Historical Research Techniques: Teaching with Database Exercises on the Microcomputer

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CRITICAL ANALYSIS is the basis of the liberal arts education, and computer analysis is so much a part of contemporary society that liberal arts majors need to learn to assess the veracity of computer-derived information just as they do the sources for a historical monograph. It is increasingly clear that humanists should acquire basic understandings of the use of the computer. Jobs for traditionally trained liberal arts majors are scarce, and computer skills will make history graduates more competitive in the job market. We are not necessarily suggesting that all historians understand "computerese," or the way some computer users talk to one another. What is important for the historian, or for any humanistic scholar for that matter, is the ability to understand the algorithm, or in the language of the humanist, the logic of how a computer program operates to produce output. This is also essential if scholars in the humanities are to be able to understand and evaluate the new social science research.[1]

Ideally, what is needed are instructional materials that simultaneously teach both history and the use of computers. As a discipline, history can be used to introduce gently the use of the computer to even the most fanatical anti-quantitative humanistic student. The historical problems posed are in the language of the humanist, and the sources used are the records of our past which the historian studies. A common criticism of quantitative

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historical methods and quantitative survey research in sociology is that statistical analysis tends to detach the result from any socio-political reality. Thus, the numerical results are atomized until they are unintelligible to meaningful humanistic interpretation.

Similar criticisms are leveled against computer-based instruction for lacking sufficient context to achieve cognitive significance. Most interactive computer-assisted instruction (CAI) relies on simple recall or recognition of minimal facts, without any exercise of higher level cognitive skills. Learning theory acknowledges the need for mastery of basic information at the level of "concrete" operations prior to exercising more complex synthetic or analytic processing skills. Unfortunately, the current generation of CAI materials seldom provides opportunity for sophisticated interactions that could aid in developing abstract cognitive ability[2] (Blomeyer, 1986).

This article is a descriptive history of prototype interactive history lessons that are being produced by an interdisciplinary team consisting of Vernon Burton and Steve White, who teach American History at the University of Illinois; Atsushi Fukada, who is a linguist and a foreign language CAI specialist as well as a computer programming consultant; and Robert Blomeyer, a former student in Education at the University of Illinois and currently in the Department of Curriculum and Instruction at the University of Houston. The computer-based lessons described here demonstrate how microcomputers can be used to simultaneously teach basic information and push the analytic and synthetic abilities of the student to new levels of complexity. Our approach to these "database lessons" makes the interactive materials a "tool" which students can use to recreate the analysis and discovery process which a generation of historians have been using to derive quantitative results from historically relevant materials (Kousser, 1980).

The general acceptance of quantitative history indicates the potential that this genre of historical research has for achieving new and significant understandings of history. Books, articles, and journals in history today often contain data that are derived computationally. Ironically, however, few students of history, particularly undergraduates, are taught how to evaluate the quality of such data on the one hand, and how to derive information in this way on the other. Since 1974 Burton has been attempting to integrate historical research into computer-based lesson materials

for his undergraduate and graduate classes at the University of Illinois. Our project is a continuing effort along this line, and with it we hope to argue for the validity of instructional computing as an integrated component of the liberal arts and sciences curriculum.

DEVELOPING THE MATERIALS

During the summer of 1985 our adventure in teamwork began. We constructed a series of computer-based exercises designed to assist students with learning the basic factual materials necessary for conceptualizing significant relationships. We divided the American history survey course into six separate chronological periods: (1) Age of Discovery and Colonial America (1000 AD–1775); (2) Revolutionary America (1763–1789); (3) Early National Period (1789–1828); (4) Jacksonian (1829–1848); (5) Antebellum (1820–1860); (6) Civil War and Reconstruction (1860–1880).

Three prototype "drill and practice" interactive computer-based lessons had been developed by Professor John Lynn at the University of Illinois, and because of the generic nature of these exercise types, they were easily adapted for use with basic facts relevant to American history during the periods outlined above. Especially useful were White's years teaching American history in high school and his experience as a teaching assistant in twice weekly discussion sections of "small" groups of anywhere from fifteen to thirty-five students. His experience in using maps proved especially valuable in the development of the geography sections of the teaching modules. He knew the limitations of students in the survey.

One exercise in each module consists of 24 identifications (they were all personalities, but we decided to expand this to general historical identification such as books and events). For each identification students were prompted with three clues which always went from the most general to the most specific. A second exercise in each module is a chronology exercise that emphasizes the important dates of each period. The object is less to memorize the exact date than to get events in the correct sequence so that relationships might be observed. Two exercises require students to identify places on maps. Since each period was a separate design module, these exercises were excellent for the presentation

and reinforcement of facts, but a serious problem remained: the significance of these facts, taken out of their historical context, seemed to be somehow lost.

We wanted more than these mechanical, repetitive exercises to challenge the more sophisticated students. Originally we had planned to develop individually tailored simulation "you were there" exercises. Burton had begun one demonstrating the different geographical influences in the development of colonial America—farms and plantations along the rivers in the South were displayed graphically on one side of a monitor screen while on the other side a diagram of a New England town appeared. Another program was a simulation of *Marbury v. Madison*.

The idea of elaborate simulation was discarded in favor of a lesson design based on the application of quantitative social science research techniques to the exposition and actual analysis of historical data. Rather than the conventional format lessons practicing recall and recognition of discrete facts, these "database lessons" were designed to provide the students with a tool that could actually simulate the techniques and protocols used by quantitative historians to analyze and interpret source materials.

EVOLUTION OF THE DATABASE EXERCISES

Since 1974 Burton had developed and taught courses for history graduate students which stressed historical research derived from computer analysis. He also developed a course for undergraduates who used the mainframe computers and the U. S. Manuscript Census Returns to do Social History projects, attempted to incorporate class computer projects in other courses, worked with individual students who had wanted independent study on historians and computer techniques, and served as the History Department's Computer Coordinator (Burton, 1979: 71–88).

With Burton's success in classes which used the mainframe computers, with the insights of Blomeyer who brought the pedagogical skills, White who had worked closely with freshman students as a teaching assistant in the American History Survey classes, and Fukada who specialized in instructional programming, we began to map out a strategy to teach use of databases on the micro-computer. The goal was to create historical database exercises which were self-contained and self-explanatory.

We reasoned that the study of history must involve the classic "who, where, when, what, and *WHY*". The best way to teach all of these to students was to have them *do* history from primary source material. By using the micro-computer with primary source materials, students are introduced to the computer and its uses in the humanities and social sciences and learn skills useful for a well-rounded understanding of social studies. With accompanying workbooks of programmed instruction questions, students' use of data sets would increase understanding of how scholars work in these fields and, more importantly, would encourage students to work out their own interpretations based on the data presented. Ideally, such data sets and programmed questions would include activities to guide students independently through an instructional process. This process of inquiry and discovery would supplement the standard didactic lecture and be very useful for humanities teachers. Instead of learning only what historians have said, students would conduct historical research for themselves. As all of us who have encountered computers are aware, they are intrinsically stimulating. By working with data sets, students are more likely to question data and its interpretation and perhaps to develop alternative explanations; we have seen this happen. At the very least, this work would help students learn to become more critical of published statistical results.

The "data base exercises" proved to be so unique as interactive lessons that they were abandoned as exercises within the planned lesson modules and eventually grew in scope to the point where they are presently viewed as separate complementary exercises.

The database exercise purports to accomplish several goals that are usually not met in either the conventional survey courses or in the mechanical drill of the first three exercises of each module we had designed. The goals we worked out for database modules are:

1. to develop critical thinking skills concerning historical studies
2. to provide experience in the use of primary sources as materials for historical study
3. to introduce subject matter from demography, economics, and political science which is not generally used in survey courses
4. to introduce students to the use of databases as a methodology used by historians and other scholars in the humanities and social sciences for conducting quantitative historical study

5. to balance the historical perspective which typically portrays the "historical elite" by focusing attention on the lives of common people who left few written records

A few comments on the fourth goal are in order. In terms of quantitative techniques, fundamental elements of statistics—measures of central tendency and correlational analysis—are introduced. Also included are the generation of simple statistics and the conversion of statistical data into appropriate graphs. The idea of these programs is to allow the student to develop the initial skills with enough ease to encourage them in the long process of mastering the computer and statistical skills necessary for a thoroughly trained quantitative historian or social scientist. We are not concerned here with the development of methodologically sophisticated students. We want students to be historians and to appreciate from first-hand knowledge how historians gather, code, analyze, and interpret data.

The format and materials to be used in each of the modules was hammered out over many meetings during the summer and even today are constantly going through revisions. After establishing the goals, we needed to decide on an appropriate set of data. Burton had amassed a huge database set for Edgefield County, South Carolina from 1850 to 1880 that could be used for the middle period of American history or for thematic courses on the family or rural, southern, or Afro-American history.[3] We initially wanted, however, to have a different database exercise for each of the chronological periods that we had designed for the drill exercises. Our first idea was to create the databases for the other chronological periods. Another possibility was to use databases from John Kolp, Director of the Laboratory for Political Research at the University of Iowa. In 1980 when Burton had published an article, "Using the Computer and Manuscript Census Returns to Teach American Social History," Kolp had contacted him about the possibility of publishing workbooks for the class (Kolp, 1980). Kolp had mailed Burton the manuals for three computer teaching packages: *Family and Society in Colonial America: An Exercise in Demographic History* (Kolp, orig. 1978), *The American Frontier: 1850–1880* (Kolp, orig. 1972), and *Hewlett-Packard Computer Curriculum Growth and Development of the United States, 1790–*

1860 (Cupertino, 1975). After studying the manuals that Kolp had developed, we decided that we could adapt them for the exercises from mainframe computers to self-contained exercises on the microcomputer. Burton contacted Kolp at the Laboratory for Political Research and arranged to purchase two of the data sets which were still available on the mainframe. The Richmond, Virginia census had been taken in 1782 and was published in *Heads of Families at the First Census of the United States Taken in 1790, Virginia* (U.S. Government Printing Office, 1908: 111–119). Professor Lynne Withey had originally placed the data in machine-readable form, and then it was considerably reformatted by Kolp for use with his instructional manual. We also purchased the data set Kolp had put together for the United States from 1790–1860 for the 36 states of the Union in 1860. With Kolp's basic outline as a structure we set about modifying his exercises and databases for our purposes and for use on microcomputers instead of mainframes. We decided to use Burton's databases on Edgefield County, South Carolina from 1850 to 1880 for the Civil War and Reconstruction period.

In Kolp's *Family and Society in Colonial America* instructional manual, the first census which students actually used on the computer was the Richmond data set. However, the first thirty-one pages of the manual were devoted to a concise and clear explanation of censuses and demographic history. He used a diary by a seventeenth-century cleric in colonial Massachusetts to demonstrate much of his discussion of the historian and demographic history. At the end of the discussion, students calculated by hand from the diary of this cleric the gender distributions and ratios, the age distribution, the average household size, family size, and number of children per family, as well as the distribution of household size and number of children per family. After working some time on adapting the Richmond census database to our purposes, we realized that we could use this simple census derived from the notebook of Reverend John Fiske of Chelmsford Massachusetts in 1656/1657 as the starting point to teach students how to build a database using primary historical documents (Pope, 1974).

The first two exercises that we have worked on are the Chelmsford (Colonial) and the Richmond (Revolutionary) exercises. The Chelmsford database exercise has been completed and tested and

is available. Thus, this essay will concentrate on describing the two exercises. The format used in these two exercises sets the tone for the database exercises that follow.

For our first database exercise we set four specific objectives. First, we had the student organize and categorize primary source data describing the households in Chelmsford, based on information from the Reverend John Fiske's notebook. Most of this is laid out for them in the accompanying workbook. Here we deal with the kinds of imperfect data that the historian typically encounters. The Reverend Fiske did not record the ages of household heads or of their wives; students must enter hyphens for these pieces of missing data. However, through other pages from Reverend Fiske's diary, which are reproduced in the students' accompanying workbook, the historian deduces that all heads and wives are at least twenty years of age. Thus, the student is able to calculate age pyramids if not exact age distributions. Second, we had students learn about a database management system by having them enter data concerning the Chelmsford households into the database. Each individual record has the following five fields: (1) individual identification number—three columns; (2) household number—two columns; (3) kinship relationship to the household: head of household (H), wife of head (W), daughter (D), son or stepson (S), and boarder or unrelated (B)—one column; (4) age by number—two columns; and (5) sex: (male M); (female F)—one column.

Additionally, we have the student review and verify the data after initial entry and operate the computer so that entry errors will be corrected. Lastly, we have the student generate reports describing the demographic characteristics of the Chelmsford "census" using analytic tools provided with the database management system. The student then records these reports in the student workbooks custom-made by Burton and White to be an essential part of the database exercises. Besides keeping a complete record of the student's work, the workbook provides historical background information (such as a map and history of Chelmsford) and incorporates questions of comparative analysis. It also includes a glossary of terms.

The first two sections of the database exercise, namely the data entry and the verification stages, are very realistic and comparable to those of commercial database systems. The one we present here

is, of course, simplified, and students are prompted throughout. For example, we could have had the program accept both lower and upper case letters as identical. However, since commercial databases distinguish between them, we decided that making this distinction would help students learn to be precise with data entry. Thus, our database system tells students when they type in "h" for household heads or "f" for females, that these letters are not acceptable. We also have built-in error detectors so that numbers cannot be accepted for letters and vice versa. In the first household, students are actually told when they have keyed in the wrong information. Also, in the first household, students are led through the data entry by a programmed highlighting and flashing on the screen of the variable to be entered. However, after the first household, a general entry screen appears and students have to enter the data from the workbook, where it is organized for them. On this entry screen a context-sensitive help facility is available which, upon request, provides helpful information about the field that the student is currently on. For example, if the student asks for help while on the kinship field, the program lists all the kinship codes for the student. At the top of the monitor screen is a counter which tells students which record they are entering. Households are numbered for them in the workbook. Only a selected number of the individual numbers are provided. Those that are provided should help students keep track with the current record to see whether they have skipped any individuals. Since individuals in historical documents are seldom numbered conveniently, we decided it would be more realistic to have students number the individuals themselves. However, after some testing, we interspersed individual ID numbers in the notebook to aid students.

Only after students have entered all 106 individuals can they then go on to the verification editor. They can leave the data entry exercise at any time after they have entered the first seven individuals of the first household. The program counts the records on their data disk to mark their place in the database exercise, and the student can select whether to review instructions or other sections or to go directly into the data entry again. With the verification editor, students can use the arrow keys to move throughout the data they have entered. The program allows the student to scroll through all 106 entries and to type over any errors. The verifica-

tion program does not allow for deletions or insertions, but the incorrect data can be replaced with correct data by typing over. Also, individuals skipped can be added at the end of the data set, since the order does not matter. If there is a duplicate record, the student can type a correct data entry over one of the duplicates, since the program will only accept 106 entries.

The report generation exercise is the only part of the program which is not realistic. At this point in the program the students are informed on the monitor that in most database systems, students have to provide formulas in order to perform statistical analysis. In this exercise these functions are built into the program. A longer explanation is provided in the workbook about how real database systems work and students are given references to books which explain how database systems do calculations. (Students are encouraged to read, for example, Robert A. Byers, *Everyman's Database Primer: featuring dBase II*, 1982, and Marija J. Norusis, *The SPSS Guide to Data Analysis*, 1986.) After this exercise students will have completed a table of results in their workbooks. At this point students will have an opportunity to look at the results presented in the graph form on the screen. This is to begin to introduce them to graphic representation of statistical information.

Originally we had wanted the database exercise self-contained on one floppy disk which would boot itself up. However, as we developed the Chelmsford database exercise we realized that students may not complete the exercise in one sitting. Thus, we decided that each student would have to maintain his/her individual data disk on which they could enter their data, leaving the database exercise at any time and returning to where they were last working. After completing the programming of the Chelmsford database exercise, however, Fukada added a program which automatically checks the data disk and formats it if it is not already formatted. The program also detects such errors as "disk drive door open" and "disk improperly inserted" and informs students how to correct the problem. Hence, the student does not even need to know how to format a disk to begin learning how to use the database system.

When the time came for us to make detailed design decisions, Blomeyer taught Burton and White how to write a design document. The best way to conceptualize a design document would be

to think of it as a draft of a manuscript you would give to a typist. The purpose of a design document is to force the designer(s) to be as specific as possible; that is, to spell out everything clearly. A design document consists of a series of screen designs in the order in which they appear and additional notes necessary for the programmer. As tedious as it may seem to prepare such a document, we have saved time in the long run because the operations of the exercise program were so clear to the programmer that it relieved him of many decisions that he would otherwise have taken time to make. This "scenario," so to speak, also proved useful as a basis on which to invite suggestions from the other team members as well as other subject matter, pedagogical and/or programming experts. Finally, equally important, a design document on a disk saves the programmer from having to type in text that appears on the screen.

The actual design documents for the first and second exercises were done on the IBM personal computer using Multimate and WordStar word processing packages, each time converting to ASCII files as we passed the design program between Blomeyer and Burton. Currently, we are using MicroSoft Word because it is capable of saving files in the ASCII format. The design document for the Chelmsford database was more than one hundred pages.

We believe that the more interactive the database system is with the student, the more students actually do themselves, the more they will learn. Accordingly, we kept instructions on the monitor screen to a minimum. Much of the information that is not absolutely necessary in using the exercise was instead put in the student workbook that elaborates on the instructions presented on the computer monitor. The rationale behind the use of a student workbook is that some information is simply much better presented on paper than on the computer. It would be a mistake to put all the instructions and supplementary information in the program, thereby turning it into an overinformative and boring "page-turning" monster. An unstated goal of the workbook is to have students learn to obtain necessary information out of computer manuals. As an integral part of the exercise, the workbook contains charts and tables (with blank places to be filled with the students' results). A section of the workbook is reserved for the student to record a personal "research diary." The information summaries recorded in the student workbook are to be used in the

class discussion sections and provide the information necessary for the completion of written assignments that will be collected by the course's teaching assistants.

Students are to write a reconstructed account of life in Chelmsford that details available information on ordinary people and their everyday lives. We included in the workbook photocopied pages of Reverend Fiske's diary. We selected actual sections and explained to students how a historian who has to work with imperfect data can use the notebook of Fiske to create a census for the town of Chelmsford. We also provided the call number for the diary in the notebook so that interested students can pursue in more detail the background on this exercise. For some students it might appear at first glance that the historian who uses databases is moving away from humanistic origins when individuals are reduced to numbers. Therefore, we tried to give them a flavor from selected sections of the Reverend Fiske's notebook; "anonymity disappears and personalities emerge. One feels the anguish of Phineas Fiske's wife as she sat week after week listening to her neighbors discuss her marital difficulties. Or one can watch the recalcitrant George Norton, who settled in Wenham because of earlier troubles in Gloucester, stubbornly resist all the pressure that the church could mount, while conniving to undermine Fiske's authority" (Pope, 1974: vii). With the workbook we tried always to keep the student focused on history and not computers. Thus we explained how the change in the calendar year made the first day of the twelfth month in the year 1656 February 1657 by our current calendar. We used the changed birthday of George Washington as an example of this change. It is our intention to primarily focus on history, and we consider knowledge about databases, computers, and quantitative techniques as tools that enhance our understanding of history, not as ends in themselves.

In testing the Chelmsford exercise, students discovered how families were much larger then than they are now. When they put their results into the comparative table in the workbook and studied family size for other communities at other times and on other continents, they came up with interesting theories to explain the results. Students also noted that all adult women were married and looked at comparative data once again to theorize about the relationship between women's scarcity and their relative power. Post tests show that students integrate the information they learned

from the Chelmsford database with the traditional lectures and readings. Most interestingly, students were thinking and working out their own interpretations based on the data they manipulated.

FUTURE PLANS

This first database exercise is only the beginning of our far-reaching future plan. From the second on, we will make each one progressively more flexible as a research tool than the previous one.

We assumed that when they start the series, students have absolutely no knowledge of either statistics, demography, economics, or computers, and we lead them gently by the hand with the first database exercise in which they learn how to take data from a primary source and enter it into a machine-readable form. Students then go through the second database exercise, which uses the Richmond census which is already in a database to teach students additional concepts such as the arrangement of a database in records (rows) and fields (columns), indexing the database as an example of manipulating databases, and some basic statistical operations. The Richmond database is particularly well-suited for teaching these concepts. First, students review data entry and verification by entering the last ten records of the Richmond census. Second, because household heads in the census contain almost all of the household information, it is crucial for any statistical operations on households to restrict the range to household heads only. For example, if students are asked how many people owned slaves, the result will be very few. However, if students look at household heads, the substantial number represents the number of families involved in slave ownership. To perform statistical operations on household heads, then, students index the database on the kinship field so that all the household heads will be grouped together. In the Richmond exercise, students are asked to graph the results in the workbook.

The next exercise will allow students to take more initiative; they will, using our tool, design and execute their own research from a data set they construct themselves. For example, we are planning to have students assemble their own prosopography of one of the early Congresses. They will find information in standard sources on religious and political affiliation, family size and

occupation. They will enter the data and report on the collective biography of the group they are studying. In later modules, students will also learn such statistical techniques as regression analysis. Our goal is not to train them to become statisticians but to familiarize them with at least the dimensions of correlation analyses. These will be explained in terms of historical developments, not in terms of statistical analysis. The workbook incorporates simple and interesting historical examples of statistics. References to statistical techniques are available but are not required.

We have now modified our original design to fit more realistically the time constraints of the survey course. Whereas we originally had planned for six database exercises to be the fourth exercise with each chronological period and that each student would do all six database exercises, after considerable debate as to the pedagogical goals, we revised our initial scheme. As we recognized the time commitments involved for students in these exercises we decided to change the presentation plan so that every student did three database exercises, and these three required exercises logically progressed to accomplish our new goals. The first database exercise, the only one complete and now working, would teach students to actually enter data in a data management system. All students would have to begin with this database exercise. The second database exercise will also be very simple. Based on the Richmond census, it will teach students the organization and manipulation of a database. For the third exercise, students will do their own research project using the same software tool.

After completing the three required exercises, students might select one of the other database exercises with data sets provided. All of the other database exercises will use the concepts learned in the first two exercises and will also introduce the student to different types of data and more sophisticated uses of databases. These additional (fourth) database exercises could be used much as a research paper. In the fourth exercise, each section will explore some historiographical issue of interest to the chronological period. From the data sets that were compiled at Iowa of the thirty-six states in 1860, students will select three states, one Northern, one Southern, and one Western to compare and contrast developments from 1790 to 1860. From the Early National period students explore population trends, growth rates,

rate formulas, life expectancy tables, and other ways to compare growth patterns of the United States whose population increased seven times and land three times between 1790 and 1860. The Jacksonian period exercise explores more closely the causes of this phenomenal growth by introducing industrial growth correlations between immigration, urbanization, railroad miles, and population growth. The Antebellum period database explores the relationship between the free black population and slavery, urbanization, land availability, and restrictive legislation. The Civil War and Reconstruction period exercise explores the relationship between slavery and crop production, manufacturing, and wealth. The data sets, programmed questions, and workbooks include activities to guide students independently through an instructional process. However, we have listed possible research topics from which exceptionally motivated students can construct a hypothesis, design a project, and use the appropriate statistical techniques on databases we provide or they themselves build. The goal is to find a happy medium between overwhelming the student and still making the exercise challenging and worthwhile.

CONCLUSIONS

In summary, our database exercises are designed to provide students with experience in the use of primary research materials to construct databases and then manipulate them to obtain statistical information from them, and therefore, they exercise higher cognitive skills than simple memorization of facts. Experience has shown that students consider this extra step exciting; basic facts become more meaningful, and students grasp more easily the complexities of our nation's past. To further promote students' critical abilities, we introduce them to a new historical perspective. By using original research materials, the students will discover an emphasis on the lives of common people, a demographic portrayal not found in most history courses. The students will organize these primary source materials themselves, learning the importance of rank and order to historical studies. In short, our software tool accomplishes three functions simultaneously: we teach history, quantitative methodology, and the use of computers.

NOTES

1 We are avoiding the use of the term "computer literacy" because its general usage includes knowledge about programming and to some extent computer hardware, and computerese; we would accept the term as it is defined by John V. Lombardi (1983:2):

> [C]omputer literacy means the ability to recognize problems for which the computer may be a useful part of the solution. Computer literate adults will be able to identify appropriate computer resources for a wide range of tasks and they will know how to ask the experts for assistance in finding solutions using computers.

2 The revised history lessons for Western Civilization and American History are available from COMPress Inc.

3 The Edgefield database is discussed in Orville Vernon Burton (1985).

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