DOCUMENT RESUME

ED 364 272 JC 930 538

AUTHOR	Rapp, Rhonda H.; Gittinger, Dennis J.
TITLE	Using Computers To Accommodate Learning Disabled Students in Mathematics Classes.
PUB DATE	15 Nov 93
NOTE	18p.; Paper presented at the Annual Conference of the League for Innovation in the Community College (10th, Nashville, TN, November 14-17, 1993).
PUB TYPE	Guides - Classroom Use - Teaching Guides (For Teacher) (052) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Community Colleges; *Computer Assisted Instruction; Computer Uses in Education; Cooperative Learning; Educational Research; *Learning Disabilities; *Mathematics Achievement; *Peer Teaching; Remedial Mathematics; Teaching Methods; Two Year Colleges; Two Year College Students

ABSTRACT

A person with a learning disability usually has average or above average intelligence, but has difficulty taking in, remembering, or expressing information. Learning disabilities can involve visual processing speed, short-term memory processing, fluid reasoning, and long-term memory retrieval. These disorders are intrinsic to the individual and occur across the life span. Improved special education in elementary and secondary schools has led to a substantial increase in the enrollment of learning disabled students in universities and community colleges. In a 1991 report, as many as 9% of first-time, full-time college freshmen reported having at least one learning disability, representing a 300% increase since 1978. Addressing the needs of this growing, non-traditional population requires teachers to reconsider traditional instructional formats. In mathematics instruction, research indicates that the lecture method is not particularly effective. Additionally, research has shown that computer assisted instruction (CAI) increases the levels of mathematics learning for low-achieving student, and shows some promise in meeting the needs of students with mild learning problems. In addition to CAI, cooperative learning approaches, in which students teach one another, may help to dislodge the traditional lecture method and help make remedial courses more effective. Tutors should be adept at integrating computers into the tutoring experience, and should be trained to deal effectively with special populations, such as the learning disabled. Contains 15 references and sample computer-oriented math problems are included. (PAA)

Using Computers to Accommodate Learning Disabled Students in Mathematics Classes

Rhonda H. Rapp
Dennis J. Gittinger

St. Philip's College
1801 Martin Luther King Dr.
San Antonio, Texas 78203
(210) 531 - 3527

Presentation at the
1993 Annual Conference of the
League for Innovation in the Community College
Nashville, Tennessee

November 15, 1993

Using Computers to Accommodate Learning Disabled Students in Mathematics Classes

Universities and community colleges are experiencing a substantial increase in the enrollment of learning disabled students. Improved special education in elementary schools, middle schools, and high schools has helped learning disabled students graduate (Nolting, 1991). It has been estimated that about 67% of high school students with learning disabilities plan to attend college (White, Alley, Deschler, Schumaker, Warner, and Clark, 1982). In their 1991 report, Freshman with Disabilities, Higher Education and the Handicapped (HEATH) Resources reported that 9% of all first time college freshman attending college full - time reported having at least one learning disability. This number represents a 300% increase in the enrollment of learning disabled students since 1978. Indications are that the enrollment of students with learning disabilities will continue to rise well into the 21st century.

As more learning disabled students enroll in community colleges and universities, faculty members, counselors, and support staff need to learn how to provide appropriate accommodations for the sake of all learning disabled students. Failure to provide appropriate accommodation(s) and assistance will result in more and more learning disabled students failing to be successful in postsecondary institutions.

This presentation was developed to assist mathematics instructors at postsecondary institutions to prepare for the rising number of students with learning disabilities on their campuses and in their classes.

NJCLD Definition on Learning Disabilities

Learning Disabilities is a general term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities. These disorders are intrinsic to the individual, and occur across the life span.

Problems in self - regulatory behaviors, social perception, and social interaction may exist with learning disabilities but do not by themselves constitute a learning disability.

Although learning disabilities may occur concomitantly with other handicapping conditions (for example, sensory impairment, serious emotional disturbance) or with extrinsic influences (such as cultural differences, insufficient or inappropriate instruction), they are not the result of those conditions or influences.

Adapted from, National Joint Committee on Learning Disabilities (1988). Learning disabilities: Issues on definition. Unpublished manuscript.

A Learning Disability ***IS NOT:***

- Mental Retardation
- A homogeneous group of disorders
- The result of:
  - Poor academic background
  - Emotional disturbance
  - Lack of motivation
  - Socio - economic deprivation
  - Visual - hearing acuity
  - English as a second language
  - Physical Handicap

Adapted from Loring Brinckerhoff - Boston University

A Learning Disability <u>IS</u>:

- Inconsistent
- Permanent
- A pattern of uneven abilities
- Average or above average intelligence
- A processing problem intrinsic to the individual

Adapted from Loring Brinckerhoff - Boston University

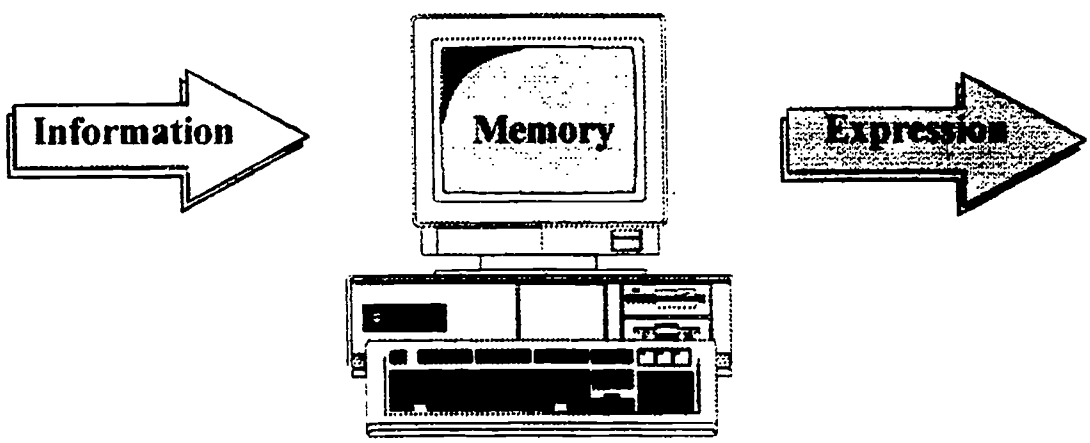
What is a Learning Disability ?

A person with a learning disability has difficulty taking in, remembering, or expressing information.

▸ **The learning process can be divided into five steps** ◂

- Take in information through the senses
- Figure out what it means
- File it into memory
- Later withdraw it from memory and "remember" it
- Feed it back to the outside world through some form of expression - speech, writing, action (Duncan, 1983)

For someone who has a learning disability, there is a breakdown somewhere in these steps. It's like having a short in the circuit board. Learning or recalling information can become an overwhelming task.



Warner, C. (1988). Understanding your learning disability. Newark, Ohio: The Ohio State University at Newark.

LEARNING DISABILITIES
Major Categories

VISUAL PROCESSING SPEED/VISUAL PROCESSING

For these students, taking notes is a major problem. They usually take very few notes or try to write everything down. They can have reversals or transpose parts of a sentence or equation while writing notes. They may also have difficulty keeping problem steps properly aligned in the correct columns. Reading textbooks of any kind will be difficult for these students. Especially textbooks that have very cluttered pages. Many learning disabled students must be taught how to read a textbook. Learning disabled students may have difficulty telling the difference between letters, numbers and symbols. This will cause major problems when the student copies material from the board or from an over-head projector.

SHORT-TERM MEMORY/AUDITORY PROCESSING

Students who have a short-term memory problem may not remember the steps of a process in order, or may forget certain steps. These students may remember most of the lecture words but get the words mixed up with other words or have gaps in their memory. These students may not be able to remember facts, understand concepts and write down this information all at the same time. Notes on the steps of a process may be in the wrong order or not there at all. Learning disabled students will misinterpret part of the instructor's lecture resulting in gaps in their lecture notes. These same students may also write down misunderstood words that make no sense at all. In either case, these students have difficulty understanding the lecture and recording the notes.

FLUID REASONING

These students usually have poor organization skills, poor problem solving skills, and trouble understanding causal relationships. Students with fluid reasoning problems may have difficulty understanding and applying a formula to a new homework assignment. They may remember the concept but forget how to use it in a problem. In general, students may have difficulty understanding abstract formulas and generalizing the formula's use to their homework or test problems. Frequently these students will demonstrate the knowledge of a concept one day and forget how to use the the same concept the next day. **Working with students with thinking/ reasoning problems will require more patience and tutorial sessions because less is learned in each session.**

LONG-TERM MEMORY RETRIEVAL

Students may appear to know their basic skills one day and the next day forget how to do the basic skill. If your students have this type of learning disability, then they may score good grades on quizzes but fail major tests. This long-term memory retrieval problem is different than thinking/reasoning problem. A long-term memory retrieval problem usually applies to the mechanics of doing something or remembering a a concept. However, the student understands the logic or reasoning behind the concept.

Nolting, P. D. (1991). Math and the learning disabled student. Pompano, FL: Academic Success Press, Inc.

Rhonda Rapp
Dennis Gittinger
St. Philip's College
1801 Martin Luther King
San Antonio, Texas 78203

League of Innovation Conference, November 15, 1993, Nashville.

Using Computers to Accommodate Learning Disabled Students in Mathematics Classes and Integrating Computers and Student-Friendly Software into the Mathematics Curriculum from Arithmetic Through Calculus

One of the frequently recurring themes in the literature is that lecturing is still the predominant method of delivering instruction in mathematics--even in developmental mathematics: "Evidence from many sources shows that the least effective mode for mathematics learning is the one that prevails in most of America's classrooms: lecturing and listening" (National Research Council, 1989). And:

> To believe that one can teach mathematics successfully by lectures, one must believe what most mathematicians know to be untrue--that mathematics can be learned by watching someone else do it correctly. Research shows clearly that this method of teaching does little to help beginning students learn mathematics, a fact underscored by the staggering rates of withdrawal or failure among students who take introductory college mathematics courses (National Research Council, 1991).

Because today's community college students are widely described as "nontraditional," it should not be surprising that traditional methods, such as lecturing, are not particularly effective for them. What may be surprising is that such methods persist. Apparently, even when researchers know what works, they have trouble getting people to adopt their ideas.

ANECDOTE. The lecture method is still thriving in many institutions. Many good instructors do not know how to teach any other way.

RECOMMENDATION. Workshops, adult education courses, and other professional development activities must be used to demonstrate to the teaching faculty viable alternatives to the lecture method.

Computers in Education

In describing computer technology as the fourth revolution in education, the Carnegie Commission on Higher Education (1980) has elevated the computer to the same status as the invention of the printing press, the creation of writing, and the development of formal schooling. As early as 1969, the Committee on the Undergraduate Program in Mathematics (CUPM) recommended that the use of the computer be incorporated wherever feasible across the mathematics curriculum. More recently, it has been suggested that even introductory courses "must be taught in a manner that reflects the era in which we live, making full use of computers as an integral tool for instruction and for mathematics" (National Research Council, 1989). It seems, then, that the question is not *whether* to use computers in education, but *how*: "Increased use of technology in mathematics education is inevitable, but wise use is not automatic" (National Research Council, 1990).

Although computers have been on the educational scene only a relatively short time, their impact has not gone undocumented. In particular, a comprehensive analysis of 254 studies revealed that computer-assisted instruction has raised student achievement in a variety of settings, particularly those involving developmental students: "Sophisticated and independent learners might not need computer help, but for underprepared students and weaker learners computers might make a real difference" (Kulik & Kulik, 1991). Clearly, computers can help *many* students, but "they can be of particular use in helping under-achievers, especially minority underachievers" (Friedman, 1991).

The computer has been described as:

- Infinitely patient
- Able to give immediate feedback
- Nonthreatening
- Nonjudgmental
- Tireless
- Able to proceed at the student's own pace
- Unbiased
- Ubiquitous, and therefore accessible to nearly everyone.

Perhaps due to some of the above characteristics, it appears that the computer has found a place in increasing the achievement of special-needs students. Lawson (1989), for example, found that CAI increased the levels of mathematics computation, concepts, and applications for low-achieving students when compared with a control group who received no CAI assistance. Likewise CAI shows some promise in meeting the needs of students with mild learning problems (Zorfass, Remz, and Persky, 1991).

Cooperative Learning

> *Two are better than one, because they have a good reward for toil. For if they fall, one will lift up his fellow; but woe to him who is alone when he falls and has not another to lift him up. . . .And though a man might prevail against one who is alone, two will withstand him. A threefold cord is not quickly broken.* (Ecclesiastes 4:9-12)

Cooperative learning is an old idea. Over the last century, over 600 studies have been conducted assessing the effectiveness of cooperative learning. More is known about cooperative learning than almost any other aspect of education.

> The best answer to the question "What is the most effective method of teaching?" is that it depends on the goal, the students, the content, and the teacher. But the next best answer is, "Students teaching other students." (Johnson, Johnson, and Smith, 1991).

Both computer-assisted instruction (CAI) and cooperative learning have some potential to dislodge the lecture method and to help make remedial courses more effective.

In his attempt to individualize remedial mathematics instruction, Nagarkatte (1989) discovered that:

- Computers can be effective in individualization by increasing the passing rates dramatically.
- Lowering the class size, per se, does not improve the passing rates.
- *The best passing rates were achieved when computers and tutoring were integrated with instruction.*

RECOMMENDATION. Tutors must be adept at integrating computers into the tutoring experience. In addition, tutors should be trained to deal effectively with special populations, such as the learning disabled.

To some, then, computers should be a part of the curriculum; they should be one resource among a repertoire of strategies available to the eclectic teacher. They might be used alone or as part of a cooperative learning experience: "The real impact of technology is the opportunity it provides for students to explore, to work in groups, to write laboratory reports, and undertake projects" (National Research Council, 1991).

RECOMMENDATION. Computers must be integrated wisely throughout the curriculum.

References

Ahrendt, K.M. (Ed.). (1987). Teaching the developmental education student. New directions for the community colleges, number 57. San Francisco, CA: Jossey Bass. (ED 280 519).

Carnegie Commission on Higher Education. (1980). Three Thousand Futures. San Francisco: Jossey-Bass.

Committee on the Undergraduate Program in Mathematics. (1969). A Transfer Curriculum in Mathematics for Two-Year Colleges. (ERIC Document Reproduction Service No. 062 150).

Committee on the Undergraduate Program in Mathematics. (1982). What mathematics should every graduate of an American college or university know? The American Mathematical Monthly. 89(3).

Friedman, E.A. (1991). Computers are the Trojan Horse of mathematics. Education Week. XI(8), 60.

Johnson, D.W.; Johnson, R.T.; & Smith, K.A. (1991). Cooperative Learning: Increasing College Faculty Instructional Productivity. ASHE-ERIC Higher Education Report No. 4. Washington, DC: The George Washington University, School of Education and Human Development.

Kulik, J.A., & Kulik, C-L.C. (1991). Developmental Instruction: An Analysis of the Research. Boone, NC: Appalachian State University, National Center for Developmental Education.

Kulik, J.A.; Kulik, C-L.C.; & Schwalb, B. (1983). College programs for high risk and disadvantaged students: a meta-analysis of findings. Review of Educational Research. 53, 397-414.

Lawson, L. (1989). Effects of computer assisted mathematics instruction on low achieving students. Dissertation Abstracts International. 7, 1725A.

Nagarkatte, U.P. (1989). An implementation of a systems approach to individualized instruction in mathematics. Journal of Computers in Mathematics and Science Teaching. 8(2), 47-55.

National Institute of Education. (1984). Involvement in learning: realizing the potential of higher education. Final report of the study group on the conditions of excellence in American higher education. Washington, DC: National Institute of Education. (ED 246 833).

National Research Council. (1989). Everybody Counts: A Report to the Nation on the Future of Mathematics Education. Washington, DC: National Academy Press.

National Research Council. (1990). Reshaping School Mathematics: A Philosophy and Framework for Curriculum. Washington, DC: National Academy Press.

National Research Council. (1991). Moving Beyond Myths: Revitalizing Undergraduate Mathematics. Washington, DC: National Academy Press.

Zorfass, J.; Remz, A.R.; & Persky, S.E. (1991). A technology integration model for middle schools. Technology Horizons in Education Journal. 19(2), 69-71.

League of Innovation Conference, November 15-17, 1993, Nashville.

Integrating Computers and Student-Friendly Software into the Mathematics Curriculum from Arithmetic Through Calculus

For numbers 1-10, use MicroCalc:

1. For each of the following equations:

   a. Graph the numerator and find out where it is zero (use pinpoint, bisection, ten-section, or Newton-Raphson if necessary).

   b. Graph the denominator and find out where it is zero (use pinpoint, ten-section, or Newton-Raphson if necessary).

   c. Graph the function. When the numerator is zero, is the function also zero or is there a "hole" in the graph? When the denominator is zero, does the function have a vertical asymptote or is there a "hole" in the graph?

   i. $f(x) = \dfrac{2x - 3}{x - 5}$　　ii. $f(x) = \dfrac{(x + 3)(2x + 5)}{x^2 + 2^x - 17}$

   iii. $f(x) = \dfrac{(x - 3)(2x + 5)}{x^2 + 2^x - 17}$ (Compare with ii.)

---

2. i. Find $\lim\limits_{x \to 3} \dfrac{(x - 3)(2x + 5)}{x^2 + 2^x - 17}$ (a) graphically (b) using "limits."

   ii. Graph $y = \left(1 + \dfrac{1}{x}\right)^x$ and $y = (1 + x)^{\frac{1}{x}}$ Show that the horizontal asymptote for one curve passes through the "hole" in the other curve (which occurs when x = 0 in each case). Relate to the definition of the number e.

---

3. Find the minimum value of x^x on $(0, \infty)$

   a. by examining the graph

   b. by using the "extrema" option after estimating the value by looking at the graph.

---

4. Solve: $x^2 = 2^x$

   a. by graphing $y = x^2$ and $y = 2^x$ and noting where they intersect.

   b. by graphing $y = x^2 - 2^x$ and finding the x-intercepts (use bisection, ten-section or Newton-Raphson if necessary).

5. Use "conic sections" to graph $x^2 - y^2 - 6x - 10y - 41$.

6. If $y = x^x$ use "derivatives" to find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$

7. First, for $-1 \leq x \leq 4$, graph $y = x^2 + 1$ and $y = 2^x$ on the same set of axes and note where they intersect. Then,

   a. Use "area" to find the area bounded by the two curves.

   b. Use "solids of revolution" to find the volume of the solid generated by revolving around the x-axis the region bounded by the curves.

   c. Use "volume by slabs" to find the volume of the solid generated by revolving around the x-axis the region bounded by the curves.

---

8. Use "Riemann Sums" to evaluate $\int_0^1 e^{x^2} dx$

9. Use "integration" to evaluate $\int_0^1 \frac{dx}{\sqrt{x^2 + 1}}$

10. Use "implicit differentiation" to find $\frac{dy}{dx}$ if $x^2y - xy + xy^2 = 1$

11. Use Trigpak's "row reduce a matrix" to find A^{-1} and B^{-1} if

$$A = \begin{bmatrix} 3 & -5 & -2 & -3 \\ 1 & -2 & -1 & -2 \\ 2 & -5 & -2 & -5 \\ -1 & 4 & 4 & 11 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} 7 & -24 & 1 & -2 \\ 3 & -10 & 0 & -1 \\ 7 & -29 & 3 & -2 \\ -3 & 12 & -1 & 1 \end{bmatrix}$$

Presenter: Dennis Gittinger, Mathematics Department, St. Philip's College, 1801 Martin Luther King, San Antonio, Texas 78203

MicroCalc, by Harley Flanders, is available from:

MathCalcEduc
1449 Covington Dr.
Ann Arbor, MI 48103-5630

Trigpak, by John Mowbray is available from:

Brooks/Cole Publishing
(Wadsworth)