

To: USD-268 Board of Education

From: Douglas A. Riepe

Date: July 12, 2002

Subject: A well referenced literature review of Interactive Math Program®.

CC: Mr. Neuenswander Mr. Traxson Concerned Patrons

Introduction:

This effort started with the author reading the freshman level Interactive Math Program® (IMP) book last December. It continued with the author contacting numerous university professors and departments concerning the use of calculators in freshman calculus classrooms. The author also contacted the registration offices at Kansas State University (KSU) and The University of Kansas (KU) to verify that IMP was accepted for entrance requirements to the state universities of Kansas. The author voiced concerns as to the nature of IMP to a board member and met with the high school principal, the director of curriculum and testing, and a high school math teacher March 14, 2002. The research continued in an attempt to verify the article in the *Cardinal Connection* that IMP was an “exemplary” math program. The sources of the statements made in the “Conclusions and Recommendations” area are given in the body of the report. All references used in this review are appended to the survey for the convenience of the reader. The conclusions are the opinion of the author, other opinions may differ.

The reader is encouraged to examine all of the references listed to verify 1) that the reference exists; 2) that the author has not electronically altered the reference; and finally 3) that the author has not taken the quote out of context. Since this is a literature review, the author makes frequent and lengthy use of quotations from the sources that have nothing to gain from the sale of textbooks. The intervening text is present to transition from one source to the next.

Conclusions and Recommendations:

- 1) The expert panel that granted the “exemplary” rating to IMP and other programs had the appearance of conflict of interest as well as other issues. While the “exemplary” rating is an historical fact, it is of little value.
- 2) IMP is a program designed to retain the attention of students who will either not attend college or will major in non math fields. It lacks the depth of study for students who will study math in college. It is not a college prep math curriculum.
- 3) SAT scores from high schools in California that use and are “satisfied” with IMP are lower than the California state average.
- 4) Some college professors do not allow the use of calculators and college professors in general warn of reliance on calculators being a handicap for students. Some KSU freshman calculus coordinators do not allow the use of calculators on calculus tests.
- 5) USD-268 should contract with Garden Plain or Norwich to provide college prep math because IMP is not a college prep math program.

Discussion:

The Expert Panel.

The author first learned of the “exemplary” rating in the district newsletter. No references were cited as to a web site or journal where this rating could be studied¹. The director of curriculum and testing was contacted as to more information as to the source of the “exemplary” rating. The director of curriculum and testing forwarded reference material to the author². The IMP newsletter did not contain references as to where to find the U.S. Department of Education report cited. The author located the report after searching the U.S. Department of Education web site³. The report gave no indication as to the source of the data used to arrive at the “exemplary” rating. The report gave no references or bibliography. The author located a list of Expert Panel members⁴. The author located a “contacts” list for the expert panel⁵. The contact person for the Mathematics and Science Education Expert Panel, Ms. Carol Sue Fromboluti, was contacted⁶ to obtain a copy of the references used to prepare reference 3. Ms. Fromboluti told the author that no bibliography existed. No data other than that provided by IMP had been used to prepare the report that gave IMP an “exemplary” rating.

Following the endorsement of the “exemplary” and “promising” curriculums a letter was sent to the United States Secretary of Education, Richard Riley⁷. It was published in the *Washington Post*. The letter to Secretary Riley was authored and endorsed by⁸

“Department heads at many universities, including Caltech, Stanford, Harvard, and Yale, along with two former presidents of the Mathematical Association of America also added their names in support. Seven Nobel laureates and winners of the Fields Medal, the highest award in mathematics, also endorsed. In addition, several prominent state and national education leaders co-signed our open letter”

The authors (4 of 6 were from California while 85 of 218 co-signers were from California) of the letter also stated,

¹ April 2002 issue of *The Cardinal Connection*, “Curriculum Corner” by Amy Wallace, Director of Curriculum and Testing, Cheney USD 268. Page 17 of report.

² *IMPressions*, The Spring 1999 newsletter for IMP. Page 18 of report.

³ The Interactive Mathematics Program (IMP), pages 19-26 of report. website: http://www.enc.org/professional/federalres.../document.shtm?input=CDS-000496-496_1

⁴ U.S. Department of Education Math and Science Education Expert Panel, pages 27-29 of report website: <http://www.enc.org/professional/federalresour.../document.shtm?input=CDS-000496-49>

⁵ Expert Panels – Contact list, pages 30-31 of report web site: http://www.ed.gov/offices/OERI/ORAD/KAD/expert_panel/contact.html

⁶ Phone call, D. A. Riepe to C. S. Fromboluti, May 1, 2002

⁷ An Open Letter to United States Secretary of Education, Richard Riley, pages 32-57 of report. posted at: <http://www.mathematicallycorrect.com/riley.htm>

⁸ Testimony of David Klein Professor of Mathematics, California State University, Northridge, April 4, 2000, to U.S. House of Representatives Committee on Appropriations Subcommittee on Labor, Health and Human Services, Education and Related Activities. Page 58 of report.

*"We would like to emphasize that the standard algorithms of arithmetic are more than just 'ways to get the answer' – that is, they have theoretical as well as practical significance. For one thing, all the algorithms of arithmetic are preparatory for algebra, since there are (again, not by accident, by the virtue of the construction of the decimal system) strong analogies between arithmetic of ordinary numbers and arithmetic of polynomials."*⁹

The letter also states:

*"It is not likely that the mainstream views of practicing mathematicians and scientists were shared by those who designed the criteria for selection of "exemplary" and "promising" mathematics curricula. For example, the strong views about arithmetic algorithms expressed by one of the Expert Panel members, Steven Leinwand, are not widely held within the mathematics and scientific communities."*¹⁰

Mr. Leinwand was on the advisory board for IMP¹¹.

The letter states¹²,

"The Expert Panel that made the final decisions did not include active research mathematicians. Expert Panel members originally included former NSF Assistant Director, Luther Williams"

NSF provided funding for many of the programs submitted to the Expert Panel. Others voiced concerns¹³

"But some panel members were mystified and wondered whether having NSF officials on the expert panel opened the door to charges of vested interests. "Not enough thought had gone into the makeup of the panel," says James Rutherford, an advisor to the American Association for the Advancement of Science, who was on the panel, too. "I really wondered if Luther should have been there at all. After all, at the NSF he was directly involved in funding the very programs that we were evaluating."

The output of the Expert Panel appeared to favor NSF funded programs,

*"Even after Williams left the panel, there was another NSF official on board. In the end, six of the 10 programs selected by the panel were NSF funded – a striking success rate since only 13 were NSF funded in the 1990's"*¹⁴

At least one of the members of the Expert Panel had no ties to the NSF or to book publishers, Dr. Manuel Berriozabal, a mathematician at the University of Texas at San

⁹ Ibid 7, page 2 of 26. Page 33 of report.

¹⁰ Ibid 7, page 1 of 26. Page 32 of report.

¹¹ Mark Clayton, "How a new math program rose to the top", *Christian Science Monitor*, May 23, 2000, page 11 of 12, web site: <http://www.csmonitor.com/sections/learning/mathmelt/p-2story052300.html>. Page 71 of report.

¹² Ibid 7, page 1 of 26. Page 32 of report.

¹³ Ibid 11, page 10 of 12. Page 70 of report.

¹⁴ Ibid 11, page 10 of 12. Page 70 of report.

Antonio. Dr. Berriozabal was asked to join the Expert Panel by the U.S. Department of Education.¹⁵

Dr. Berriozabal is well acquainted with preparing high school students for college math programs as he is the coordinator for TexPREP.¹⁶ TexPREP is a program that identifies the top math students in the state of Texas and prepares them for college engineering programs.¹⁷ Dr. Berriozabal was also inducted into the Texas Math Hall of Fame.¹⁸

Dr. Berriozabal commented on the Expert Panel

*"The panel was a good idea," Dr. Berriozabal says, "but we made some bad judgements. From the best I could tell, none of the programs we selected as 'promising' or 'exemplary' had any kind of long-term track record of achievement.'"*¹⁹

Dr. Berriozabal abstained or voted against all 10 programs designated "exemplary" or "promising".²⁰

Dr. Berriozabal commented in a recent e-mail

*"Over a period of several days, the panel examined the reports and during this time we had hard copies of the program materials if we wanted to review them. I believe that evaluations for over 50 programs were submitted. Consequently, in my opinion, very little per program was given to an indepth study of a program."*²¹

If 50-60 programs were reviewed, let's say several days was one week (5 working days) that would allow for between 2/3 to 4/5 hour per program. 40 to 48 minutes is hardly enough time to read textbooks for a 4 year curriculum.

When asked to comment specifically on IMP, Dr. Berriozabal stated:

*"I am unable to provide you with any specific critiques on the IMP Program (or any other program) but I suggest that the Mathematically Correct group in California might be a good source. The e-address which I have for them is www.mathematicallycorrect.com/books.htm."*²²

The reader is invited to "surf" to the web site and read through the material on IMP and other curriculums.

¹⁵ Ibid 11, page 4 of 12. Page 64 of report.

¹⁶ Manuel Berriozabal – Home Page, web site:

<http://applied.math.utsa.edu/berriozabal/index.html>. Pages 73-76 of report.

¹⁷ TexPREP site, web site: <http://www.math.utsa.edu/~prep/sa013.htm>. Pages 77-78 of report.

¹⁸ Ibid 16, Pages 73 - 76 of report.

¹⁹ Ibid 11, page 4 of 12. Page 64 of report.

²⁰ Ibid 11, page 5 of 12. Page 65 of report.

²¹ e-mail from Manuel Berriozabal to Douglas Riepe, Friday, May 10, 2002. Page 79 of report.

²² Ibid 21. Page 79 of report.

In summary it can be said that reasonable people can have difficulty accepting the decisions of the Expert Panel due to the make-up of the panel, the criteria used by the panel, and the lack of time spent reviewing the actual textbooks by the panel.

Dr. Klein states in his testimony to Congress:

*"The ten so-called "exemplary" and "promising" math programs recommended by the Department of Education for our children include some of the worst math books available. The programs I have examined radically de-emphasize basic skills in arithmetic and algebra. Uncontrolled calculator use is rampant. One can draw a parallel between the philosophy that underlines the failed "whole language learning" approach to reading, and the Department of Education's agenda for mathematics."*²³

Is IMP college prep material?

The bulk of this section is material taken from two texts: "Review of the Interactive Mathematics Program (IMP)"²⁴ by H. Wu, Berkley and "A Preliminary Analysis of SAT-I Mathematics Data for IMP schools in California"²⁵ by R. James Milgram, Stanford. The authors and endorsers of the letter to Secretary Riley recommend these texts, so at least 200+ college level math teachers agree with the authors of references 24 & 25.²⁶

Dr. Wu first reviewed the IMP program (IMP was called CPM at the time) in March of 1992²⁷. Dr. Wu has been a college math teacher for over 20 years. During that time, Dr. Wu has been a quality control inspector for high school math programs²⁸. That is Dr. Wu has had to deal with students that were poorly prepared for college calculus. Just as a college coach knows what skills he wants to see in freshman recruits, Dr. Wu knows what skills must be present in college freshman entering calculus class.

Dr. Wu examines the "audience" for high school math programs. Dr. Wu comes to the conclusion that there are two target audiences or groups:

"Group 1: those who will not go to college as well as those who will, but do not plan to pursue the study of any of the exact sciences (mathematics, astronomy, physics, chemistry), engineering, economics, or biology, and
Group 2: those who plan to pursue the study of one of the exact sciences, engineering, economics, or biology, and those who entertain such a possibility."²⁹

Dr. Wu describes how the needs of Group 1 varies from Group 2. As students enter high school, not all the students can grasp or be "comfortable" with college prep mathematics

²³ Ibid 8 . Page 58 of report.

²⁴ "Review of Interactive Mathematics Program (IMP) at Berkley High School", posted at <http://www.math.berkeley.edu/~wu>. 35 pages, Pages 84-118 of report.

²⁵ "A Preliminary Analysis of SAT-I Mathematics Data for IMP Schools in California", posted at <ftp://math.stanford.edu/pub/papers/milgram/>. 10 pages. Pages 119-128 of report.

²⁶ Ibid 7, page 2 and 3 of 26. Pages 33 & 34 of report.

²⁷ Ibid 24, page 1. Page 84 of report.

²⁸ Ibid 24, page 26. Page 109 of report.

²⁹ Ibid 24, page 5. Page 88 of report.

courses.³⁰ Dr. Wu is not advocating the past practices where school officials "decided" who would take college prep classes. Dr. Wu states:

*"It should be firmly stated at the outset that I am not advocating the "tracking" of mathematics classes in the usual sense of having the school authorities dictate who should be assigned to which track. What I have in mind is a system whereby the high school students get the free choice of enrolling in either track, and are allowed to switch between tracks later on. In other words, they should be allowed to choose their mathematics classes the same way college students do. One may call this **"tracking by choice"**. The issue of when this choice should be first offered to the students may be left to another discussion"*³¹

At present Cheney USD 268 does not offer separate math curriculums for non college math versus college math. Thus it appears that all of the square pegs are pushed through the round hole or visa-versa. Dr. Wu's review goes to great detail to explain the difference between the two requirements and the reader is encouraged to read Dr. Wu's review in its entirety. If any of the mathematical concepts discussed by Dr. Wu are unfamiliar to the reader, the author will be happy to explain them.

Dr. Wu considers IMP's approach to Group I students to be superior to traditional approaches in many ways.³² Dr. Wu further states that IMP was targeted at Group 1 students:

*"After talking to the designers of the curriculum, I slowly came to an understanding of their objectives and their accomplishments. They aim this curriculum squarely at the students of Group 1"*³³

But Dr. Wu cites the following as areas where IMP should improve:

- "(a) The almost total absence of drills.*
- (b) The inability of the IMP text to follow through in its presentation of new ideas.*
- (c) The misrepresentation of mathematics through the abuse of "open-ended problems" and the de-emphasis of correct answers.*
- (d) The presentation of mathematical puzzles (also known as brain-teasers) as straight mathematics.*
- (e) The refusal to acknowledge that mathematics could be inspired by abstract considerations."*³⁴

Rather than plagiarize Dr. Wu's explanations, the reader is encouraged to read them at pages 11-14 of Dr. Wu's review.

Dr. Wu explains that Group 2 students, college math prep, are:

"already motivated to learn. In addition, one must take into account the fact that their technical skill must be sufficiently developed in order to meet the

³⁰ Ibid 24, page 4, Page 87 of report.

³¹ Ibid 24, page 5, Page 88 of report.

³² Ibid 24, page 10, Page 93 of report.

³³ Ibid 24, page 18, Page 101 of report.

³⁴ Ibid 24, pages 11-14, Pages 94-97 of report.

challenge they face in college. Thus the mathematics curriculum for this group can minimize the sweet-talk and at the same time be more exacting. When viewed from this perspective, the IMP curriculum falls far short of the ideal”³⁵

Dr. Wu’s examination of IMP for the college bound math student are as follows:

- “(A) Lack of depth and breadth in the topics covered.*
- (B) Insufficient emphasis on technical drills(Compared to football on p.20)*
- (C) Insufficient emphasis on precision....*
 - 1) The exposition overextends itself in the direction of chattiness and informality. This leads to sloppiness. Precise definitions are not always offered, and when they are it is often done with almost an apology...*
 - 2) The IMP curriculum does not make any serious concentrated attempts at teaching students what a mathematical proof is all about...*
 - 3) This particular aspect in which IMP curriculum contributes to an erosion of the standard of precision is more difficult to encapsulate in a single phrase or sentence. It is more of an attitude, pervasive and ever present, that encourages excessive discursiveness and informality,*
- (D) Over emphasis on group activities...*
 - “If a camel is a horse designed by a committee, what then is the kind of mathematics learned exclusively from compulsory group activities?”³⁶*

Dr. Wu’s historical perspective on IMP is unchanged after being familiar with the IMP (originally named CPM) curriculum for a decade:

“Other than the expected pedagogical and expository refinements, the virtues and defects – such as I perceived them and discussed in the report – of the preliminary 1991 version made available to me back in 1992 have in the main survived in the published version. In particular, the reservations against IMP detailed in III and IV below regarding its lack of precision and its inattention to mathematical closure apply equally well to the 1997 text. Thus I believe this review still serves a purpose. My recommendation against the use of IMP for future college students in science, engineering, and (of course) mathematics is in my view as valid now as before.”³⁷

IMP emphasizes the relation between the highest level of mathematics studied in high school and college degree completion. A portion of an article by Dr. N. Webb at the University of Wisconsin summarizes this:

“One of the most powerful predictors of ultimate completion of college degrees is the highest level of mathematics one studies in high school (Adelman, 1999). The number of years of high school mathematics is a better predictor than high school grades or standardized tests”³⁸

³⁵ Ibid 24, page 15, Page 98 of report.

³⁶ Ibid 24, pages 15-25, Pages 98 to 108 of report.

³⁷ Ibid 24, page 2, Page 85 of report.

³⁸ Ibid 25, page 6-7, Pages 89-90 of report.

The only issue is that Dr. Adelman's results:

*"refers explicitly to Algebra II, and the courses subsequent to it were trigonometry, pre-calculus, and calculus (see page 17 of C. Adelman, "Answers in the Toolbox, Academic Intensity, Attendance Patterns, and Batchelor's Degree Attainment", U.S. Department of Education, Office of Educational Research and Development, 1999 for details). Thus, implicit in Dr. Webb's discussion above is the presumption that IMP 3 and IMP 4 are equivalent in terms of preparation for college mathematics courses to the more traditional curriculum"*³⁹

There apparently exists no or very limited evidence to evaluate if IMP 3 and IMP 4 are equivalent to Algebra II, Trig, and Pre-calculus. Especially since IMP substitutes statistics and probability for algebra in the high school curriculum.⁴⁰ The lack of evidence is not surprising since IMP is used by a relatively small number of schools.

College classes on statistics and probability are typically not taught until the junior year. This allows the students to complete classes in calculus (3 semesters) and differential equations(1 semester). Calculus and differential equations are required for a full and rigorous treatment of statistics and probability. The reader is encouraged to examine a class schedule for KU or KSU to verify when statistics classes for engineers and mathematics majors are taught and what classes are required.

Research at the University of Colorado at Boulder found:

*"Algebraic preparation from high school is the single best predictor of a student's success in Calculus I at CU-Boulder. In turn, success in Calculus I is the single best predictor of whether a student will graduate with a degree from CU's College of Engineering and Applied Science and potentially pursue such technical careers"*⁴¹

In summary it can be said that a college math teacher at Berkley who has followed and reviewed IMP (CMP) for 10 to 11 years and has written and periodically updated a review of IMP math has found it lacking for potential college math students. Also a college math teacher at Stanford has pointed out the assumptions made in the IMP logic that more of any math classes are good when the actual study was done based on Algebra II, trig, and pre-calculus. And lastly, the University of Colorado at Boulder has found that Algebraic preparation especially,

*"solid algebra, trig, and precalculus skills are crucial for success in college-level calculus"*⁴²

³⁹ Ibid 25, page 7 and 8. Pages 125-126 of report.

⁴⁰ Ibid 25, page 10. Page 128 of report.

⁴¹ "Bridging the Mathematical Gap Between High School and the University"; Dougherty, Anne and Nelson, Mary; University of Colorado at Boulder Community Affairs, CU's Outreach and In-service Program Guide for Colorado's Teachers. Pages 129 & 130 of report. Posted at: [.../search.cgi?id=13&sort=grade&resource=0&lang=0&curr=5&grade=3&x=41&y=21&pla](http://search.cgi?id=13&sort=grade&resource=0&lang=0&curr=5&grade=3&x=41&y=21&pla)

⁴² E-mail from Anne Dougherty to Douglas Riepe, June 4, 2002. Pages 131 & 132 of report.

The percentage of students entering California State University students requiring remedial mathematics courses has increased from 23% in 1989 to 54% in 1998.⁴³ Professor Milgram attributes the increase:

“As an indication of the effect of programs like IMP in California since 1989”⁴⁴

Based upon Dr. Wu’s analysis of IMP and the historical data from California, discerning educators, but especially those who have taken college calculus could question if students in IMP will receive a set of solid algebra, trig and pre-calculus skills equivalent to those taught in a traditional setting.

SAT Scores for California Schools that use and are Satisfied with IMP

Two studies are quoted in this section. The primary one was completed by Dr. Milgram and a study conducted by N. Webb with “rest of the story” data analysis by Kim Mackey.

The 83 schools using IMP in California in the 1998-1999 school year were contacted to find out their level of satisfaction with the program. The schools were contacted to determine if IMP was the only math program in use and how long it had been in use (students taking the SAT had only taken IMP). These questions narrowed the list of schools to 33. The SAT scores for these schools were reported by the California Department of Education. The results for the schools that were satisfied with the IMP curriculum is given below:

“In short, no discernible improvement in the overall performance of the students in these IMP schools against the measure of success in the SAT-I math test could be verified. It is worth noting that these schools consistently scored from 14 to 21 points below the overall state means, 14 points below the baseline years 1989 and 1990 and then more thereafter.”⁴⁵

Dr. Milgram points out that between the school list for 1997 and the school list for 1999:

“Thus, combining the two lists we find that at least 15 schools in the 1997 list have since changed to other curricula, and it is likely that a further number de-emphasized the program”⁴⁶

The test score data are given in tabular form in Dr. Milgram’s report. The reader is invited to study the data. It is interesting that the IMP sites not satisfied (planning to change curriculum, limited use, for at risk students only)⁴⁷ with IMP had higher SAT-1 scores, though still below the California state average.⁴⁸ Dr. Milgram’s data cover a larger number of schools than the IMP web site data. There are a number of possible explanations besides IMP for the below average test scores from the schools using IMP. It is not known by the author with what frequency schools typically change math curriculum, thus the number of schools quoted in footnote 45 may or may not be significant.

⁴³ Ibid 25, page 6. Page 124 of report.

⁴⁴ Ibid 25, page 6. Page 124 of report.

⁴⁵ Ibid 25, page 3. Page 121 of report.

⁴⁶ Ibid 25, page 4. Page 122 of report.

⁴⁷ Ibid 25, page 2-3. Pages 120 & 121 of report.

⁴⁸ Ibid 25, page 4. Page 122 of report.

The following work was conducted by Kim Mackey and describes the student groups used in a well known IMP study:

*"One definitive study that can tell us more about IMP's effectiveness is a study quoted by IMP in their spring 1995 Evaluation update. This study, report number 95-4 is "Impact of the Interactive Mathematics Program on the Retention of Underrepresented Students: Class of 1993 Transcript Report for School 2: "Hill High School"" by Norman Webb and Maritza Dowling. Excerpt from this report have also appeared in the winter 1996-1997 edition of WCER Highlights and is available on-line at the WCER website. Both the IMP update and the WCER highlights article make much of the fact that SAT scores for IMP students were nearly identical with those of non-IMP students in one carefully match group. But what about other groups at this high school? When comparing student groups it is always important to consider the student population from which they are drawn."*⁴⁹

The rest of the story is that based upon 7th grade Comprehensive Test of Basic Skills (CTBS) scores. The students taking IMP math, except the "other" category, were higher, statistically higher, than those not selected for the program:

*"Thus, IMP students in most categories had higher math achievement as 7th graders than non-IMP students who took algebra, and other math classes. (not included in the study were a 25 percent group of the population at the high school who took geometry or higher math classes as freshmen)... The conclusion seems to be that lower achieving students in the non-IMP groups made up a tremendous amount of ground on the IMP students in terms of math achievement between the 7th grade and the time the SAT was taken, usually in 11th grade. From this data it appears that IMP is a great leveler, not by pushing lower achieving students up but by holding higher achieving students back."*⁵⁰

There would appear to be data available that would suggest that test scores do not show improvement. The proof will be in the pudding as the USD-268 evaluates testing results to see if it can replicate report 95-4.

A most interesting comment comes from reviewing the effort of math reform in California:

*"Cohen and Hill point out that many teachers, including those who liked much about the new approach, continued to practice conventional math instruction. Considering that the state decided in the late '90's, to reemphasize computational skills and the like, these teachers, it now appears, were more wise than stubborn in not buying into the new approach"*⁵¹

⁴⁹ IMP: A Student's View, with Comments by Kim Mackey, page 5. Page 137 of report.

⁵⁰ Ibid 49, pages 5 and 6. Pages 137 & 138 of report.

⁵¹ "Reviews: Surprise Endings", David Ruenzel, *Education Week*, March 1, 2002, web site: <http://www.edweek.org/tm/tmstory.cfm?slug=06review.h13&keywords=math>. Page 142 of report.

Use of Calculators in Class

The use of calculators in college math classes was once strictly forbidden. Math and statistics classes were theory classes and numerical methods classes were where computers were used to apply the theory to problem solving issues.

The author contacted area colleges and talked to freshman calculus coordinators (catch words to use if you want to talk to the professors who set up the testing for all of the introductory calculus classes at a particular university), department secretaries, and the professor who taught the author differential equations.

KSU, KU, Newman University, Wichita State University, and the University of Nebraska at Lincoln were contacted for information concerning calculator usage.

KSU and KU reported that to be admitted to a calculus class a student had to have an ACT math score of 28 or higher. If Cheney begins to teach calculus in the high school, the faculty should consider having a similar cut off. Based upon his high school class, the author estimates that Cheney will likely have 5 to 10 students each year that are qualified to take the class. If the class is taught to land-grant college standards some of those will have to switch classes or fail.

The KSU freshman calculus coordinator reported that the TI-83 is used only to “check work”. The students must show all steps in derivatives and integration by hand. The instructor stated that the ability to do algebra by hand is very important. The instructor also stated that calculator usage should be restricted especially for freshman and sophomore high school students. Not all freshman calculus coordinators allow the use of calculators on tests at KSU.⁵² Time is provided during class for students to learn how to use the calculators, so prior experience apparently is not an advantage.

The department secretary at KU reported that the TI-86 was used in class.⁵³

The Wichita State University Mathematics Department does not require calculator usage in their classes and the TI-83 is the calculator of choice.⁵⁴

Newman University’s freshman calculus coordinator reported that the calculus tests at Newman contained sections where no calculators were used and sections where calculators were allowed.⁵⁵

The University of Nebraska-Lincoln Mathematics Department secretary reported that in college algebra and above TI-83 is allowed and TI-86 is used in calculus, but the students

⁵² Phone call from Douglas Riepe to Dr. Todd Cochran, Freshman Calculus Coordinator, KSU, (785)532-6750 x-0565, January 2002,

⁵³ Phone call from Douglas Riepe to KU Mathematics Department (785)864-3651, January 2002.

⁵⁴ Phone call from Douglas Riepe to Wichita State University Mathematics Department, January 2002, (The phone number is in the Wichita phone book).

⁵⁵ Phone call from Douglas Riepe to Dr. Joel Burgeson, Freshman Calculus Coordinator, Newman University, (316) 942-4291 x-162, January 2002

must do differentials and integration by hand.⁵⁶ The use of calculators in college classes was briefly discussed with Professor Gordon Woodward. Professor Woodward reiterated what the department secretary had said, that the students are required to show derivative work by hand and the calculator is used to double check or do simple calculations. Dr. Woodward said that if the student is dependent on calculators then they are in trouble.⁵⁷

KSU is not the only school in the U.S. where a student potentially may not be able to use a calculator. A student from a Core Plus curriculum made the following comment:

*"The reason I have not taken any math courses in college is because the math I learned in high school does not apply to college math. I used the TI-82 for linear programming and colleges do math by hand, which is very tedious. Colleges all need to change ..."*⁵⁸

Core Plus was rated as "Exemplary" by the Expert Panel.⁵⁹

Another student stated:

*"Core Plus taught me math well; however, it did not teach me how to show my work. Because of that I failed college math."*⁶⁰

Another comment on Core Plus:

*"The high school math program was good. The problems arose because colleges haven't re-structured their math programs accordingly."*⁶¹

Other countries around the world use calculators in the class room, the only problem is that most of them are in the bottom half of the math testing with the U.S. Ten of 11 nations with scores below the international average allowed the usage of calculators everyday.⁶² This contrasted with the fact that 3 of the top 5 countries (Japan, Belgium, and Korea) do not allow calculators at all.⁶³

A comment by a college freshman sums up the risks of heavy calculator usage in high school:

"I feel as though three years of math at high school were lost," says Amir Emami, a freshman at Kalamazoo College. Even though he graduated with a 3.4 grade point average, he has a weak understanding of math. "The

⁵⁶ Phone call from Douglas Riepe to the Mathematics Department, University of Nebraska-Lincoln (402)472-3731

⁵⁷ Phone call from Dr. Gordon Woodward, (402) 472-3731 x-7239 to Douglas Riepe, January 15, 2002.

⁵⁸ "Outcomes Analysis for Core Plus Students At Andover [Michigan] High School: One Year Later", R. James Milgram, Department of Mathematics, Stanford, University, website: <http://math.stanford.edu/pub/papers/milgram/andover-report.html>. page 10 of 32. Page 153 of report.

⁵⁹ Ibid 11, page 2. Page 62 of report.

⁶⁰ Ibid 58, page 11 of 32. Page 154 of report.

⁶¹ Ibid 58, page 11 of 32. Page 154 of report.

⁶² "Calculators in class: freedom from scratch paper or 'crutch'?", *Christian Science Monitor*, May 23, 2000, Mark Clayton, page 179 of report. website: <http://www.csmonitor.com/sections/learning/mathmelt/p-7story052300.html>.

⁶³ Ibid 62, page 4 of 4. Page 179 of report.

answers [in high school] were written paragraphs, not equations or number crunching. You learn to depend on our TI-82 calculator.”⁶⁴

The last reference in this section is for a study, which concerned the question of “Could the use of technology increase test scores?” Most of the schools in the study have spent large sums of money on technology, the answer?

“They (authors) also point out that the one school in their study that has been reluctant to invest in technology, Renaissance High in Detroit, also has the best academic track record.”⁶⁵

The initial paragraph of the review is particularly interesting:

“Several years ago, three researchers at SRI International’s Center for Technology in Learning in Menlo Park, California, set out to discover what it takes for urban high schools to effectively incorporate technology into the curriculum. The answer, as they tell it in this engaging book, is a discouraging “everything and more”. Indeed, school administrators reading this volume may come to see computers and other new technologies as something akin to a pricey new boat – that proverbial hole in the water into which the unfortunate owner pours great sums of money. This sense of foreboding is rather ironic given that the authors are boosters of educational technology and its potential to improve teaching and learning.”⁶⁶

Integrated Math Programs

USD-268 personnel make much of the fact that “the rest of the world” uses “integrated” math programs. But as Dr. Richard Askey points out in his article:

“There are two types of “integrated programs.” There are those like the ones in Singapore, which teach some arithmetic or algebra and some geometry each year with connections among them used. This is something that mathematicians have been proposing for a very long time (Mathematical Association of America 1923). Similar programs exist in many other countries. Singapore is mentioned because textbooks in that country are good, are written in English, and are accessible in the United States. (See www.singaporemath.com.)

The other is illustrated by some of the National Science Foundation (NSF)-funded programs from the NSF call for new programs in the early 1990s. These have a different focus, trying to teach mathematics in the context of

⁶⁴ Ibid 62, page 4 of 4. Page 179 of report.

⁶⁵ “Reviews: Vision Quests, THE CONNECTED SCHOOL” reviewed by David Ruenzel, *Education Week*, April 2002, page 2 of 5. Page 181 of report. website:
<http://www.edweek.org/tm/tmstory.cfm:slug=07books.h13&keywords=math>

⁶⁶ Ibid 65, page 1 of 5, Page 182 of report.

*real-world problems. It is the second type of integrated program that has become the focus of controversy in the United States.*⁶⁷

Professor Woodward mentioned that New York state has an “Integrated” math program⁶⁸, which Professor Woodward described as being “good”.

Closing Thoughts

The author is left to ponder why USD-268 selected a largely unknown curriculum, a curriculum which had been reviewed for nearly 10 years (since 1991 or 1992) as unsuited for college prep, a curriculum which really didn’t claim to improve standardized test scores, if the goal was to improve ACT scores or the odds of USD-268 students excelling in college, why not contact the area colleges and see if a consensus could be formed, ie., what high school math program is consistently mentioned as being the best? Another tack would be to survey the surrounding school systems and determine the curriculums used and the teaching methods used to teach them.

In talking with members of the community, it is mentioned that small groups have been used to teach math. If USD-268 wants to prepare students for college then, perhaps the classes should mimic college classes. In college there will be no small groups in mathematics classes, the professor will lecture & the students will take notes. The class will not work on problems for 4 to 5 weeks. Students will solve problems in minutes. The professor will assign grades, not classmates. There seems to be a number of disconnects between the math curriculum currently used in USD-268 and what a student can expect to face in college.

Author’s motivation

The author has undertaken this literature survey after finding that the Board of Education of USD-268 and perhaps the administration and staff of USD-268 selected and supported a math curriculum based, (from comments of “there was a nice presentation” and the sole supporting literature was an IMP news letter) apparently on a sales presentation and quarterly newsletters from the vendor. Having been through calculus, the author realizes the importance of a firm mathematical foundation in college.

As stated by Dr. Klein (reference 23) the approach to teaching math used by IMP and other NSF funded curriculums is similar to “whole language learning”. “Whole language learning” has been taught in kindergarten at USD-268 during the years 2000-2001 and 2001-2002. My son Evan was enrolled in kindergarten during the year 2001-2002. Evan's reading skills are poor. He can’t sound out words. He guesses at words. Among my three children he received the poorest kindergarten education. My other children had the advantage of phonics based reading programs. Apparently the whole language learning curriculum was forced on the grade school and teachers by the central administration of USD-268. This despite:

⁶⁷ “There Are Integrated Programs, and There are Integrated Programs”, National Council of Teachers of Mathematics, January, 2001, website: <http://www.nctm.org/dialogues/2001-01/20010113.htm>. Page 185 of report.

⁶⁸ Ibid 57.

“Compounding the problem is the fact that the reading instruction to which your daughter was forced to submit is not phonics-based; rather, it is based on word-memorization, also known as “whole language.” The research indicates that phonics-based instruction significantly lowers the incidence of reading problems. I’d strongly advise that for next year, you find and enroll your daughter in a school that respects the differences between children and embraces phonics, not fad.”⁶⁹

This coming year, USD-268 is going back to a phonics based curriculum in the kindergarten. The children that were taught with “whole language learning” are behind their peers at other schools, but with patient elementary teachers, they probably will catch up, eventually, probably without lasting effects. Interesting USD-268 is not trumpeting this change of curriculum in the newspaper nor is it offering remedial phonics for the students that were left behind by the “whole language learning” curriculum used over the last 2 years.

As a parent of a student that at present is enrolled to attend high school at USD-268, I fear that the same “whole learning” syndrome that has left my son Evan with poor reading skills will leave my daughter with poor math skills. This is simply unacceptable. The concerned parent is left with the following alternatives: 1)Move to another district, all of the area districts contacted have a standard curriculum, 2)Attend a neighboring school as an "out of district" student, 3)Attend a boarding school, 4)Home school, 5)Tutor children at home for the duration of high school. Option 5 would give the student adequate math skills, but science classes would still be dragged down by the lack of math taught to the remaining (IMP) students. The experiences of others (in California) indicate that the IMP curriculum will likely leave students without the math abilities required for science classes as the following quotations illustrates:

“STUDENTS: It is uncommon to find students attending a parent-teachers meeting at 7pm but such a meeting at TMASH(SFUSD’s Thurgood Marshall Academic High School) on 3rd December 96 was attended by several students. The discussion was suitability of IMP as the only mathematics offering for an “academic” school. Quotes “Science class has stopped (for the second year in a row) because students didn’t know necessary mathematics”⁷⁰

The essay continues with feedback from parents:

“Chemistry and Physics teachers are having to provide extra mathematics drills”⁷¹

The experience of those in California was that IMP was unable to provide the basic skills needed in chemistry and physics classes. It would appear that the concerned parent would also have to tutor the physical sciences as well as math to compensate for the

⁶⁹ “What’s a Parent to Do?”, (Labeling children isn’t helpful), *The Wichita Eagle*, May 9, 2002, John Rosemond. Page 188-189 of report

⁷⁰ “Interactive Mathematics Program Manifesto on an Experimental Concept Gone Awry”, Shaumen Datta, page 1 of 6, website: <http://mathematicallycorrect.com/impsf.htm> . Page 190 of report.

⁷¹ Ibid 70, page 5 of 6. Page 194 of report.

effects of IMP. Thus option 5 appears to be unacceptable. It is the author's sincere hope that the Board of Education for USD-268 will take a look at IMP and evaluate whether it merits continued use at USD-268. Those who don't learn from history are doomed to repeat it.

Author's Academic Background

The author's background includes but is not limited to the following:

High School:

Member Honor Society
High School Class Valedictorian
UN-L Regents Scholarship (1-year)
ACT test score of 32 (the ACT score has since been "recentered")
ACT math test score of 36 (a score of 32 was at the time a 99.9 percentile)
Winner of Inter-High scholastic contests
4 year football letterman, district champion-wrestling
Co-winner of conference academic award for high ACT test score.

College:

Freshman chemistry student of the year at the University of Nebraska – Lincoln
Graduated with 3.9 average while majoring in Chemical Engineering
Graduated with honors
Member Tau Beta Pi
Master of Science in Engineering Thesis "Computer Control of Laboratory Equipment"

Copies of transcripts available at author's residence.
Calculus books, 1 twenty year old book and 1 new book used by Friends University.

Professional:

Beginning and advanced SPC training
Understanding Industrial Experimentation
Completion of training for "Six Sigma Statistical Black Belt"