.** *Facilitating On-line Learning: Effective Strategies for Moderators*. Madison, WI: Atwood Publishing, 2000.
31. **Bonk, C., R. A. Wisher and J. Y. Lee.** Moderating learner-centered e-learning: Problems and solutions, benefits and implications. In T. S. Roberts (Ed.), *Online Collaborative Learning: Theory and Practice*, 54–85. Hershey, PA: Information Science Publishing, 2004.
32. **Arbaugh, J. B.** How instructor immediacy behaviors affect student satisfaction and learning in web-based courses. *Business Communication Quarterly* 64(4): 42–45, 2001.
33. **Arbaugh, J. B.** Managing the on-line classroom: A study of technological and behavioral characteristics of web-based MBA courses. *Journal of High Technology Management Research* 13: 203–223, 2002.
34. **Berge, Z. L.** Barriers to online teaching in post-secondary institutions. Can policy changes fix it? *Online Journal of Distance Learning Administration* 1(2): 1998.

35. **Garrison, D.** Online collaboration principles. *Journal of Asynchronous Learning Networks* 10(1): 2006.
36. **Gunawardena, C.** Social presence theory and implications for interaction and collaborative learning in computer conferences. *International Journal of Educational Telecommunications* 1(2/3): 147–166, 1995.
37. **Rourke, L., T. Anderson, D. R. Garrison and W. Archer.** Assessing social presence in asynchronous text-based computer conferencing. *Journal of Distance Education* 14(2): 2001.
38. **Swan, K.** Building communities in online courses: the importance of interaction. *Education, Communication and Information* 2(1): 23–49, 2002.
39. **Gunawardena, C. and F. Zittle.** Social presence as a predictor of satisfaction within a computer mediated conferencing environment. *American Journal of Distance Education* 11(3): 8–26, 1997.
40. **Richardson, J. C. and K. Swan.** Examining social presence in online courses in relation to students' perceived learning and satisfaction. *Journal of Asynchronous Learning Networks* 7(1): 68–88, 2003.
41. **Collins, A., J. S. Brown and A. Holum.** Cognitive apprenticeship: Making thinking visible. *American Educator* 15(3): 6–11, 38–46, 1991.
42. **Feger S. and M. Zibit.** Online Facilitation: Building Professional Knowledge Among Participants. Presented at *Technology as an Agent of Teaching and Learning*, San Francisco, 2006.
43. **Conrad, D.** University instructors' reflections on their first online teaching experiences. *Journal of Asynchronous Learning Networks* 8(2): 32–44, 2004.
44. **Borko, H., B. M. Stecher and S. McClam.** Artifact packages for measuring instructional practice: A pilot study. *Comparative Analysis of Current Assessment and Accountability Systems*, The Regents of University of California, 2003.
45. **Lave, J. and E. Wenger.** *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, 1991.
46. **Asbell-Clarke, J., E. Rowe, S. Leibowitz and P. Hubbard.** *Learning Science Online: A Descriptive Study of Online Science Courses for Teachers*. Poster presented at AERA, San Francisco, 2006.
47. **Asbell-Clarke, J. and E. Rowe.** *Learning Science Online: A Descriptive Study of Online Science Courses for Teachers*. In press, to be released at http://www.terc.edu.

THE PRESENTATION OF SELF IN EVERYDAY ETHER: A CORPUS ANALYSIS OF STUDENT SELF-TELLINGS IN ONLINE GRADUATE COURSES

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ABSTRACT

This study examines the patterns and substance of student self introductions in nine fully online graduate courses in education. A composite of social identity frameworks with an emphasis on language as the tool for self-presentation is first developed to guide the analysis and interpretation of these data. In particular Sfard and Prusack's operationalization of the *telling* of identity [1], along with Bruner's construct of turning points in self-tellings [2] are discussed and employed as analytic lenses. The question of how, in a tightly defined social/academic context, adults use written language to present themselves to others is taken up through content analysis supported by linguistic concordancing. Two hundred twenty-three "Meet Your Classmates" entries are examined for their form and content. Entries composed by preservice teachers, inservice teachers, and doctoral students reveal differences regarding academic and professional identity-telling with the tenacity of institutionally situating and situated forces prevailing.

KEYWORDS

Social Identity, Online Identity, Language of Introductions, Asynchronous Courses, Education, Preservice Teachers, Inservice Teachers, Concordancing

I. INTRODUCTION

What do we know about students in our online distance education courses? What do they choose to tell us about themselves? What mechanisms do they use to present this information? When asked for a self introduction in an asynchronous online course, what autobiographical stories do students tell? In attempting to address these questions, theoretical principles from four broad areas are employed: language in education, critical discourse analysis, narrative identity, and computer-mediated communication. Using these multiple points of entry, we examined the text archives of the Meet Your Classmates (MYC) entries of 223 graduate students in educational theory and practice in an attempt to characterize patterns of self-presentation. We used simple concordancing software to establish patterns in the corpus of student entries. Patterns of self-tellings were examined by states as defined by Sfard and Prusak [1], and what Bruner [2] terms the "turning points" that are characteristic of self-tellings. These two analytic tools were used to compare the forms and substance of self-introductions by students' academic status: preservice teacher, inservice teacher, and doctoral student.

We first lay out a brief overview of current social identity terrain as discussed within related fields and how these concepts might apply in analyses of self-introductions. The analytic lenses of self-tellings as applied to our examination of student online self-introductions are also discussed. How identity in computer-mediated communication has been conceived and examined socioculturally is then considered.

Finally, we present the findings of our analyses and discuss their implications for online instruction and for instruction broadly conceived.

II. SOCIAL IDENTITY

> *I think of Self as a text about how one is situated with respect to others and toward the world – a canonical text about powers and skills and dispositions that change as one's situation changes from young to old, from one kind of setting to another.* Jerome Bruner [3]

In recent decades, a widely accepted working construct of identity has proved illusive [4]. Although a uniform sense of the term seems a common component of popular lay speech and popular culture whereby it typically refers to personal information that can be stolen and misused, within and across the realms of academe its sense shifts between disciplines and ideologies. From the broad and tenuous "way of being in the world" [5, p.151], to the more focused "how people understand their relationship to the world, how that relationship is constructed across time and space, and how people understand their possibilities for the future" [6, p.410], the term is widely used across fields, across discourses, and for multiple purposes with the most common orientation being towards the players who populate given social contexts. For the purpose of this study, the term social identity is used in a restricted sense as it applies to, and is reflected in a single telling by an individual when introducing him or herself in an online graduate course.

III. FRAMEWORK

In his landmark *The Presentation of Self in Everyday Life*, Irving Goffman [7] engages the notion of social identity and how individuals present themselves through what he calls "impression management" in the varying social contexts of everyday life. Current notions of identity indeed converge around the dynamic nature of the social self in interaction with others; the fact that we all possess a repertoire of social identities that are simultaneously subject to continual change [8, 9, 10, 11], to power relations between speakers [12, 13, 14, 15], and that are inextricably dependent on the contexts in which they are both formed [16] and exercised [17, 18].

To present oneself effectively in various social contexts and to be attended to by others, the actual "telling" of who one is, what Bruner calls "self-telling", must have a solid "why tell" behind it. The "why tell" behind the information one selects to share when introducing oneself to others is steered by numerous factors, including one's personal narrative repertoire at the time of the telling and the context in which the introducing takes place. First and foremost, Bruner argues, "we wish to present ourselves to others (and to ourselves) as typical or characteristic or 'culture confirming' in some way" [2, p.29]. The aim is to present oneself in a manner that is socially and institutionally sanctioned given the context and interlocutors whereby certain shared presuppositions about oneself and one's place in the world can be mutually and unambiguously understood. In other words, telling about ourselves is most often a bid for membership [19].

For Bruner, a key component of self-telling is that of turning points—linguistic means of organizing and marking attention to important life events. Turning points serve to "distinguish what is ordinary and expectable …from that which is idiosyncratic and quintessentially agentive" [2, p.32]. Turning points are what mark the individual as unique -"quintessentially agentive" —within the conventional frames of self presentation while also anchoring one's identity to the known, to the contextual community. Turning points are chronologically situated by a speaker/writer on an imagined timeline, an underlying space for the plotting of events [20, 21]. In this study, the notion of turning points is used to determine patterns as well as to assess similarities and differences in self presentations. Tellers of their life stories use the narrative conventions called for by the community in which they are situated, for which they are bidding membership, and in which they are constructing their tellings. Such narrative turning points not only provide structure, but also the cohesion needed by hearers/readers of the stories to make sense of tellers' lives.

In addition to Bruner's turning points, we employ the analytic device of states using Sfard and Prusak's recent definition [1]. In their effort to operationalize the concept of identity for educational research, Sfard and Prusak cast identity telling and identity making as communicative, discursive activities. The central component to their definition is that identity telling is storytelling and, as such, can be subject to linguistic analysis. To qualify as being identity telling, statements made (stories told) about identity are

- reifying — a statement about a state;
- endorsable — consistent with the world;
- significant — when a change in state will mean a change in perception of reader/listener.

These components of identity telling are not only invaluable analytic tools in the study of identity as presented through language generally, they are also particularly relevant to a study of academic identity, a context in which institutional norms are well established and widely understood. To talk about one's life using statements about states of being (e.g., where one "is" within an academic program and/or a career track) is a natural component of academic discourse communities. These statements are likewise endorsable in that they make reference to academic degrees and employment experience that are, in theory, verifiable. Academe is especially predisposed to states through its system of grades, degrees, certifications, and promotional structures, all of which are reifying and endorsable. Moreover, academe to a large degree determines legitimacy in the broader socioeconomic realm by providing "endorsements"; degrees, diplomas, and status.

The third requirement for Sfard and Prusak's identity telling is that the utterance be significant. To be significant it must change the interlocutor's understanding of the teller's identity. This element of significance aligns with Bruner's why tell? component of self-telling. When talking of oneself, statements must make a difference to the interlocutor's perception of the person presenting. In order to be significant and to answer Bruner's why tell?, one must have a good sense of who one's listeners/readers are and what the community/contextual norms might be to make a successful bid for membership. Given this knowledge, the storyteller/autobiographer can then consider and construct herself the way she understands how she ought to be in a given context.

As the focus of this study is the form and content of self introductions in fully asynchronous online graduate courses, one would suspect that the anatomy of the social and institutional motives behind such written presentations of self are indeed dependent on the context, power relations, and, most importantly, the writer's understanding of his or her relationship to this text-only microworld. Moreover, the shared cultural model of class introductions might assure that certain known conventions are followed [22]. As such, a manifestation of students' understanding of academic online culture and their place within it gets expressed in written language when they are directed to share with other students and their instructors who they are.

IV. IDENTITY ONLINE

The popular notion that technologies can somehow influence and even dictate human behavior has long persisted. However, in the last decade, this technocentric perception has seen its demise among social, cultural, and even economic theorists. To a great extent, Sherry Turkle's work on online fantasy identities [23] marked the obsolescence of technocentric, cause and effect understandings of human-machine relationships and paved the way for new modes of sociocultural investigations of evolving online communities and the social identities that develop within these. Her groundbreaking Second Self illuminated the question of who we are and how we present ourselves in online environments. Her work has drawn the attention of cultural theorists, anthropologists, and sociologists among others and has underscored the importance of telling the complete stories of individuals interacting online. Numerous studies that examine the social dimensions of Computer Mediated Communication (CMC) discourse, and that employ ethnographic, anthropological, and discourse analytic techniques have subsequently appeared in the last decade [cf., 17, 24, 25, 26, 27, 28].

Issues around online identity and its authenticity have abounded in the popular media where news of identity theft and other online scams, whereby imposters take advantage of the internet's visual anonymity to steal, are common. Contrary to this version of human behavior on the internet, the vast majority of people who communicate on the web do not breach the trust of others by misrepresenting who they are [18, 29]. Indeed, there are some online social spaces where writers experience less inhibition and more openly express their true nature than in face-to-face (f2f) contexts [30]. In the limited number of extensive studies of internet communication, the aspect of community membership—exhibiting those discursive patterns and strategies the writer deems as fitting the conventions of a given online context—have emerged as predominant. Bidding for membership online—like Goffman's f2f impression management—is a primary social response that requires that certain situational assessments be made and the performance of identity undertaken accordingly. In an online community, this takes place chiefly through written language.

It is widely held that the online social spaces that have organically evolved through our shaping of technologies to our own human needs and purposes are sites where specific discourse conventions and self presentation practices have likewise evolved. That is, like live human-human interaction, how identity gets performed is very much context-dependent. One fairly uniform assumption is that online communication hovers somewhere between text and speaking with most CMC communicators claiming that what they write online is more like speaking than formal writing [31]. As in f2f communication, what we say with text in CMC often conveys messages about our background, our educational level, and our orientation towards the topic and context. Our self-presentation is imbued with bids for membership in the groups in which we communicate: newsgroups, lists, blog feedback, chats, and the like. Even in the construction of personal webpages there are evolving in-group, out-group conventions, what Hine calls "authenticity claims", that are closely adhered to [25] with the means by which membership requirements are determined and bid for being chiefly through written language.

Languaging identity online takes on special significance as new social spaces are continually evolving and as we are ever-adapting our discursive practices to these novel venues. The difference between these constant adaptations and those we make in real life is that it is the text, the words on the screen that do the talking, modulating, gesticulating, etc. In arguing for the centrality of language in both constructing and interpreting social identity, Ochs characterizes the two-way, synergistic nature of language and social identity as follows: "[l]inguistic constructions at all levels of grammar and discourse are crucial indicators of social identity for members as they regularly interact with one another; complementarily, social identity is a crucial dimension of the social meaning of particular linguistic constructions" [10, p.288].

Ochs goes on to emphasize the individual agency behind these verbal constructions of self with and through language: "In all situations, even the most institutionalized and ritualized, people are agents in the production of their own and others' social selves" [10, p.296] [emphasis in the original]. In the study of online self-presentations, we have the luxury of studying the agentive self-tellings of students' social and academic selves as reflected through their linguistic choices, choices that, like in f2f communication, are constrained by shared and unshared understandings, communicative goals (individual and collective), and personal accountability. Like Goffman's f2f impression management, we are often called on to do the same via written language online.

V. METHODOLOGY

A. Setting

The setting for this study is comprised of nine graduate courses in Education: two courses in Educational Research, three courses in Media Literacy and four courses in Using Media in the Language Classroom. All courses were delivered asynchronously online. All nine courses treat educational theory and practice. Students are pre- and inservice educators and doctoral students interested in teaching and learning with technology. To successfully complete these courses, they are directed to logon at least five times per week and engage in readings, discussions, group work, and to complete written assignments. Only in rare instances do students and their instructors speak to or see one another face-to-face: all communication is mediated through a learning management system interface. Assignments, evaluations, and discussions are orchestrated in a widely used, easily navigable, course management system.

B. The Meet Your Classmates Entries

The first task for students to undertake in these online courses is to go to the Meet Your Classmates (MYC) section of the course and post a self- introduction. These mini-autobiographies can be accessed by the instructor and by other students in the course to read and reference at any time during the semester. For example, some students and instructors report opening an individual's MYC entry in one window while reading that person's discussion post or class assignment in another. In this way they report having a better sense of the author of the text they are reading.

Students are provided the following instructions for the MYC entry task:

Tell your classmates/students a little about yourself.

Fields for composing text, attaching photographs, and linking to websites are provided. Once they have submitted their MYC entry, students are instructed to proceed into the course.

The MYC entries were archived from nine graduate courses conducted over a two-year period. Students in these courses all shared the common goal of achieving a graduate degree in education and securing, or continuing related professional work in their academic area. They are all, in short, in the process of building their professional identities through advancement in higher education. It was of interest, therefore, to compare the ways this was accomplished by students at three different academic/professional career points: preservice teachers (novice, non-practicing), inservice (experienced, practicing), and doctoral students. For all participants the question of what constitutes perceived membership – as expressed through one's states, narrative turning points, and progress in the academic context - is of interest as well as if and how this differs between the three groups. Because the number of doctoral students was so small (n=9), and because their entries were markedly different in form and content, comparison of their entries with those of the other two groups (preservice=95; inservice=127) is greatly restricted. For this reason, discussion of the doctoral student entries will be taken up separately.

C. Research Questions

The following questions guided data collection and analyses:

1. How do graduate students present themselves in their brief, online self introductions?
2. What are the formal elements (structure and content) of these online self introductions?
3. Do the structure and content of these autobiographies differ when composed by preservice teachers, established inservice professionals, and doctoral students?
4. What makes these written representations of self unique to the context for which and in which they are composed?
5. How might linguistic concordancing serve to support our understanding of online social, professional, and academic identity?

The corpus of MYC entries was converted into .txt files and the Simple Concordance Program (http://www.textworld.com) used to capture patterns of states and turning points as these fell out similarly and differently between the three groups of students. According to Biber et al. [32], corpus-based concordancing allows the following:

- representation of naturally occurring discourse from a range of registers;
- (semi) automatic linguistic processing that assists in determining the linguistic characteristics of single or multiple texts;
- accurate quantitative analysis of linguistic features;
- possibilities to apply both corpora and analytic method to subsequent studies.

Concordances of the MYC entries were run on a range of lexical and syntactic items to capitalize on these features and treat the MYC entries and the students' self tellings expressed in them as discursive. Additionally, the concordanced data were handcoded by the following:

- state, academic
- state, professional
- state of mind
- action (turning point), academic
- action (turning point), professional
- other (personal, geographic, etc.)

D. MYC Models

By happenstance, for six of the courses from which these data were drawn instructors initially supplied a MYC entry of their own. In the three other courses instructors did not do so. The difference in number of words per MYC entry between those who had an instructor model for the entry and those who did not is worth noting (Table 1, below). Although there is limited empirical evidence of online communicators using uptake in their postings, indeed there is some evidence that they do not [33]. In the case where the source of the model is in a position of authority (the instructor for the course), it appears to make a difference in the length of students' self-tellings. In addition to responding to the authoritative text of the instructor, by assessing the length and content of instructors' postings students may also be gauging an appropriate format/length for their bid for membership in the group, an aspect reflected in the overall content of their entries as we shall see.

	With Model	Without Model	All
Preservice (n=38+57)	88	63	73
Inservice (n=94+ 33)	110	82	103
Doctoral (n=9)	155	-	155

Table 1. Average Number of Words per MYC Entry

VI. RESULTS

A. Overall MYC Content

To some extent introducing oneself in a class can be viewed as ritualized. Though what gets said and how may vary from discipline community to discipline community, the basic script appears to remain somewhat stable. In these entries, we can indeed glimpse some consistency in presenting or "performing" oneself [7] within the highly codified institution of education: one states who one is in relation to the institution and oftentimes who one is outside of the institution whereby a link between the two is significant and endorsable.

The content of the MYC entries appears to have been developed through a sense of who writers saw themselves as, individually and collectively, in their degree programs and, by extension, to others in the same or similar academic programs: practicing teachers relate themselves as teachers, preservice teachers as preservice teachers, students as students. These are the pivotal points of identity that appear to be collectively reifying through the MYC entry. All writers appear to be intimately familiar with the codes and context of this classroom-based genre of communication. All self-identify either via their academic status and/or as professionals of some kind. All state their progress in achieving the next level on the academic/professional membership trajectory.

	INSERVICE			PRESERVICE		
	Total N=12,898	Model N=10,228	No model N=2,670	Total N=6,854	Model N=3,297	No model N=3,557
Teach	18.8 (243)	17.5 (179)	23.9 (64)	12 (82)	10.6 (35)	7.0 (25)
School	11.3 (146)	11.1 (114)	12.7 (34)	4.2 (29)	3.6 (12)	5.3 (19)
Year	9.9 (125)	8.9 (91)	13.1(35)	7 (48)	6.4 (21)	8.4 (30)
Class	8.5 (110)	8.5 (87)	8.6 (23)	6.9 (47)	7.9 (26)	5.9 (21)
Work	8.4 (108)	9.0 (92)	6.4 (17)	8.5 (58)	6.7 (22)	11.0 (39)
Look forward	6.4 (82)	6.6 (68)	5.2 (14)	3.2 (22)	3.9 (13)	2.5 (9)
Course	5.7 (74)	5.9 (60)	5.2 (14)	5.3 (36)	5.2 (17)	5.6 (20)
Program	4.9 (63)	4.9 (50)	5.2 (14)	8.3 (57)	7.6 (25)	9.3 (33)
On-line	4.9 (63)	4.9 (50)	4.9 (13)	6.1 (42)	7.0 (23)	5.3 (19)
Student	4.8 (62)	4.7 (48)	5.2 (14)	5.5 (38)	5.2 (17)	5.9 (21)
Educate	4.3 (56)	4.5 (46)	6.7 (18)	4.1 (28)	3.3 (11)	4.5 (16)
Semester	4.4 (55)	4.7(48)	2.2 (6)	4.8 (33)	4.9 (16)	4.5 (16)
Grade	4.3 (55)	4.5 (46)	6.7 (18)	0.9 (6)	0.9 (3)	0.8 (3)
Learn	3.6 (47)	3.7 (38)	3.4 (9)	2.6 (18)	4.2 (14)	(4)
Degree	3.6 (46)	3.6 (37)	3.4 (9)	4.4 (30)	5.2 (17)	(13)

Table 2. 15 Most Frequently Used Roots (Frequency per 1000 Words, Raw Number in Brackets)

Table 2 presents by inservice descending order the fifteen most frequently occurring words by root in the MYC entries. As is reflected in these frequencies, inservice teachers highlight where they teach, what they teach and how long they have taught. Preservice teachers relate where they completed their undergraduate studies, what they studied, and where they plan to go academically and professionally. These trends are well reflected in the most commonly occurring lexical items. The conclusion that can be drawn from this list is that student entries reflect bids for membership to the group, the characteristics of which they see as converging around educational goals and professional prospects. By locating themselves institutionally, both academic and professional, writers literally enter a bid for membership in the community that they are in the process of establishing.

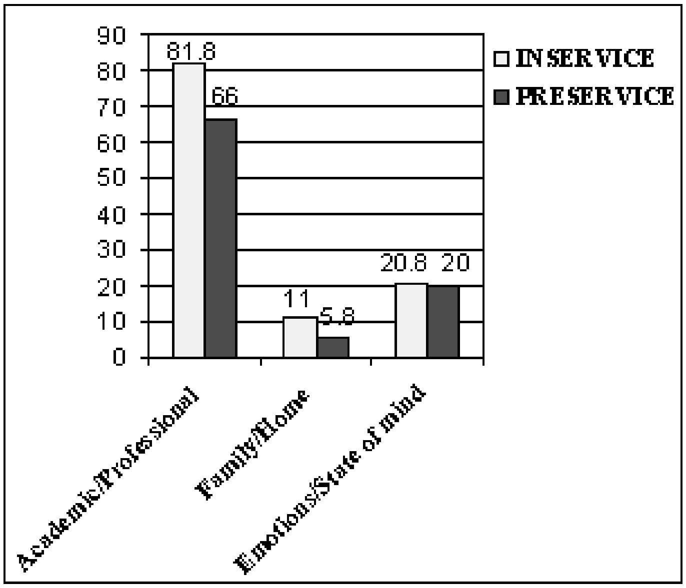

Table 3. Most Common Topics by Group

In their effort to establish common ground and locate themselves accordingly, writers focus primarily on academic and professional status. As in Davis and Mason's [34] study of online communication where "participants chose to derive or construct authority externally from professional credentials" [34, p.55], these graduate students, albeit to varying degrees, presented themselves primarily in terms of their academic and professional status and accomplishments. This is reflected in Tables 2 and 3 (above). Also, common content to both groups were expressions of looking forward to the course and to working with others, and mention of marital status, children, and pets. Both groups also frequently identified themselves by the number of courses they had completed or had yet to complete in their particular graduate program.

Structurally, these texts more clearly resemble a spoken versus a formal written style of communication—exactly what one would expect from CMC communications. Indeed, writers appear to draw their readers' attention to the content of their entries, not to the form and structure they employ. They tend to thus employ anti-rhetorical devices such as simple declarative sentences with few rhetorical transitions [35]. Unlike spoken f2f classroom self-introductions, however, the MYC entries do not generally begin with *My name is* statements. This would be redundant information as the entry is otherwise automatically labeled with the writer's name in two highly visible places on the screen. Alternatively, most entries begin with a greeting: *Hi! Greetings!* and the like. If not, the writer launches directly into self description (*I am a… I teach… I currently…* and the like); statements about states as related to their academic professional status. A typical overall format of the entries can be best described as casual listing of these states along with chronologically ordered academic and professional turning points. These appear in paragraph format, but not as constructed, cohesive written paragraphs. The casual nature of the entries is also marked by a predominantly verbal rather than nominal style. Like spoken, casual texts, the MYC entries are also "characterized by relatively high frequencies of the present tense, by relatively many verbs like think and feel, which express private states and emotions" [36, p.137], characteristics that align with Biber et al.'s research on spoken language corpora [32].

Although the corpus of MYC entries was concordanced using several potential linguistic indicators of state, by far the most productive indicator was the verb *be* (see Table 4, below). For identity telling, "the use of is-sentences…do the job of 'freezing the picture' and turning properties of actions into properties of actors, [and] is grounded in the experience - engendered expectation - indeed, hope—that despite the process of change, much of what we see now will repeat itself in a similar situation tomorrow" [1, p.16]. *Be* statements and other statements that reveal academic, professional and states of mind were handcoded as follows:

- state, academic
- state, professional
- state of mind

As indicated in Table 4, as might be expected, the preservice teachers' statements more frequently described their academic states or status—"I am a …student"—while the inservice teachers' statements more frequently described their professional states or status—"I am a teacher …" While both groups made statements about their state of mind—"I am nervous…" "I am looking forward to…", the preservice teachers were more inclined to express these states than their senior counterparts.

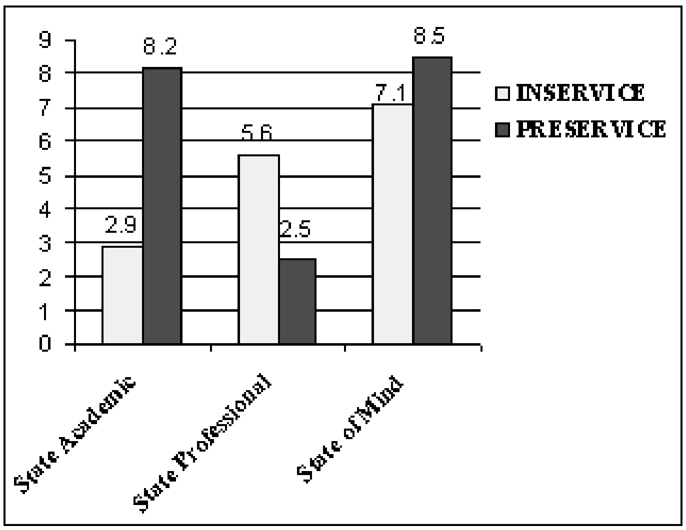

Table 4. States—Academic, Professional, of Mind—by Group

B. Turning Points

Turning points were handed coded as either academic or professional. For past actions, Table 5 illustrates again that the most frequently employed verbs in the past tense were those denoting academic and professional acts.

	INSERVICE (total words = 12,898)	PRESERVICE (total words = 6,854)
Taught	1.5 (19)	0.44 (3)
Graduated	0.9 (12)	3.4 (23)
Was	0.7 (9)	0.3 (2)
Worked	0.5 (7)	0.44 (3)
Studied	0.16 (2)	0.15 (1)
Learned	0.08 (1)	0.15 (1)
Completed	0	1.2 (8)
Finished	0	0.7 (5)
TOTAL	3.9 (50)	6.7 (46)

Table 5. Most Frequently Used Verbs Describing Past Actions (per 1000 Words, Raw Number in Brackets)

Table 6 (below) illustrates the high frequency of reference to academic turning points for the preservice group and the contrasting high frequency of professional turning points for inservice teachers. Turning points that are most pertinent to preservice teachers are clearly tied to their academic lives while the turning points for inservice teachers are both more frequent by virtue of their having had relatively more life experience in general, and lengthier professional experience as teachers in particular.

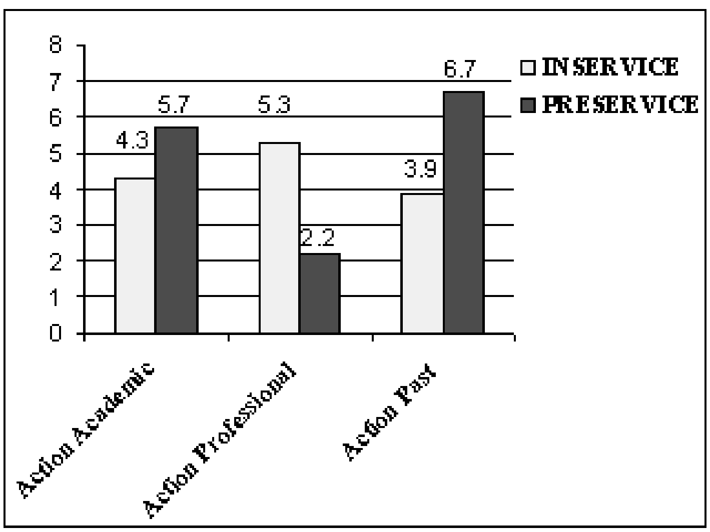

Table 6. Frequencies of Turning Points by Group

Comparisons by the linguistic patterns expressing states along with those that report turning points reveal informative distinctions between the two groups. First, these differences indicate shared understanding of an underlying institutional trajectory, what Gee, Allen and Clinton [37] call "achievement space", used by students when selecting the information to include in these brief autobiographies with their own positions along the trajectory serving as the main chronological anchor in their identity tellings. Secondly, these students generally mark their status on an imaginary timeline made up of time remaining until a degree is obtained, time in profession, marital status, and the like. Finally, they state an endpoint at which they envision themselves being at the end of the academic/professional trajectory.

C. Awareness of Audience and 'Achievement Spaces'

According to Ochs [10], the choices that a speaker makes are continually mediated by their and their audience's understandings of the context and the conventions of the moment. In this online context, audience includes the instructor from whom a nod confirming that she recognizes the student as a serious one is sought. Other students in the course are most likely strangers to the writer, the only information the writer having about the group being through others' MYC entries. Statements made in the MYCs, then, draw strategically on what the writer can confidently assume is shared knowledge given the non-present group and the context of their tellings. The substance and structure of these entries evolve accordingly, the designated identity serving as the lynchpin between the socially constructed and the individual experiences reported. Identity trajectories [5, p.163], whereby the future is laid out as part of one's past and present, are particularly salient here. The common underlying assumption is that what matters in an academic (albeit online) context and the social/academic terrain is well understood: it is successful progress along this trajectory to a final state of academic and professional development. These individuals have spent a great portion of their waking lives immersed in the academic culture. Its structures are consequently well, if not unconsciously, appropriated. A major imperative of these self-tellers is to place themselves as members; a key strategy for doing so being to place oneself along a trajectory of academic accomplishment. The underlying trajectory along which each student situates himself or herself is an act of "self-location…through autobiography we locate ourselves in the symbolic world of culture" [20, p.133].

Locating selves culturally within the structures of educational institutions is a symbolic placing along well-known metaphorical pathways to achieving the endorsements of those institutions. This act of locating very much resembles the use of "achievement spaces" in Gee, Allen and Clinton's findings regarding middle and upper middle class adolescents as they told about themselves [37]. A similar use of self-placement along an achievement trajectory is evident. Intermixing statements about one's personal life is a secondary strategy of locating oneself in society in a way that reinforces membership. Part of group membership is understanding what is important for your interlocutors to know about you in order to 1) interpret your utterances and 2) grant you membership. In the main, these online students do not stray from the member trajectory in their self-tellings. There are occasional bids for individuality and creativity, but only once the base membership trajectory information has been supplied. They are thus illustrating unequivocally what Wortham terms "versions of social-historical categories [that] are contextualized and circulate locally" [11, p.717].

D. Straying From the Script—The Doctoral Students

The few doctoral student entries (n=9) interestingly broke with this pattern. Although there are too few doctoral student entries to make any numerical comparisons with the pre and inservice teacher/students, the length of their entries is strikingly longer (see Table 1) and tend to be characterized by the cohesion of written, not spoken forms. There is also a uniform lack of trajectory/achievement placement in favor of the personal/professional commentary of advanced scholars in training. Doctoral student entries tend to be less about professional membership and more idiosyncratically personal: statements of research interests that are interspersed with personal sentiments and, in some cases, detailed life stories. This may reflect this group's socialization to the academy beyond achieving the teaching credentials the others seek. Indeed, a distinctive characteristic of academe is its "complex public-private dialectic" [38, p.144], an aspect of the academy that might explain the doctoral students' comfort with sharing the personal as it relates to who they are as scholars. This marked difference in the types of states and turning points reported and the manner in which they are presented represents a different type of membership bid; such bids of necessity aligning with local understandings and expectations concerning what it is to be a student/graduate student in an instructor-monitored academic context.

VII. IMPLICATIONS

As the number of online courses grows larger, more than ever we need mechanisms for understanding who our students are—at least who they are presenting themselves as being at the time they are taking our classes. Instructors may, as a matter of course, take informal tallies of their students' positions within the academy/profession, but supporting this impressionistic process with hard, easily sorted data may be helpful in ascertaining more precise views of who students see themselves as being in an online course through the self-telling choices they make. Better understandings of who our students are through analysis of their ways of telling their own stories might consequently assist in shaping instructional conversations in online courses. Attention to individual and collective learner identity may also help promote learner-centered pedagogical approaches in asynchronous teaching and learning environments. Moreover, increased awareness of the forms online learner identity can take may also help attenuate the sometimes constraining forces of institutional normalizing that get imposed on self expression. That is, the more aware instructors are of institutionally generated scripts of student identity, the better equipped they may be to counteract mimicry, marginalization, and attrition through dialoging with individual learners and thus drawing them out as more than merely institutionally identifiable.

Awareness of the tensions students experience between their more global, as opposed to the decidedly more local identities is an important awareness. As one young preservice teacher lamented, "I never know what college wants you to say". That learners are constructing profiles of themselves that conform to notions of academe is important background knowledge to hold as one designs and implements instructional tasks and orchestrates instructional conversations online. After all, in online environments we don't have the luxury of witnessing our students' immediate reactions to what we present and challenge them with. The study of such self-tellings may be one of many compensatory strategies.

Research on the expression of identity through language has variously examined themes, narrative structures, patterns, code-switching, stylistics, and the rules of genre. Genres are especially powerful determining patterns in the production of self expression as they supply the walls and boundaries that include or exclude elements of culture, ideology, and value. We are thereby "bound by strong conventions regarding not only what we say when we tell about ourselves, but how we say it, to whom, and so on" [20, p.129]. Unstated rules and conventions regarding the presentation of self to others in introductory contexts, then, represent a fairly restricted genre of language use. Add the fact that the context is academe, and the restrictions are even tighter as to what is considered appropriate information to share about oneself. Indeed, a MYC genre appears to be arising out of these very specific human discourse practices: those of academe; those that are a part of a standard, Western sense of felicitous self introduction; and, especially, those that organize along a trajectory of academic/professional achievement. Moreover, because the MYC genre is restricted to the written, to a specific audience, for a restricted purpose, it is unique in the limited number of environmental factors that come to bear in contrast to less institutional, less controlled contexts where self-introductions take place.

In everyday life, our primary tool for informing others about ourselves is language. Stripped of the non-verbal (visual, auditory, and kinesthetic) information available in face-to-face self-introductions, along with the breadth of possibilities for distributed communication, the role of language in its hybrid written/spoken CMC form takes on special importance, especially in how we present ourselves to others and the sense they make of our self presentations online. In the context of asynchronous online self-introductions, Sfard and Prusak's argument about identity as discursive and thus analyzable from a linguistic perspective becomes particularly compelling. If online writers employ utterances that communicate reifying, endorsable, and significant states, these can in turn be readily and reliably analyzed and contextualized patterns determined.

VIII. CONCLUSION

In 1995, Turkle observed that online identity was more “multiple and fluid” than in prior, pre-internet times, and that we were therefore freed to organize and switch our identities at will in the ether [23]. In contrast, this study underscores the power and tenacity of social and institutional influences over how we present ourselves in particular contexts. Where online environments continue to provide unique venues in which to observe free form experimentation in human thought and behavior, certain constraints, as in the case of these online graduate courses, are not attenuated by the fact of the medium, by the venue, nor by forms for self expression. Where other CMC venues may invite the creating and shifting of identities, of *protean* identities, the Meet Your Classmates entry represents a place where specific, socio-institutional parameters appear to be the common frame. The answer to the question *Who am I to be in this context?* is clearly delineated by one’s knowledge and experience with schooling, by Halliday and Hasan’s “model in the mind” [39, p.28] in consort with the online learning community that continually reinforces such conformities [5]. In short, the content selected and the language used in these self introduction entries, as in other studies of academic discourse, was clearly shaped by tenacious institutional customs and controls [9, 40].

If social identity is taken as inextricably tied into one’s orientation to differing groups, this group of online students and their method of introducing themselves to their instructor and classmates reflect this well. In their bid for membership, online students selected to link their personal and professional experiences to the extant frames they assumed were shared by others given the venue. These shared assumptions were comprised of well established, ingrained notions of academic and professional being that had developed through years of schooling enculturation. Whereas early CMC theoreticians predicted an anarchic override of well established hierarchies and social barriers in favor of social liberation, these subjects’ self-tellings reveal quite the opposite. Indeed, in accord with Montovani’s [41] observation that CMC reinforces social conformity, these data suggest that placing oneself along, and thereby establishing one’s identity on a well established achievement trajectory is a uniform trend for the students in this context of online course self introductions. These controlled self-tellings are miniature reflections of the tenacity of Western institutionalism and ritual. They reflect what is important in the minds of these well educated graduate students who have selected a career in Education. Moreover, they reflect the culture, ideology and value that these young people are taking into their classroom practices. The mantra of achievement and its formative, locally crucial role in identity formation is a powerful theme that plays a determining role in the languaging and consequent shaping of identity in this context with far-reaching implications for education professionals and their spheres of influence.

In sum, learning is very much tied to identity [11] and as such is an integral part of our instructional practices, both online and off. Understanding who our students are becomes even more critical online where we do not enjoy, and our impressions are not swayed by, the sociophysical features of human interaction. One manner of attaining some initial understanding of who our students are and how they see group membership in an online course is to undertake this sort of simple language concordancing. By doing so we can assess the frames and trajectories in which and on which our students collectively and individually self-place while confronting the trend that CMC is reinforcing established social/institutional boundaries and barriers.

IX. REFERENCES

1. **Sfard, A. and A. Prusak.** Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher* 34(4): 14–22, 2005.
2. **Bruner, J.** Self-making and world-making. In J. Brockmeier and D. Carbaugh (Eds.), *Narrative and Identity: Studies in Autobiography, Self and Culture*, 25–37. Amsterdam: John Benjamins, 2001.
3. **Bruner, J.** *Actual Minds, Possible Worlds*. Cambridge, MA: Harvard University Press, 1986.
4. **Abdelal, R., Y. Herrera, A. Johnston and R. McDermott.** *Identity as a Variable.* Weatherhead Initiative, Harvard University, 2005. http://www.wcfia.harvard.edu/misc/initiative/identity/publications/ID011605.pdf.
5. **Wenger, E.** *Communities of Practice: Learning, Meaning and Identity*. New York: Cambridge University Press, 1998.
6. **Norton, B.** Language, identity, and the ownership of English. *TESOL Quarterly* 31(3): 409–429, 1997.
7. **Goffman, E.** *The Presentation of Self in Everyday Life*. New York: Doubleday, 1959.
8. **Hansen, J. and J. Liu.** Social identity and language: Theoretical and methodological issues. *TESOL Quarterly* 31(3): 567–576, 1997.
9. **Kramsch, C.** Social discursive constructions of self in L2 learning. In J. Lantolf (Ed.), *Sociocultural Theory and Second Language Learning*. New York: Oxford University Press, 2000.
10. **Ochs, E.** Constructing social identity: A language socialization perspective. *Journal of Research on Language and Social Interaction* 26: 287–306, 1993.
11. **Wortham, S.** The interdependence of social identification and learning. *American Educational Research Journal* 41(5): 715–750, 2004.
12. **Chen, C.** The development of e-mail literacy: From writing to peers to writing to authority figures. *Language Learning Technology* 10(2): 35–55, 2006.
13. **Gee, J.** Identity as an analytic lens for research in education. *Review of Research in Education* 25: 99–125, 2001.
14. **Fairclough, N.** Technologisation of discourse. In C. Caldas-Coulthard and M. Coulthard (Eds.), *Text and Practices: Readings in Critical Discourse Analysis*, 71–83. London: Routledge, 1996.
15. **Pierce, B.** Social identity, investment, and language learning. *TESOL Quarterly* 29: 9–31, 1995.
16. **Luke, A.** The body literate: Discourse and inscription in early literacy training. *Linguistics and Education* 4: 107–129, 1992.
17. **Miller, D. and D. Slater.** *The Internet: An Ethnographic Approach*. New York: Berg, 2000.
18. **Wynn, E. and J. Katz.** Hyperbole over cyberspace: Self-presentation and social boundaries in internet home pages and discourse. *The Information Society* 13: 297–327, 1997.
19. **Schegloff, C.** Notes on a conversational practice: Formulating place. In D. Sudnow (Ed.), *Studies in Social Interaction*, 75–119. New York: Free Press, 1972.
20. **Bruner, J. and S. Weisser**. The invention of self: Autobiography and its forms. In D. Olson and N. Torrance (Eds.), *Literacy and Orality*. 129–148. Cambridge: Cambridge University Press, 1991.
21. **Polkinghorne, D.** *Narrative Knowing and the Human Sciences*. Albany, NY: State University of New York Press, 1988.
22. **D'Andrade, R.** A folk model of the mind. In D. Holland and N. Quinn (Eds.), *Cultural Models in Language and Thought*, 112–148. Cambridge: Cambridge University Press, 1987.
23. **Turkle, S.** *Life on the Screen: Identity in the Age of the Internet*. New York: Simon and Schuster, 1995.
24. **De Montes, L., S. Oran and E. Willis.** Power, language, and identity: Voices from an online course. *Computers and Composition* 19(3): 251–271, 2002.
25. **Hine, C.** *Virtual Ethnography*. London: Sage Publications, 2000.
26. **Lee, J.** Exploring the relationship between electronic literacy and heritage language maintenance. *Language Learning Technology* 10(2): 93–113, 2006. http://llt.msu.edu/vol10num2/lee/default.html.

27. **Nakamura, L.** *Cybertypes: Race, Ethnicity, and Identity on the Internet*. New York: Routledge, 2002.
28. **Warschauer, M.** *Electronic Literacies: Language, Culture, and Power in Online Education*. Mahwah, NJ: Lawrence Erlbaum, 1999.
29. **Byam, N.** The emergence of on-line community. In S. Jones (Ed.), *Cybersociety 2.0: Revisiting Computer-Mediated Communication and Community*, 35–68. Thousand Oaks, CA: Sage, 1998.
30. **Meskill, C.** *Teaching and Learning in Real Time: Media, Technology and Language Acquisition*. Houston, TX: Athelstan, 2002.
31. **Giese, M.** Self without body: Textual self-representation in an electronic community. *First Monday* 3(4): 1998. http://www.firstmonday.org/issues/issue3_4/giese/.
32. **Biber, D., S. Conrad and R. Reppen.** *Corpus Linguistics: Investigating Language Structure and Use*. New York: Cambridge University Press, 2002.
33. **Lazonder, A., P. Wilhelm and S. Ootes.** Using sentence openers to foster student interaction in computer-mediated learning environments. *Computers and Education* 41(3): 291–308, 2003.
34. **Davis, B. and P. Mason.** Trying on voices: Using questions to establish authority, identity, and recipient design in electronic discourse. In P. Levine and R. Scollon (Eds.), *Discourse and Technology: Multimodal Discourse Analysis*, 47–58. Washington, DC: Georgetown University Press, 2004.
35. **Potter, A.** Interactive rhetoric for online learning environments. *Internet and Higher Education* 7: 183–198, 2004.
36. **Johnstone, B.** *The Linguistic Individual: Self-Expression in Language and Linguistics*. New York: Oxford University Press, 1996.
37. **Gee, J., A. Allen and K. Clinton**. Language, class, and identity: Teenagers fashioning themselves through language. *Linguistics and Education* 12(2): 175–194, 2001.
38. **Chouliaraki, L. and N. Fairclough.** *Discourse in Late Modernity: Rethinking Critical Discourse Analysis*. Edinburgh: Edinburgh University Press, 1999.
39. **Halliday, M. and R. Hasan**. *Language, Context and Text: Aspects of Language in a Social Semiotic Perspective*. Oxford: Oxford University Press, 1985.
40. **Lemke, J.** Metamedia literacy: Transforming meanings and media. In D. Reinking, M. McKenna, L. Labbo and R. Kiffer (Eds.), *Handbook of Literacy and Technology: Transformations in a Post-Typographic World*, 283–302. Mahwah, NJ: Lawrence Erlbaum Publishers, 1998.
41. **Mantovani, G.** Is computer-mediated communication intrinsically apt to enhance democracy in organizations? *Human Relations* 47(1): 45–62, 1994.

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