What do We Mean by Cyberlearning: Characterizing a Socially-Constructed Definition With Experts and Practitioners

Devlin B. Montfort*

Shane Brown*

**Department of Civil and Environmental Engineering*

Washington State University

405 Spokane St, Sloan 101

Pullman, WA 99164-2910

(Tel) 509-335-2576

(Fax) (509) 335-7632

dmontfort@wsu.edu

Abstract

The term "cyberlearning" reflects a growing national interest in managing the interactions of technology and education, especially with respect to the use of networking and information technologies. However, there is little agreement about what the term means. Such disagreements reflect underlying differences in beliefs about the purposes of education. These disagreements are problematic for anyone interested in evaluating cyberlearning practices. This study used surveys and interviews to investigate how practitioners and experts in the field of cyberlearning define it, how they implement it and what they believe its purpose to be. Little agreement was found among participants in terms of their definitions of cyberlearning, which was supported by the wide variety of practices labeled "cyberlearning." Although most participants emphasized the purpose of cyberlearning as a form of content delivery, an often-passionate minority argued for the potential of cyberlearning to encourage a shift away from content-delivery paradigms. The participants' spoke from a variety of perspectives about cyberlearning including as educators, designers, activists, and policymakers, which led them to construct diverse narratives about the purposes and problems facing education and education policy. While the differences in embodied in these narratives remain an important consideration, some emerging points of convergence are identified.

Keywords: cyberlearning, pedagogy, educational technology policies

Introduction

"Cyberlearning" is a term that has recently risen to prominence, and reflects an important shift in approaches to educational technology. The National Science Foundation (NSF) Taskforce on Cyberlearning published a report in 2008 that is often described as the origin of the term, and provides an insightful and thorough meta-analysis of the literature and general movements in educational technology that led to the authors' adoption of the term (NSF Task Force on Cyberlearning 2008). The Taskforce defined cyberlearning as "…the use of networked computing and communications technologies to support learning" (p. 5). The authors go on to explain that although the prefix "cyber" has come to be associated with computer technology, they also intend it to be used in its original sense, which was "…built etymologically on the Greek term for 'steering'." Although the focus is clearly on the networking technologies that are defining the Information Age (e.g. cloud computing and social media), the report authors intentionally left the term open in order to refer to any form of future technology that mediates the human interactions that are at the heart of education. It is this inclusiveness that marks the important development inherent in the term. Instead of attempting to name the newest technologically driven advances in education, the Taskforce aimed to create a term that would encapsulate the way technology and education interact, without specific reference to a particular innovation or even era. Changes in education and learning due to technological/cultural shifts are unavoidable, the report argues, but careful planning can ensure that those changes are positive. A recently released Request for Proposals in NSF's "Cyberlearning: Transforming Education" program builds on this definition of the term, and calls for "cyberlearning research [that] will marry what is known about how people learn with advances in information and communications technologies" in order to "cultivate a citizenry" more able to address current societal needs (see program solicitation at http://www.nsf.gov/pubs/2011/nsf11587/nsf11587.pdf).

Most definitive reports (Committee on Improving Learning with Information Technology 2003; Steering Committee on Improving Learning with Information Technology 2002; Atkins et al. 2003) approach educational technology in basically the same way by focusing on the unrealized potential of existing technology to change the practice of engineering. The background for these reports focuses on national problems, such as the United States' ability to stay competitive in a global economy, and places education in the context of a possible solution to these problems. The U.S. Department of Education's (DOE) National Education Technology plan for 2010, however, deems education to be intrinsically valuable, and therefore approaches educational technology with a different emphasis (Office of Educational Technology 2010). The focus is on how technology—particularly the networked computer and communications technologies emphasized in the original definition of cyberlearning—could fundamentally change the nation's education system to provide more equitable educational opportunities for all learners.

These differences may seem academic or semantic in nature, but they underscore a facet of the interactions between education and technology that may be centrally important in shaping education in the future. The formulation and implementation of public polices can be difficult enough, even when stakeholders generally agree on the intended goals of the policies (Fischer 1995). When those involved disagree about exactly what the problem is, developing policy becomes what Rittel and Webber (1973) called a "wicked problem," which cannot be solved through standard means. In the case of education and technology, Zucker (2008) argues that there are six distinct goals that stakeholders could be referring to when they discuss "improving schools."

The DOE and NSF Taskforce reports seem to be laying out different narratives about cyberlearning that cast education and technology in different roles. Public policy arises as much from these defining narratives as it does from the more overt interactions between stakeholders (Heclo 1978; John 2003; Kingdon 2003; Stone 2002). The purpose of this study is to begin to investigate these potential differences in a specific (and therefore manageable) context, and to analyze their implications for the future of education.

Characterizing a Constructed Meaning

It is not the goal of this work to describe the different ways in which individuals define the word "cyberlearning," but rather to investigate differences in the shared meaning of that term. In this paper, a "shared meaning" is one that is socially constructed by members of a community. This is a challenge to measure, and must be carefully operationalized in ways that don't subvert the intended focus on the participants' perspectives in favor of our own interpretations as researchers. We have operationalized the constructed meaning of cyberlearning to consist of three parts: how it is defined, how it is applied, and how it is intended to be applied. The differences between the last two items draw on what has been referred to as the differences between "formal" (also called "distal") definitions of a field that are idealized and generally apply to others, and more "practical" or "proximal" definitions that are actually employed by an individual in their decisions and behaviors (Hogan 2000; Sandoval 2005).

Purpose and Research Questions

The purpose of this study is to investigate whether the fundamental differences in approach to cyberlearning apparent in various national reports are pervasive, and to begin to characterize the socially constructed concept of cyberlearning as it stands in the field now. In order to characterize this constructed meaning, the following research questions must be answered:

1. How is cyberlearning defined, implemented, and intended to be implemented by the participants?
    a. In what ways is the meaning of cyberlearning shared among the members of a community, and in what ways does it differ?
2. What narratives about cyberlearning emerge from those constructions of cyberlearning?
    a. What are their implications for how individuals will address or respond to policy about cyberlearning?

Methods

The first methodological decision necessary for this study was to choose which community the constructed meaning of cyberlearning would be investigated within. The defining of communities is a significant research endeavor in itself, so this research required a somewhat formally defined group whose members would be expected to share some important features. The community chosen for this study was limited to educators and educational researchers primarily applying cyberlearning in the undergraduate university setting. This is an example of what Patton (2002) calls “critical case sampling,” because differences in this limited group would support the assumption that there would also be differences in larger and more diverse groups. Other communities (e.g. K-12 educators, or stakeholders interested in education but not directly involved in a public school) may collectively be different than the university educators studied here. This is discussed as a potential direction for future research in the Conclusions section.

Data Collection

Data was collected through two means: a survey of current practitioners, and interviews with noted experts on educational technology. The combination of these methods allowed for both the breadth and depth necessary to achieve the purposes of this research. The general intent of the survey was to include as many diverse people as possible in answering the three research questions. (See Table 2 for a summary of how each survey question contributed to answering the research questions.) A combination of closed and open-ended questions was used in order to maximize the comparability of responses while still maintaining the openness needed to address the research questions. The open-ended questions were necessary to capture the range of possible responses, and also served to clarify or support responses to the closed questions. The survey design drew from the national reports cited previously, and was pilot tested. Even open-ended questions in surveys, however, could not provide the depth necessary to characterize the participants’ understanding of cyberlearning. The interviews gave this required depth, and also provided a means of triangulation with survey results to check the survey content validity (Maykut 1994; Wolcott 1994). The interview questions were designed parallel to the survey questions, and drew from the same sources.

Participant Identification

Survey Sample Selection

Information was downloaded on all active and recently expired Course, Curriculum and Laboratory Improvements (CCLI, now known as the Transforming Undergraduate Education in Science, Technology, Engineering, and Mathematics program) grants through NSF’s Award Search Utility. Of these projects (nearly 1,600), 298 were identified as involving cyberlearning through the content of their abstracts and titles. Based on the national reports cited above, cyberlearning was taken in this study to refer to any form of learning mediated by technology in a way that changed the learners’ access to and interaction with information.

The 298 awards identified reflected a broad range of start dates (1995 to December 2010), sizes (single institution Type I grants to Type III’s), content areas, and organizing institutions. Additionally, 42 projects in various award programs were identified through the Award Search utility that included the term “cyberlearning” in the title or description. The total sample included 340 projects.

This sample was designed primarily for diversity in what Patton calls maximum variation sampling (Patton 2002). The goal is to include participants in the sample who are expected to be very different in terms of the research purpose. Due to the popularity and centrality of the CCLI program, this sample is also a fairly broad cross-section of those involved in post-secondary science, technology, engineering, and mathematics education.

All of the 340 project Principal Investigators (PI's) were invited to participate in an online survey. Following Dillman's (2007) methodology to increase survey response rate, each PI was contacted three times: a first invitation, a second reminder, and a final notification of the survey's ending date. Each contact with the PI's was personalized with the inclusion of their name, as well as a direct reference to the title of their project. Finally, each invitation explained that the survey was designed to take less than 15 minutes to complete. The combination of these practices is expected to have increased the survey response rate by 15 to 40 percentage points (Dillman 2007; Schaefer and Dillman 1998).

Of the 340 people invited to participate in the survey, 198 (58%) eventually responded. The respondents reflected the same diversity as the 340 projects identified in terms of project scope, start date (including completed projects and projects that had not yet started), geographical location, and type of grantee (including single researchers, multi-institution collaborations, non-university institutions, and collaborations with K-12 public schools). The largest difference between the respondent pool and the total population is that a slightly lower proportion of PI's from CCLI Type 3 projects responded. Seven of the 19 CCLI Type 3 PI's (38%) eventually completed a survey.

This is a low overall response rate, but is within the expected range of unsolicited email surveys (Schaefer and Dillman 1998). A possible reason for the low response rate is the intentionally open inclusion criteria. A PI involved with a project utilizing scientific modeling in the classroom, for example, may not be sufficiently interested in cyberlearning or educational technology to volunteer time. Dillman proposes up to 30 repeated requests to each participant, or the use of financial incentives to increase the response rate above the typical 60% (Dillman 2007), but such a campaign was deemed inappropriate with this population.

Interview Sample Selection

Potential interviewees were identified through three channels. First, the abstracts of the 340 CCLI projects previously identified as including cyberlearning were reviewed, and the PI's of projects directly investigating cyberlearning processes, implementation, or outcomes were included. This resulted in 54 potential interviewees, of which 20 agreed to be interviewed. The second source of interviewees was the contributors to the national reports described in the Introduction section. Of the 33 listed contributors, 16 were unavailable or were not currently involved in work relating to cyberlearning. Six of the remaining 17 contributors agreed to be interviewed. Finally, each interviewee was asked to recommend other potential interviewees. Although references to local collaborators (for example the IT consultant in their department) were frequent, these were not pursued, because they would increase the scope of the project without adding significant new information. Of the remaining references, 26 were recognized experts, and 5 were general recommendations (to talk to university administrators, for example). Six of the experts referred had already been interviewed, as well as representatives of 4 of the 5 general recommendations, so the recommendation process resulted in 20 potential interviewees, leading to four additional interviews.

Table 1 summarizes the response rates of invited interviewees. Although 28% is a low response rate, it is important to note that the group of people interviewed was still able to provide important perspectives. The interviewees included governmental and non-governmental policymakers; widely published and recognized researchers in the fields of education and educational technology; and dedicated, experienced practitioners of cyberlearning.

Survey Development

The survey consisted of 13 questions designed to collect information about the respondents' constructed meaning of cyberlearning. As operationalized in this study, this consists of (1) how they define it, (2) how they have implemented it, and (3) how they think it should be implemented. Participants were encouraged to express their definition of cyberlearning in open-ended questions, as well as respond to others' definitions. The responses to others' definitions of cyberlearning were obtained by asking the participants to rank components of cyberlearning in terms of the importance to them. The components of cyberlearning were taken from the definitions put forth in the national reports cited previously. For example, survey items 4 and 5 asked participants to rank the importance of "flexibility in assessment" as a potential component of cyberlearning, because its potential to enhance assessment was a frequent theme in NSF's Taskforce on Cyberlearning Report (NSF Task Force on Cyberlearning 2008), and the Blue-Ribbon Committee on Cyberinfrastructure (Atkins et al. 2003). The following potential components of cyberlearning were included in the survey: connecting educators; flexibility in assessment; high quantity, quality, and diversity of data available to learners; personalization of how, when, and where learning occurs; inclusion and motivation of diverse students; and an "Other" category.

Further questions were included to clarify what participants took each of the components to mean. The follow-up questions about flexibility in assessment, for example, asked participants to rank the following potential sub-components: fast or real-time assessment feedback; archiving for program evaluation (e.g. accreditation, progress reports); and archiving for formative, student-centered feedback. These sub-components were also based on the differing definitions of cyberlearning included in the national reports. The sub-components of flexibility in assessment, for example, were based on statements like the following one taken from DOE's National Plan summarizing assessment in the 21st century: "The model of 21st century learning requires new and better ways to measure what matters, diagnose strengths and weaknesses in the course of learning when there is still time to improve student performance, and involve multiple stakeholders in the process of designing, conducting, and using assessment" (Office of Educational Technology 2010). The structure of the survey and the wording of each question were piloted within a focus group of three typical engineering faculty members to improve clarity and ease of implementation. The survey questions are summarized in Table 2, and reproduced in full in an appendix.

The survey responses imply that the wording and predefined categories captured the majority of the participants' perspectives. For question 5-12, for example, only 10% of respondents (about 20 individuals) noted that they were unable to rank the items. In each case approximately half attributed their inability to rank them based on equal importance, writing for example, "I think these are all quite important, and the differences between my rankings are slight," or "These are all equally highly ranked for me." Half ascribed it to poor question design: "I'm not really clear on the differences between some of these items," or "These different components did not make sense to me. I'm not really sure how to rank them." Some of the participants who selected "Other" made comments that suggested that their projects would fit into one of the predefined categories, but the respondents had been confused by the wording of the prompt. For example, one respondent wrote "fast feedback. But I would say that 'flexibility in assessment' [one of the predefined components] becomes more limited." Comments in the "Other" responses that did not fit into existing categories are reported and described in the Results section.

Interview

Similar to the design of the survey, a key requirement of the interview protocol was that it be short to encourage participation. Each interviewee was asked the following questions:

1) How would you explain the term "cyberlearning" to someone?
2) Would you talk about it differently with different audiences?
3) Overall, what are the pros and cons of cyberlearning?
4) How have you been involved in cyberlearning?
5) What personal goals or values encourage you to be involved?
6) Do you encourage others to use it?
7) What have you found to be most important in designing successful cyberlearning, or achieving your goals with it?
8) What's an example of something you've done very well in this area?
9) What are potential pitfalls you could advise others to avoid?
10) If you were trying to evaluate programs utilizing cyberlearning, what would you look for?
11) Is there anyone else you recommend I talk to?
12) Is there anything that you believe is central to discussions of this topic that wasn't covered by these questions?

These interviews were semi-structured (Patton 2002), which means that although the 12 questions listed were asked in the same form to every interviewee, the follow-up and clarification questions were different in each interview. This combination of structure and flexibility is particularly well-suited to this study because of the emphasis on definitions and clarifications (Fontana and Frey 2003; Ginsburg 1997). The interviews were audio-recorded, and notes were taken summarizing the responses to each question (Emerson et al. 1995).

Like the survey questions, the interviews were designed to elicit participants' constructed meaning of cyberlearning in terms of its definition, application, and purpose. The freedom to follow up with spontaneous questions during semi-structured interviews, however, meant that each question could potentially address any aspect of their constructed meaning of cyberlearning. These follow-ups were also essential in describing the narratives in which participants' responses were framed. When participants seemed uncomfortable with the wording of a question, for example, it was possible to directly address which assumptions or word choice was problematic. This often encouraged participants to explain their perspective, rather than simply answering questions.

Analysis

The audio recordings, interview notes, and survey responses were all collected in a qualitative analysis program. The interview and open-ended survey responses were categorized based on common or similar responses. This required a two-pass approach to coding, in which the first pass described the data by simply labeling the responses, and the second pass collected the similar labels into categories (Braun and Clarke 2006; Miles and Huberman 1994). For example, the survey question about the benefits of cyberlearning, and the interview question about its pros and cons shared the same general categories, some of which are listed in Table 3. Every response to each survey item and interview question was categorized in this way. The Results and Discussion arose from comparing the prevalence and content of the different categories.

The second research question guiding this work investigates the narratives implied by participants' constructed meaning of cyberlearning. Analysis at this level requires more interpretation and inference, but is still originally and iteratively based in the participants' statements. Of particular importance in describing these narratives were the assumptions that participants made, and which aspects of cyberlearning they emphasized over others. Comparison between participants also played a vital role in providing the perspective necessary to describe the various ways in which participants approached the concept of cyberlearning.

Results

The participants' constructed meaning of cyberlearning (the first research question) is addressed in the Results section. The narratives implied by those constructed meanings (the second research question) will be addressed in the Discussion section.

How is it defined?

There was very little agreement among the participants about the definition of cyberlearning. Thirty-six percent of the survey respondents said that they preferred to use terms involving "online" or "web" instead of cyberlearning, indicating that they believed the term to be limited to those technologies. Similarly, 30% of the interviewees limited cyberlearning to only involving networked or online technologies, while 53% included other computer-based technologies. The remaining interviewees either did not use the term, or were unwilling to define it so precisely. A small number of participants limited the term to one specific technology, such as the use of interactive visualizations, or used it as a synonym for distance learning.

The results are characterized by divisions among the participants, in which a small group argues against the perspective expressed by a larger group. For example, although the majority of participants viewed cyberlearning primarily as a new form of content delivery, some interviewees argued that this view limits the transformative potential of the technology by tethering it to outmoded practices and pedagogies. Similarly, a small group of participants argued strongly that cyberlearning is no different than traditional learning, saying, for example, "It is all learning. I am not certain that it needs to be categorized," or "It has never occurred to me to differentiate this as a special kind of learning. But I would call it something like 'learning with technology.'" Participants arguing this point often provided the longest responses in the short-answer survey questions, because they provided supporting reasoning and evidence. For example, in describing the term preferred to cyberlearning, one participant wrote, "Learning. Cyberlearning implies learning is different when mediated by web-based technologies. Learning is not any different. Different technologies are being used. Like distance learning. Learning is not different, but teaching is being mediated by a different set of technologies. If you had to go with one word, I suggest cyberteaching, because teaching might be different, but learning is not different."

Participants with more expertise in communication and information technology understandably defined cyberlearning in terms of the technological challenges and opportunities it presented. In particular, they referred to the problem of how to design cyberlearning systems that are stable, but don't rely too heavily on underlying infrastructure that is likely to change. Many participants noted that the newness of the field and the speed with which technology and our relationship to it is changing requires effective projects to be forward-looking. Instead of developing one tool to meet a specific need, for example, one interviewee suggested focusing more on developing an architecture that would create the means to develop infinite tools to meet different needs. One interview participant said, "It's software, so as much as we try to make things platform-independent, it's not, and things become obsolete." Additionally, many participants referred to the problem of how to integrate non-technical end-user feedback into useful product specifications. When discussing the target audience, some respondents referred to the difficulty in defining the end-users for cyberlearning materials. In one sense, it is obviously the learners themselves, but many respondents also pointed out the vital role instructors play in choosing content and practices to be made available to the learners. This was mostly referenced in the context of K-12 settings, but it was also an issue in universities. One survey respondent advised, "If you are engaging with technology solutions, while your institution in general does not, then it's harder to get the students excited about it. It's hard for them when … they have only one class which actively and creatively uses technology."

About 10% of participants mentioned motivation as a component of learning that is especially important in the context of cyberlearning, but half of those participants were referring to students' motivations, and the other half were referring to instructors'. A similar proportion of participants referred to students' technical competencies as vital, but again the references were only tangentially related to each other. About half of those participants felt that cyberlearning would benefit from students' existing proficiencies that weren't otherwise being utilized in most education, while the other half listed low student understanding of technology as one of the primary potential pitfalls facing educators hoping to implement cyberlearning.

How is cyberlearning applied?

Most participants used multiple forms of cyberlearning. Generally, more complicated or resource-intensive forms of cyberlearning (e.g. remote access laboratories) were less popular than the simpler forms. The majority of respondents (87%) indicated that they used online learning modules. Because online learning modules is a very general phrase, it might appear that participants really are only using one form of cyberlearning, but included online learning modules because it constituted a part of their overall use. For example, a participant might have only used cyberlearning in the form of a remote access laboratory, but included online learning modules because some of the lab reports and procedures were available online. The data, however, show that only 14 respondents (about 7%) checked online learning modules and only one other form of cyberlearning. Table 4 summarizes the data from survey item 3, which asked participants to identify which forms of cyberlearning they had utilized. Respondents that marked "Other" were asked to "please specify" in a comment box. These responses resulted in two new categories noted with asterisks in Table 4. Six percent of participants used cyberlearning in a form that emphasized collaboration between students, and 3% used online course management systems. The remaining comments varied, including references to visualization, grading, games, access to scientific resources, and specific proprietary programs or systems.

One surprising feature of this data is that most of the participants used cyberlearning in a variety of ways. This reflects a constructed meaning of the term that transcends specific practices and perhaps technologies. The dominant implementations (i.e. the first four rows in Table 4) emphasize changes in the way content is communicated, rather than deeper pedagogical changes. The implementation of virtual laboratories, computerized scientific modeling, and personal response systems, however, are all likely to incorporate more interaction than typical lectures. This suggests that most participants are using cyberlearning as a tool to pursue their existing pedagogical practices and goals, without significantly modifying them.

What is the purpose of using cyberlearning?

As suggested by the different interpretations of cyberlearning included in the national reports cited previously, one of the ways peoples' understandings of cyberlearning can differ is in their assumptions about its purpose. For many of the participants in this study, the purpose of cyberlearning was clearly focused on the delivery of content to students. When asked to pick the most important aspects of cyberlearning, for example, 75% chose options centered on students (as shown in the first three rows in Table 5), while only 15% chose components emphasizing the instructor's role (the last two rows in Table 5). The emphasis on students is even more pronounced when the follow-up survey questions are considered. The student-centered sub-components of "Flexibility in assessment" were much higher-ranked than the administrative components, as shown in Table 6.

In response to the open-ended question, "What are the benefits of cyberlearning?" 80% of the survey respondents emphasized the benefits of information access for students. Access to data also stood out among the interviewees' responses to a similar question, although their more diverse responses meant that even though it was among the most common responses, only a third of the interviewees mentioned it. Most interview participants, however, also emphasized the ways in which cyberlearning forces instruction away from a transmissionist model of simply delivering information to the students. The use of cyberlearning as a communication tool was the most marked difference between the practitioners who responded to the surveys and the experts who were interviewed. While most of the survey respondents viewed cyberlearning as a new way to transmit information, most of the experts (nearly 75%) emphasized the ways in which cyberlearning could increase co-construction of knowledge with students. As one interviewee put it, "To the extent that it [cyberlearning] is just an automated version of having them read something and answer questions…it's really not all that exciting."

There are two additional purposes of cyberlearning that were cited by small but significant portions of both the survey and interview respondents. First, three of the interviewees defined cyberlearning as the use of technology to allow students access to what was referred to in one interview as "authentic science." This also appeared in the survey responses in respondent comments, although in very low numbers (one or two comments per question). This view is intellectually related to earlier movements in educational technology. As described in the 2008 Taskforce Report, one motivating force behind the interest in cyberlearning is the desire to leverage cyberinfrastructure investments in the sciences to also improve science education (NSF Task Force on Cyberlearning 2008). As described by one interviewee, the best way to achieve this policy goal is to use the same cyberinfrastructure resources in the classroom as scientists are using in their research.

The second alternative purpose emphasizes the potential power of cyberlearning in creating more equitable education in the United States. Similar to the DOE's report (Office of Educational Technology 2010), these interviewees took education to have an inherent value based on their personal values and beliefs about society. They therefore described access to education as a national problem, instead of the solution to various challenges (for example the need for a more innovative and skilled workforce). Cyberlearning is seen as a way to change educational practice, perhaps even somewhat subversively. One interviewee gave the example of how smartphones with internet access have significantly weakened the "pretense of authority" inherent in traditional, lecture-based courses. For this small group, cyberlearning is a tool to be used in encouraging paradigmatic changes in the practice of formal education toward a more decentralized, equitable model.

Somewhat surprisingly, considering the diversity of expressed purposes for implementing cyberlearning, 26 of the 30 interviewees said that they actively promoted the use of cyberlearning. Many of the survey responses also placed the respondent in the role of a proponent of cyberlearning. For example, one respondent wrote, "We need to have enough user support so that teachers and students feel they can use the tools properly." Some participants at universities focused on encouraging their colleagues to adopt cyberlearning practices, others focused on K-12 teachers, and still others have targeted school administrators. For these participants, part of the purpose of implementing cyberlearning is to encourage others to implement it.

Discussion

The second research question guiding this study concerns the narratives embodied in the participants' constructed meanings for cyberlearning. In order to best illustrate the importance of these narratives, we have chosen the three that were most strongly represented in the data, and which have profoundly different implications. Following the description of these narratives in the following sub-sections, Table 7 presents them in what is meant to be a convenient summary of the narratives as we have interpreted them.

One Issue Among Others

Four of the interviewees involved in this study were faced with the dilemma of establishing policies about cyberlearning, either as administrators in their educational institutions, or as leaders of national agencies committed to supporting and improving science education. Participants from this perspective unanimously expressed the narrative of cyberlearning as one management problem among many. In the larger context of group decision-making, cyberlearning and education policy in general are questions of compromise and resource allocation. This means that one of the primary challenges posed by cyberlearning in this narrative is how to measure its effectiveness. As described above, diverse fields of expertise all bear on cyberlearning, and its implementation is as important as its design in determining its effectiveness. It is very hard to assess the effectiveness of any policy with regards to cyberlearning while taking all of this into account. The difficulty in assessing the effectiveness of proscriptive cyberlearning policies means that the push may be less to understand the phenomena or to develop effective metrics, but rather to craft a policy that achieves maximum benefit without the added cost of those complicated research tasks. Recent history suggests that the search for effective metrics could be contentious among educational researchers, which complicates the role of research in informing policy (see Feuer 2006; St. Pierre 2006), and, from the policymakers perspective, increases the cost of informing policy through educational research.

Policymakers are typically charged with representing some set of constituents who rarely express clear consensus of opinion. The formation of policy that satisfies disparate stakeholders is necessarily a process of compromise, where participants attempt to achieve a balance that adequately satisfies everyone's values and goals (Kingdon 2003; Smith and Larimer 2009; Stone 2002). This presupposition of eventual compromise, along with the need to evaluate the costs and benefits of various alternatives is vital to understanding this narrative's approach to cyberlearning. From this perspective, no one stakeholder or interest will be completely satisfied with the solution, and educational researchers' and practitioners' voices must be balanced against others'.

Opportunity for Reform

A small number of the participants understood cyberlearning as the set of changes educators must make "in response to societal changes." Many interviewees cited the societal and generational shifts accompanying new information technology, but these changes were central in only a few interviews and survey responses. One interviewee, for example, expressed certainty that physical textbooks will be replaced in the next decade by some form of online media. He viewed this as an economic necessity similar to the music publishing industry's struggles with the online market. For him, cyberlearning refers to the practical necessity for educators to be prepared to utilize resources that are unavoidably shifting to the online world. Another interviewee said that "students who have been born into cyberspace" would be expected to bring very different "motivations and skill sets to the classroom, and we [educators] *need* to capitalize on it."

This narrative is uniquely aware of the other narratives surrounding the issues of cyberlearning, particularly that of cyberlearning as a policy or management problem among many others. The clearest example of this was the way participants framing their responses in this narrative would directly address other narratives' concern for the cost of cyberlearning. One respondent wrote, "I think… that people who have never tried it think it is cheap," and one interviewee summarized, "I would be very surprised if cyberlearning turned out to be cheaper than traditional pedagogy." Although cost did not come up very often in the surveys (only about 5% of respondents mentioned it), most references to it phrased decreased cost as a potential benefit of cyberlearning, saying, for example, "It's cheap and easily replicable," or "lower cost versus hardcopy textbooks or physical labs." The interviewees who said that it wasn't cheap, then, were direction (and somewhat ruefully) identifying a potential obstruction in the way of cyberlearning-based reform.

Against the backdrop of rapidly shifting technological capabilities, participants also discussed educational reform as being "necessary" and "overdue." In this narrative, the educational system has failed to keep pace or respond to revolutions in educational research (e.g. the cognitive revolution or the emergence of constructivist learning theories), and is therefore suffering under outdated practices and modes of thinking. Broad educational changes are imminent, inevitable, and necessary, but will not necessarily be positive. People who view cyberlearning and the future of educational technology through the framework of this narrative are attentive to it in the context of public policy, and motivated to work toward realizing their visions for the nation's education system to ensure that these inevitable changes are leveraged to accomplish existing reform goals.

Latest Trend

Many survey respondents and a few interviewees felt that, regardless of how cyberlearning was defined, the interest in it implied by the existence of this study was more than it merited. While this perspective was relatively rare among the interviewees (as might be expected due to the selection criteria of having established expertise related to issues of educational technology), there was an underlying frustration or confusion in a quarter to a third of the survey responses to any given question. As described in their definitions of the term, many participants felt that cyberlearning was just "learning," and that attention in the form of research studies, policies, or funding revealed a fundamental naiveté about education and educational systems.

In this narrative, cyberlearning is just the latest in an ongoing list of revisions to the educational system motivated and implemented by people who are fundamentally external to the systems being revised. This casts the educators—those embedded in educational systems—as struggling to maintain their own values, standards, and practices against changes that may contradict them. Several survey participants expressly argued against the perception that cyberlearning was a "panacea" that would solve any number of challenges on its own. Underlying these arguments is the assertion that a great deal of the complexity of education, and therefore the potential effectiveness of any reforms, is hidden from outsiders like researchers or policymakers, who are believed to be short-selling the true problems facing educators by trying to fix education with broad and sweeping changes.

Conclusion

The single most common understanding of cyberlearning among the participants is that it is the use of networked computer technology to change the way content is delivered to learners, and that this slight change does not generally merit the interest being paid to it. This perspective on cyberlearning—and the narrative describing the nation's education system and the policies intended to shape it—is prevalent even among this sample of university educators specifically chosen because of their NSF-funded interest in implementing cyberlearning in their classrooms.

The point in summarizing it this way is not to imply judgment or relative merit compared to the other perspectives implied and discussed in this paper, but to emphasize the apparent and fundamental *differences* between this perspective and that assumed by both policymakers and educational researchers. These differences may explain a great deal of the history of contentious educational reform. We would like to suggest, however, as part of our own narrative of cyberlearning, three important ways in which these contradictory narratives converge.

First, none of the participants disparaged or devalued the importance of effective assessment in the implementation of cyberlearning, or any educational efforts. While the scales and emphases of the proposed assessments were different, particularly in the case of the importance and expected efficiency in terms of cost, all three narratives shared a basic respect for the importance and difficulty of assessment. Secondly, policies addressing cyberlearning in and out of the classrooms will need to explicitly address the differences between schools' access to technology and how those differences often align with demographic differences among their students. In this way, the practical goal of uniform standards for education may align with the more abstract goal of equity in education. Finally, the participants' various perspectives on cyberlearning and its purpose highlight the need for more information; practitioners need more information about what learners know, product designers need more information about how their tools are being used, and everybody needs to know more about how these carefully-designed cyberlearning tools are actually being implemented, and their effects on students. In what is both a great challenge and opportunity, there is a great deal of knowledge situated in different academic fields that could help those involved with cyberlearning.

Future work on this topic may necessarily be confined to specific disciplines and narratives (as this work is), but these efforts can be targeted specifically toward the potential for convergence. Of particular interest would be research explicitly focused on characterizing the differences in understanding of assessment between important stakeholders in the educational policymaking process. Similarly, further describing the narratives that educational researchers, practitioners, and policymakers use to frame discussions of equity and access to technology in public educational settings could be enlightening, and help the entire policy process more accurately incorporate disparate viewpoints. Finally, the work reported here is focused relatively narrowly on the university level. It will be an important future step to include perspectives from K-12 education, as well as from those involved in education outside of the traditional public schooling systems.

Acknowledgements

This report was prepared during an internship funded by Washington State University's "Nitrogen Systems: Policy-oriented Integrated Research and Education" (NSPIRE) program (NSF grant number DGE - 0903714) for Russell Pimmel, a Program Director in the National Science Foundation's (NSF) Division of Undergraduate Education.

References

Atkins, D.E., Doroegemeier, K.K., Feldman, S.I., Garcia-Molina, H., Klein, M.L., Messerschmitt, D.G., et al. (2003). Revolutionizing science and engineering through cyberinfrastructure: Report of the National Science Foundation Blue-Ribbon advisory panel on cyberinfrastructure.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*, 77-101.

Committee on Improving Learning with Information Technology (2003). Planning for two transformations in education and learning technology: Report of a workshop. National Research Council.

Dillman, D.A. (2007). *Mail and Internet surveys: The tailored design method* (2nd ed.). Hoboken, NJ: John Wiley & Sons.

Emerson, R.M., Fretz, R.I., & Shaw, L.L. (1995). *Writing ethnographic fieldnotes*. Chicago: Univeristy of Chicago Press.

Feuer, M.J. (2006). Response to Bettie St. Pierre's "Scientifically based research in education: Epistemology and ethics." *Adult Education Quarterly, 56*(4), 267-272.

Fischer, F. (1995). *Evaluating public policy*. Chicago: Nelson-Hall.

Fontana, A., & Frey, J.H. (2003). The interview: From structured questions to negotiated text. In N. K. Denzin, & Y. S. Lincoln (Eds.), *Collecting and interpreting qualitative materials* (2nd ed.), pp. 61-106. Thousand Oaks, CA: Sage.

Ginsburg, H.P. (1997). *Entering the Child's Mind: The Clinical Interview in Psychological Research and Practice*. New York: Cambridge University Press.

Heclo, H. (1978). Issue networks and the executive establishment. In A. King (Ed.), *The new American political system* (pp. 97-124). Washington D.C.: American Enterprise Institute.

Hogan, K. (2000). Exploring a process view of students' knowledge about the nature of science. *Science Education, 84*(1), 51-70.

John, P. (2003). Is there life after policy streams, advocacy coalitions, and punctuations: Using evolutionary theory to explain policy change? *The Policy Studies Journal, 31*(4), 481-498.

Kingdon, J.W. (2003). *Agendas, alternatives and public policies* (2nd ed.). New York: Longman.

Maykut, P., & Morehouse, R. (1994). *Beginning qualitative research: A philosophical and practical guide*. Washington D.C.: Falmer Press.

Miles, M.B., & Huberman, A.M. (1994). *Qualitative Data Analysis* (2nd ed.). Thousand Oaks: Sage.

NSF Task Force on Cyberlearning (2008). Networked world: The cyberlearning opportunity and challenge. National Science Foundation.

Office of Educational Technology (2010). Transforming American education: Learning powered by technology. Draft National Educational Technology Plan. U.S. Department of Education.

Patton, M.Q. (2002). *Qualitative Research and Evaluation Methods* (3rd ed.). Thousand Oaks, CA: Sage Publications.

Rittel, H., & Webber, M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*, 155-169.

Sandoval, W.A. (2005). Understanding students' practical epistemologies and their influence on learning through inquiry. *Science Education, 89*, 634-656.

Schaefer, D.R., & Dillman, D.A. (1998). Development of a standard e-mail methodology: Results of an experiment. *The Public Opinion Quarterly, 62*(3), 378-397.

Smith, K. B., & Larimer, C.W. (2009). *The public policy theory primer*. Philadelphia: Westview.

St. Pierre, E. A. (2006). Scientifically based research in education: Epistemology and ethics. *Adult Education Quarterly, 56*(4), 239-266.

Steering Committee on Improving Learning with Information Technology (2002). Improving learning with information technology: Report of a workshop. National Research Council.

Stone, D.A. (2002). *Policy paradox: the art of political decision making* (Revised ed.). New York: W.W. Norton & Company.

Wolcott, H.F. (1994). *Transforming qualitative data: description, analysis and interpretation.* Thousand Oaks: Sage.

Zucker, A.A. (2008). *Transforming Schools with Technology: How smart use of digital tools helps achieve six key education goals*. Cambridge, MA: Harvard Education Press.

Table 1 Summary of sample selection and participation.

Source	Total Potential Interviewees	Unreachable / Non-responsive	Interviews Declined	Interviewed
NSF Award Search	54	26	8	20
Experts in Literature	33	16	3	6
Referrals	26	13	3	4
Totals	**107**	**63 (59%)**	**14 (13%)**	**30 (28%)**

Table 2 Summary of survey questions.

Prompt	Response Type	Component of Constructed Meaning Addressed
1. Do you prefer terms other than "cyberlearning" to refer to learning that is affected by computers, networked computers, the Internet, or web-based platforms or applications? If yes, what terms to you prefer?	Yes or No, with comment box	Definition
2. Please mark the forms of cyberlearning you have utilized as an instructor or designed for use by other instructors.	Multiple choice, with "Other" comment box	Use
3. What are the benefits of cyberlearning?	Short answer	Intended Use
4. Given the following potential components of cyberlearning, please choose which is the most important in determining the effectiveness in achieving your goals for cyberlearning.	Forced choice, with "Other" comment box	Use, Intended Use
5 – 12. Please rank the following potential components of cyberlearning in terms of their importance in achieving your goals for cyberlearning. Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)	Forced choice ranking, with comment box	Definition, Use, Intended Use
13. What does it take to make cyberlearning successful?	Short answer	Definition, Intended Use
14. What are some common mistakes or potential pitfalls you have discovered that may limit the effectiveness of cyberlearning?	Short answer	Intended Use

Table 3 Sample of categorization scheme for survey question 3 and interview question 2.

Category Name	Description (Responses emphasized…)	Characteristic Response
Assessment	Data collection, feedback, grading	"better ability to track student learning and provide automated or teacher

		feedback"
Equity	Creating access to typically underserved groups	"democratizing education across different populations"
Access to Information	Availability of data, resources, or modules designed to increase access to data	"Access to data; variety of resources"
Personalization	Flexibility to better suit individual students' needs	"24-hour access, students can choose their own pace, infinite attempts"

Table 4 Summary of survey responses to "Please mark the forms of cyberlearning you have utilized as an instructor or designed for use by other instructors." *These categories were not predefined options, but arose from the data.

Form of Cyberlearning	Respondents Indicating Use	Respondents Using Only This Form
Online learning modules	161 (87%)	10 (5%)
Supplemental reference materials (e.g. online textbooks)	109 (59%)	12 (6%)
Access to online databases or archives of scientific data	99 (54%)	1 (<1%)
Distance learning	78 (42%)	0
Virtual laboratories	75 (40%)	3 (2%)
Computerized scientific modeling	71 (38%)	1 (<1%)
Personal response systems	69 (37%)	1 (<1%)
Remote access laboratories	42 (23%)	1 (<1%)
Other	36 (7%)	0
Student collaboration*	11 (6%)	0
Online course management systems*	6 (3%)	1 (<1%)

Table 5 Responses to "Given the following potential components of cyberlearning, which is the most important in determining the effectiveness in achieving your goals for cyberlearning." *Each interviewee mentioned more than one benefit, so the total of their responses is greater than 100%.

Components of Cyberlearning	Survey Respondents Identifying it as Most Important	Interviewees Mentioning it as a Benefit of Cyberlearning*
High quantity, quality, and diversity of data available to learners	36%	43%
Personalization of how, when, and where learning occurs	26%	37%
Inclusion and motivation of diverse students	13%	3%
Other (Please Explain Below)	10%	60%
Connecting educators	10%	0%
Flexibility in assessment	5%	13%

Table 6 Survey responses to "Please rank the following potential components of 'flexibility in assessment' in terms of their importance to you or your project."

Potential Component of "Flexibility in Assessment"	Respondents who Ranked it as "Most Important"	Respondents who Ranked it as "Least Important"
Fast or real-time assessment feedback	57%	20%
Archiving for formative, student-centered feedback	30%	22%
Archiving for program evaluation (e.g. accreditation, progress reports)	15%	57%

Table 7 Partial summary of narratives implied in participants' constructed meanings of cyberlearning

Narrative	Problems Posed by Cyberlearning	Inclusive "We" That Faces the Problem	Values Informing Potential Solutions	Characteristics of Solutions Considered Effective
One Issue Among Others	Use of existing resources	Policymakers and constituents	Efficiency, Cost/benefit, Negotiated socio-political goals and values	• Measurable outcomes • Iteration to maximize benefits • Justifies past and ongoing expenses • Founded on ideals of compromise
Opportunity for Reform	Managing inevitable changes caused by technology to pursue reform goals	Diffuse group of "like-minded" educators and researchers, not officially organized	Student development, social justice	• Supports and guides any changes required of systems and people • Is perceived as "practical" by others without sacrificing core ideals • Found on educational research findings, including theories of learning
Latest Trend	No specific problem posed by cyberlearning, although misguided policies may create one	Diverse educators who may or may not be represented by larger organizations	Education as practiced and embodied in an inherently valuable system made of people	• Minimizes changes required in system • Supports changes with observable benefits • Respects educator expertise in development and implementation

Appendix

Survey Question 1

Do you use or prefer terms other than "cyberlearning" to refer to learning that is affected by computers, networked computers, the Internet, or web-based platforms or applications?

Checkboxes – Yes or No

If yes, what terms do you prefer?

Short-answer response field

Survey Question 2

Please mark the forms of cyberlearning you have utilized as an instructor or designed for use by other instructors.

Checkboxes – Online learning modules; Virtual laboratories; Remote access laboratories; Computerized scientific modeling; Access to online databases or archived scientific data; Personal response systems; Distance learning; Supplemental reference materials (e.g. online textbooks)

Other – Please specify.

Short-answer response field

Survey Question 3

What are the benefits of cyberlearning?

Short-answer response field

Survey Question 4

Given the following potential components of cyberlearning, please choose which is the most important in determining the effectiveness in achieving your goals for cyberlearning? Note that you will have a chance to elaborate on what these terms mean to you in the following questions.

Checkboxes – Connecting educators; Flexibility in assessment; High quantity, quality, and diversity of data available to learners; Personalization of how, when, and where learning occurs; Inclusion and motivation of diverse students; Other (please explain below)

Other

Short-answer response field

Survey Question 5

Please rank the following potential components of cyberlearning in terms of their importance in achieving your goals for cyberlearning.

Ranking checkboxes – Connecting educators; Flexibility in assessment; High quantity, quality, and diversity of data available to learners; Personalization of how, when, and where learning occurs; Inclusion and motivation of diverse students

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Survey Question 5 – Alternate (used if participants checked "other" in response to Question 4)

Please rank the following potential components of cyberlearning in terms of their importance in achieving your goals for cyberlearning.

Ranking checkboxes – Connecting educators; Flexibility in assessment; High quantity, quality, and diversity of data available to learners; Personalization of how, when, and where learning occurs; Inclusion and motivation of diverse students; Other (as explained above)

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Please describe an experience or example of when the component you listed in the "Other" category was particularly important or successful.

The following 5 questions ask for more information about the options you were asked to rank in Question 5. Each question refers to one of the components of cyberlearning listed in that question.

Survey Question 6

"Connecting Educators"

Please rank the following potential components in terms of their importance to you or your project.

Ranking checkboxes – Sharing lesson plans and/or curricular materials; Instructor-to-instructor interaction and/or counseling; Instructor-to-student interaction or lesson delivery; Building educator communities; Instructor-to-instructor sharing about students

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Survey Question 7

"Flexibility in Assessment"

Please rank the following potential components in terms of their importance to you or your project.

Ranking checkboxes – Fast or real-time assessment feedback; Archiving for program evaluation (e.g. accreditation, progress reports); Archiving for formative, student-centered feedback

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Survey Question 8

"High quantity, quality, and diversity of data available to learners"

Please rank the following potential components in terms of their importance to you or your project.

Ranking checkboxes – More information available to learners; More diverse information available to learners; More interaction between information and learners; More pertinent information available during tasks

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Survey Question 9

"Personalization of how, when, and where learning occurs"

Please rank the following potential components in terms of their importance to you or your project.

Ranking checkboxes – Availability of course materials outside of class time and/or place; Self-paced tasks and information; Information provided only when it is needed

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Survey Question 10

"Inclusion and motivation of diverse students"

Please rank the following potential components in terms of their importance to you or your project.

Ranking checkboxes –Access to information regardless of geographic location; Support for non-traditional (e.g. distance learning) curricula; Accommodation for multiple styles of learning; Support for diverse aptitudes and abilities within one course design

Any additional comments on your ranking? (e.g. ties or large differences between sequentially ranked items)

Short-answer response field

Survey Question 11

What does it take to make cyberlearning successful?

Short-answer response field

Survey Question 12

What are some common mistakes or potential pitfalls you have discovered that may limit the effectiveness of cyberlearning?

Short-answer response field