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TITLE: The American journal of distance education.
IMPRINT: University Park, PA : Office for Distance Education of the College
of Education at the Pennsylvania State University, c1987-
ARTICLE: Hillman, D. "a new method for analysing patterns of interaction"
VOL: 13 :NO: 2 :DATE: 1999
VERIFIED: OCLC ISSN: 0892-3647 [Format: Serial]
PATRON: Wilmarth, Paul

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Statement of Purpose

The American Journal of Distance Education (AJDE) is a refereed professional journal that provides research and information and act as a forum for critical reflection and practice of distance education in all its forms. The journal is on the role of print, electronic, and multimedia systems in the delivery of education to universities and colleges, business and industry and public schools.

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ones. Epistemologists debate the relative value of these approaches, since each operates under very different assumptions about the nature of truth. However, as researchers, we argue that all views of truth have an important perspective since they do, in fact, seek truth in different ways.

Administrators, politicians, and taxpayers will continue to want to know if the latest technology works as well as the status quo. And decision-makers will continue to put resources into studies designed to answer these questions. Simply decrying comparative studies as “passed” or “out-of-fashion” serves no useful purpose. There is no right frame when it comes to posing questions about the quality of learning and teaching. We need to find ways to improve comparative studies so that they can help us answer some (albeit not all) of the questions in our field. So to Dr. Saba, we respond by saying, yes, we are “fine-tuning”; fine-tuning poor research into fine research seems to be a fine idea.

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THE AMERICAN JOURNAL OF DISTANCE EDUCATION
Vol. 13 No. 2 1999

A New Method for Analyzing Patterns of Interaction
Daniel C. A. Hillman

Abstract

This case study examined a new method for analyzing patterns of interaction in face-to-face and asynchronous computer-mediated classrooms. Using software and a coding system developed by the author, the text of all spoken and written discourse was analyzed from four face-to-face (FTF) courses and two courses taught via computer-mediated communication (CMC). The results indicated that the interaction patterns in the computer-mediated courses resembled discussion, whereas the patterns in the FTF courses resembled recitation. In addition, problems with comparing synchronous FTF courses and asynchronous CMC are examined.

Introduction

Although the ease of storing and manipulating transcripts from courses taught via computer-mediated communication (CMC) has often been noted, little analysis of what occurs in a computer-mediated course has been performed. Much of the current examination of interaction in computer-mediated courses takes the form of counting participants’ e-mail or the number of characters sent. Unfortunately, this gives a rather cursory view of what really happens in the computer-mediated classroom. Counting e-mail messages or the characters in e-mail does not indicate the nature of what is said. For example, the message “What was the assignment for the next class?” could be described as a single post containing forty-two characters. Its pedagogical meaning, however, would be rather different from the message “The answer to the last test question is 42” or “You, sir, are a disgrace to the profession,” both of which meet the same numerical criteria.

On the other hand, relatively small samples of face-to-face (FTF) classroom interaction have been examined in great detail (Dillon 1994; Sinclair and Coulthard 1975). Given the large amount of labor involved in transcribing and coding such interactions, this research rarely examines large amounts of classroom discourse. In addition, due to the differing nature of FTF and computer-mediated interactions, coding systems used
for synchronous communication are inappropriate for analyzing asynchronous communication.

This study combines both forms of research. By using a modification of a coding system originally designed for the examination of FTF interaction and by taking advantage of the capabilities of inexpensive database technology for working with large quantities of data, this study examines patterns of interaction in both types of classrooms: specifically, by analyzing four FTF courses and two CMC courses.

Data Collection

The data for this study were recorded from courses in Systems Analysis and Database Management taught at the school of continuing education of a large metropolitan university. Four FTF courses and two courses taught via CMC were analyzed. Both the FTF and the computer-mediated courses covered the same information. The FTF courses met once a week for three hours over ten weeks. They were taught by two different lecturers and were observed during the fall of 1994 and the spring of 1995. Each FTF class contained between six and twenty-seven students, with a mean of 17.12 and median of 18 students. On average, there were nine males and eight females in each FTF class.

In the FTF courses, verbal interaction between teachers and students was recorded on audiocassette. The data were transcribed by people naive to the nature of this research. Only public interaction that had the potential to take place between all members of the course was transcribed; interaction between teachers and students during breaks or after class was not transcribed, nor was discussion among small groups of students.

The computer-mediated courses were offered as a series required for the completion of a certificate, and the same nineteen subjects—thirteen male and six female students—were enrolled in both. The computer-mediated courses were taught entirely at a distance via Lotus Notes groupware during the summer of 1995. Notes groupware permitted threaded asynchronous discourse as well as e-mail. The computer-mediated courses were taught by different primary instructors. In addition, the computer-mediated courses each had two to three secondary teachers who posted messages and answered questions but who did not disseminate the majority of the course content, and one guest teacher. At the end of the term, the public postings of the computer-mediated courses were downloaded from the Notes databases.

Problems in Comparing FTF Interaction

Comparing FTF interaction with CMC presents some problems. Some basic data collected in their examination. For example, the idea about the relationships that exist raw numbers. If a teacher does 90% of the talk, there is much discussion taking place.

Meaningful comparison of synchronous requires more than merely counting the number of teacher-student exchanges. In a face-to-face context, FTF interaction is limited by participants’ rate of speech. Given a normal average speaking rate of 250 words per minute (Bach & Schiffrin, 1982), one could expect about 37 minutes of FTF course. Taking into account that the number could not be exceeded significantly.

As with a FTF class, it is possible to say nothing in a given week; however, it is possible for many more words to be exchanged. In a CMC interaction, the input could range from hunting and gathering—talking for 5 minutes—s/he is limited only by the time. A single person, typing thirty words a minute, might type 352,800 words in a session, which does not include quoted text from newsgroups. The activity is often used to establish context, to “breathe” between courses of the number of words.

A second problem with using raw numbers themselves provide too much information about the discourse. One student, while another might post information that is redundant, counting alone fails to distinguish interaction, which do nothing more than talk. The CMC activity generated by participants is used to derive meaningful conclusions from the data from the courses, neglecting their qualitative aspect.
are inappropriate for analyzing asynchronous forms of research. By using a modification of the FTF Interaction of the capabilities of inexpensive computer with large quantities of data, this study explored both types of classrooms: specifically 25 asynchronous and two CMC courses.

Problems in Comparing FTF Interaction with Asynchronous CMC

Comparing FTF interaction with asynchronous CMC inevitably presents some problems. Some basic quantitative information can be helpful in their examination. For example, it is possible to arrive at a general idea about the relationships that exist in a classroom by examining the raw numbers. If a teacher does 90% of the talking, it is unlikely that there is much discussion taking place. However, more sophisticated analyses are impossible.

Meaningful comparison of synchronous and asynchronous interaction requires more than merely counting the number of words spoken or the number of teacher-student exchanges. In terms of a comparative word count, FTF interaction is limited by the length of each class and the participants' rate of speech. Given a three-hour class (with breaks) and an average speaking rate of 250 words per minute (Crystal and House 1982), one could expect about 37,500 words to be uttered per week in a FTF course. Taking into account the limits of these two variables, this number could not be exceeded significantly.

As with a FTF class, it is possible for members of a CMC course to say nothing in a given week; however, unlike a FTF class, it is also possible for many more words to be generated in a CMC class. Although each participant's output is limited by his/her typing speed—which could range from hunting and pecking to more than 100 words per minute—s/he is limited only by the week itself, rather than by classroom time. A single person, typing thirty-five words per minute, could theoretically type 352,800 words in a single week. Furthermore, this number does not include quoted text from previous participants which, in CMC, is often used to establish context. It is possible (though unlikely) for any given CMC student to contribute ten times more words than an entire three-hour FTF class, thus skewing the results of a straight comparison between courses of the number of words generated.

A second problem with using mere word counts in CMC is that the numbers themselves provide too little information about the nature of the classroom discourse. One student might post a new theory of relativity, while another might post information on how to make Money Fast; counting alone fails to distinguish. Yet, studies are routinely presented which do nothing more than tally the number of words, postings, or e-mail generated by participants in CMC and then attempt to draw meaningful conclusions from these numbers about what transpires in the courses, neglecting their qualitative aspects. The numbers themselves
mean little unless they are accompanied by an examination of the content of their words.

Comparing the raw numbers of social exchanges between FTF and asynchronous classrooms is a poor strategy as well. Given the nature of FTF classroom interaction, it would be unrealistic to presume that the same number of social acts occurring in FTF communication would occur in a class taught via asynchronous CMC. The majority of FTF classroom interaction takes the form of Initiation Response Feedback in which the teacher initiates an action, the student responds, and the teacher gives feedback (Dillon 1994; Sinclair and Coulthard 1975; Stubbs 1983b). In asynchronous communication, however, it would be impractical for the instructor to post a single question to a single student, wait for the response, and then follow up with an evaluation. Indeed, Paulsen (1995) recommends that CMC teachers spend a fair amount of time summarizing information, rather than responding to each point.

A further difficulty in comparing FTF interaction and asynchronous CMC is the effect of asynchrony on speech. Atkinson (1981) explains that the ability to respond and participate in synchronous interaction is made possible by associating one’s utterance with the one immediately preceding it. Asynchronous communication lacks this immediate feedback. One may still prefaced communication such as e-mail with a greeting, but one is unlikely to limit the message to just that portion and wait for an acknowledgment before continuing. Thus, the patterns of interaction between FTF and asynchronous CMC are different. For example, in CMC a question could be the direct result of interaction with the course content or in response to an utterance by the teacher or another student. The interaction cannot be examined merely in terms of the order in which it was transcribed; it must first be situated within its context.

Analyzing Discourse by Sentence

All these problems can be solved by examining small, purposeful units—sentences—by themselves in terms of their purpose in the communication process. Although the number of sentences uttered in a course will vary, the function, method, and ratio of the contents of these classroom interactions can be compared more fairly.

There is one difficulty in working with a system based on sentences. The problem lies in defining what the sentences are in the first place. Within conventional written language, sentences are easy to determine because the author defines them using the sentences from CMC transcripts as they are written. Examination is more difficult. People do not always convey the syntax of spoken language in written language (Crystal 1980). Spoken language is coordinated clause complexes rather than containing at least one subject with a verb and a phrase.

Stubbs (1983a) notes that an important sentence “involves making arbitrary, due to the large number of choices of other items such as but and then” of sentence structure are learned communication skill. As such, most experience in this area involves transcriptionists, people for whom reading is an essential job qualification.

Data Preparation and Management

During transcription of the FTF and CMC, whether the speaker was a teacher or a student, the computer-mediated courses were records on text files, their head was the coding characters similar to the FTF scripts were then broken down into database records. Each record contained the classroom name, the classroom role and the number of hours of classroom time for the record number, and finally, the text itself. (Some scripts display a single sentence, its record code from within three sets of context, views or layouts.)
of social exchanges between FTF and CMC. The majority of FTF interaction takes place through a form of Initiation Response Feedback in which, the student responds, and the teacher responds (Sinclair and Coulthard 1975; Stubbs 1983). In asynchronous CMC, however, it would be impractical to present a question to a single student, wait for an answer, and then respond with an evaluation. Indeed, Paulsen (1997) reports that teachers spend a fair amount of time responding to each point in a synchronous chat program.

When FTF interaction and asynchronous communication are compared, Atkinson (1981) explains that in FTF interaction the participant in a synchronous interaction is physically present, which means that an utterance with the one immediately following it in the conversation lacks this immediate feedback. In asynchronous communication such as e-mail, the effect of the message to just that portion of the intended audience is not immediate, and the message may be read at any time. The nature of the written message is therefore important in that it must first be situated within its context.

Data Preparation and Management

During transcription of the FTF courses, each paragraph of text was prefaced with a coding character to indicate the speaker's sex and whether the speaker was a teacher or a student. After the transcripts of the computer-mediated courses were downloaded from the Notes databases as text files, their header information was removed, and, by means of software written by the author, each posting was prefaced with coding characters similar to the FTF transcripts.

Using software written by the author, both the FTF and CMC transcripts were then broken down into sentences and converted into database records. Each record contained information about the course, class, and term from which the text was transcribed, the text's method of delivery, the classroom role and sex of its speaker, a unique, sequential record number, and, finally, the text itself. Between the four FTF courses and the two CMC courses, 52,081 sentences were recorded—the equivalent of 130 hours of classroom talk. The database was designed to display a single sentence, its record number, and radio buttons to select a code from within three sets of codes. (This was one of several possible views or layouts.)
The transcripts of both the FTF and computer-mediated courses were then printed out without information identifying the speakers. Using these transcripts, the coder could examine each sentence in its context while remaining ignorant to the sex and role of its speaker. To help the coder find the sentences in the printouts, the range of record numbers of the sentences in each paragraph was added to the end of each paragraph.

The latest version of this software integrates the sentence database with a World Wide Web server. This permits each sentence to be viewed in the context of its paragraph via a WWW browser while being individually coded. This also permits redundant and simultaneous coding with a minimum of data management.

**Coding System**

The coding system used was an adaptation of Bellack et al.’s (1966) model of pedagogical moves, which was originally designed to examine the back-and-forth interactions of a FTF classroom. The new system classifies each sentence on three levels. The first level of the coding system describes the purpose of the sentence. This serves to summarize the sentence’s instructional intent, and each sentence is coded as Organizing, Lecturing, Eliciting, Responding, Humanizing, Idling, or Not Clear. The second tier of the coding system describes the mechanism of the sentence, the means or agency by which the meaning of the sentence took place, or how the subject of the sentence was discussed. These codes are Fact-Stating, Explaining, Opining, Performing, Repeating, Rating, Rhetorical Device, Filler, and Not Clear. The final tier of the coding system refers to what was being discussed—the content being considered or statements about something. These codes consist of Person, Action, Procedure, Content, Supplies, and Not Clear.

Each sentence was assigned a code from each of the three tiers. For example, the sentence “In a minute, I’ll be handing you an overview of the course as well as handouts for the first session” was coded as having a purpose of Organizing, a mechanism of Fact-Stating, and a content of Procedure. (The coding system is explained at greater length at <http://www.quahog.org/thesis/new.html>.)

To determine coder reliability, 1,000 of the 52,081 records in the database were randomly selected and coded by two people. Inter-coder agreement, as measured by Cohen’s kappa, was strong for Purpose (.96), Mechanism (.93), and Subject (.95).

**Analysis of Interaction**

After each sentence was coded, both the FTF and CMC courses were standardized by personal observation. Both courses contained different teachers as well as other differences, which were noted and recorded. Each sentence was then coded as either FTF, CMC, or Not Clear. A well-documented aspect of FTF is the role of the teacher as speaker, who is likely to have the most control of a classroom (Dillon 1994; Flanders 1970; Grant 1992). In FTF courses, in which the teacher is usually the main speaker, the students may be less engaged in the classroom discussions.

These results differed from previous research, in which analysis of e-mail and VaxNotes found that the students engaged in the discussion. The study of 408 total messages sent in the classroom found that less than 20% of the 408 total messages sent were from the teacher to the students. Further, in this study 41% of the messages were sent by students. Yet altogether, the CMC sentences, indicating the longer postings than the students did, arise due to factors such as teaching style.

Excluding the results of the interaction, a larger number of postings in the CMC showed additional information. Based on previous research on FTF, we would expect to find FTF teachers using more than students do. However, the students did not post nearly as much as the teachers. This could be because the students did not have the freedom to speak or write in a classroom, or because of the higher use of Organizing by the students.

As expected, in both modes of interaction, the students were organizing in a greater percentage of the sentences with the FTF teachers (x = 2%) were slightly higher than the CMC teachers (x = 0%), and the CMC teachers (x = 3%) were higher than the FTF teachers (x = 18%). As is noted, Organizing significantly more than
Analysis of Interaction

After each sentence was coded, the numbers of sentences from each course were standardized by percentages and plotted on graphs. This allowed courses containing different numbers of sentences to be compared on the same time and quantity axes. Initial analyses examined the amount of talking or writing performed by teachers and students. One well-documented aspect of FTF classrooms is the dominance of the teacher as speaker, who is likely to do two-thirds or more of the talking (Dillon 1994; Flanders 1970; Graddol 1989). This was borne out in the FTF courses, in which the teachers uttered 73% of the sentences. Comparatively, the teachers in the CMC courses wrote only 49% of the sentences.

These results differed from the findings of Zhu (1996), who, in her analysis of e-mail and VaxNotes from a 15-week course, found that only 20% of the 408 total messages sent were written by teachers. However, the differences may be due in part to different methods. Unlike Zhu’s analysis, this study examined only public postings and did not examine e-mail. Further, in this study 41% of the 572 postings in the CMC courses were sent by teachers. Yet altogether these postings contained 49% of the CMC sentences, indicating that, on average, the teachers wrote longer postings than the students did. In addition, differences are sure to arise due to factors such as teaching style and subject.

Examining the quality of the interaction in addition to its quantity revealed additional information about the nature of FTF and CMC. Based on previous research on FTF classroom interaction, one would expect to find FTF teachers using the purposes of Organizing and Lecturing more than students do. Pedagogically, Organizing is used to indicate what the speaker intends to say. At its most basic level, Organizing demonstrates control, since only a situation in which one has the freedom to speak or write in several possible ways requires the use of sign posting or advance organizing. Thus, one would also expect to find the highest use of Organizing by FTF teachers. However, this was not the case.

As expected, in both modes of interaction the teachers used Organizing in a greater percentage of their sentences than the students did: the FTF teachers (x = 2%) were slightly higher than the FTF students (x = 0%), and the CMC teachers (x = 25%) were higher than the CMC students (x = 18%). As is noted, however, the CMC teachers used Organizing significantly more than the FTF teachers did.
Overall, CMC participants used Organizing in their sentences much more ($\bar{x} = 22\%$) than the FTF participants did ($\bar{x} = 1\%$), even when taking into account the subject line of each CMC posting as an Organizing/Fact-Listing/Content sentence. This difference between FTF and CMC uses of Organizing may be due, in part, to the lack of non-verbal interaction in the form of CMC used in this study. Whereas in FTF or video-based forms of CMC much can be communicated nonverbally, for the present study, Organizing information had to be, quite literally, spelled out.

Similarly, although the FTF teachers used Lecturing (talk about the course content that is not Organizing, Eliciting, nor Responding) for a much greater percentage of their sentences ($\bar{x} = 37\%$) than the CMC students did ($\bar{x} = 7\%$), they were both surpassed by the CMC participants. On average, the CMC teachers used Lecturing about as much as the FTF teachers, but with a great deal more variability ($\bar{x} = 40\%$). The CMC students, however, used Lecturing the most ($\bar{x} = 59\%$), ranging between 49 and 74 percent of the purpose of their sentences. This suggests that CMC students took advantage of the opportunity to speak at length about the course content.

Given the nature of asynchronous, text-based CMC, one would expect to see other behaviors, such as Humanizing and Opining. Humanizing is used to create and maintain an atmosphere conducive to interaction; students are made to feel welcome with jokes, comments about the weather, or other light banter (Monson 1978). Relevant personal vignettes, anecdotes, and experiences encourage trust among participants and reduce anxiety (Burge and Howard 1990). This fosters a receptive learning environment, enhancing the climate for motivation, creativity, brainstorming, and risk-taking (Bruce and Shade 1994; Holmberg 1988).

As a result, one would anticipate a greater percentage of Humanizing sentences from the CMC participants, especially from the teachers, as they try to make up for the lack of FTF contact. Although overall the CMC participants did use Humanizing in slightly more of their sentences ($\bar{x} = 2\%$) than the FTF participants did ($\bar{x} = 1\%$), and the CMC students used Humanizing more ($\bar{x} = 2\%$) than the CMC teachers did ($\bar{x} = 1\%$), few meaningful conclusions can be drawn from these small amounts.

In addition, one would expect participants in a text-based form of CMC to use Opining more than those in a FTF classroom, as they are less restrained, less likely to defer to authority (Dubrovsky, Kiesler, and Sethna 1991). This was borne out in the results of the study. On average, the FTF and CMC teachers used Opining about the same amount ($\bar{x} = 4\%$) as the FTF students did ($\bar{x} = 3\%$). The FTF students did more than any other group ($\bar{x} = 5\%$), even more than CMC participants, literature indicating that shy students find themselves via CMC (Mabrito 1991), while more active students' opinions (Mason 1989).

**Recommendations for Future Research**

Although this form of analysis is exploratory, and CMC is still in its infancy, it offers promise for distance education and educational psychology. This analysis permits one to examine areas that could be improved. For example, in this study, how-to material (the mechanism of Mixed with the subject of Procedure) versus information (the environment). These sentences were used for course content, but were used to explain why a specific procedure.

An extra ten percent of computer space on non-content-related dialog. This is especially important for knowledge prerequisites in courses that all students should be familiar with before entering technology-based distance education (Gunawardena 1994). As hardware becomes easier to use, it is likely that in the future, CMC will be used as a tool to support the learning process, rather than as a tool to support the teaching process. Even then, however, these results quantify the importance of human interaction into account.

More broadly, such improvements have been possible in the past. Historically, researchers who wanted to study interaction were limited by the practical difficulties of obtaining large quantities of available data. These difficulties have been overcome. Researchers no longer need complete samples of discourse and attempts to "view distance education as educational" (Mabrito 1990), the method presented in this paper and CMC classrooms to be compared to a computer room.
Organizing in their sentences much participants did (\( \bar{x} = 1\% \)), even when taking of each CMC posting as an sentence. This difference between FTF be due, in part, to the lack of non-verbal used in this study. Whereas in FTF or can be communicated nonverbally, for information had to be, quite literally,

Teachers used Lecturing (talk about the students), Eliciting, nor Responding) for a sentences (\( \bar{x} = 37\% \)) than the FTF students, surpassed by the CMC participants. D and Lecturing about as much as the FTF variability (\( \bar{x} = 40\% \)). The CMC students 90% (\( \bar{x} = 59\% \)), ranging between 49 their sentences. This suggests that CMC is opportunity to speak at length about the

In text-based CMC, one would expect to Humanizing is atmosphere conducive to interaction; students, jokes, comments about the weather, (Shimabukuro, 1990). Relevant personal vignettes, anec- trust among participants and reduce This fosters a receptivity for and Opining. Humanizing is greater percentage of Humanizing among students, especially from the teachers, as of FTF contact. Although overall the posting in slightly more of their sentences did (\( \bar{x} = 1\% \)), and the CMC students than the CMC teachers did (\( \bar{x} = 1\% \)), drawn from these small amounts.

Participants in a text-based form of discourse in a FTF classroom, as they are less authority (Dubrovsky, Kiesler, and Seth- the results of the study. On average, the posting about the same amount (\( \bar{x} = 4\% \)) as the FTF students did (\( \bar{x} = 3\% \)). The CMC students, however, used Opining more than any other group (\( \bar{x} = 11\% \)). This finding concurs with the literature indicating that shy students, feeling confident to express themselves via CMC (Mabrito 1991), would be more likely to express their opinions (Mason 1989).

**Recommendations for Future Research**

Although this form of analysis of the patterns of interaction in FTF and CMC is still in its infancy, it offers far-reaching implications for distance education and educational research as a whole. More thorough analysis permits one to examine areas in which education at a distance could be improved. For example, 12% of the CMC utterances dealt with how-to material (the mechanism of Explaining or Performing coupled with the subject of Procedure) versus only 2% in the more familiar FTF environment. These sentences were not directly related to the course content, but were used to explain why one does something or how to do a specific procedure.

An extra ten percent of computer-mediated class interaction was spent on non-content-related dialog. This finding provides ample justification for either knowledge prerequisites (Shimabukuro 1995) or technology courses that all students should be required to complete before enrolling in technology-based distance education programs (Hillman, Willis, and Gunawardena 1994). As hardware and software continue to become easier to use, it is likely that in the future we may look back on this infancy of CMC as a time of quaint artifacts, much like slide rules and punch cards, when class time was spent teaching students the equivalent of how to configure and operate a pencil. While waiting for this to occur, however, these results quantify the importance of taking Learning-Interface interaction into account.

More broadly, such improvement is not limited to distance education. Historically, researchers who wanted to study classroom interaction were limited by the practical difficulties of transcribing and analyzing the vast quantities of available data. These problems now have a practical solution. Researchers no longer need content themselves with studying small samples of discourse and attempting to extrapolate from them. If we “view distance education as education at a distance” (Shale and Garrison 1990, 5), the method presented in this study allows interaction in FTF and CMC classrooms to be compared and contrasted. In baseball, a batter’s success at hitting a ball thrown by a specific pitcher is calculated
and is used to predict his future success against the same pitcher. In a similar way, the effectiveness of specific forms of interaction could be analyzed, and predictions could be made for the most likely form of successful interaction for a given situation.

Ultimately, this sort of analysis would permit teachers to improve both conventional FTF education and distance education by examining what works best under which circumstances, rather than limiting analysis to gross external indicators of success such as grades, test scores, and evaluation sheets.

Note

This paper is based on Daniel Hillman’s doctoral dissertation, completed at the University of Cambridge, 1996. The thesis and the latest version of the software described in the paper are available online at <http://www.quahog.org/thesis/> and <http://www.quahog.org/weasel/>, respectively.

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