REPORT ON SELECTED IBM EDUCATION PROJECTS AND COURSEWARE FOR A.B.E.L.

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NOTE

This paper reports on selected foreign IBM education projects and courseware that have relevance to the USAID project, ABEL. Due to organizational shifts in the Company, IBM has been without a foreign education project office in their Atlanta based Education Systems Group. Fragmented information has been difficult to gather and much lies outside the scope of this report. Happily, this situation is being corrected with the creation of a new IBM demonstration center in Washington, D. C. that will provide a focal point for programs and information on education projects worldwide. The attached *IBM Software for Education Catalog*[1] lists and describes educational offerings that are candidates for international applications.

[1]Available from IBM Education Systems, 4111 Northside Parkway, Atlanta, Georgia, 30327.

International Education Projects/Results

Computer as Tool--Project Genesis

As a result of a joint effort between IBM Costa Rica and the Costa Rican government, Project *Genesis* promises to put the power of computing in the hands of all that country's public school students from kindergarten through grade six by March 1990. The project started in February 1987 after a project commission appointed by Costa Rica's president, Dr. Oscar Arias Sanchez, invited computer manufacturers to present a recommended solution to the country's early childhood education requirements. IBM's award involved an initial order of almost 1200 computers (IBM PS/2 Models 25 and 50) in networks involving more than 400 educational software packages. The project expects to expand to more than 4000 PS/2s in 210 primary school teaching laboratories throughout the country.

At the heart of the program is a computer language *Logo*. Through simple programming techniques, students solve math problems, write stories, compose songs, draw pictures in color, and even animate the drawings. Students work in pairs and discover with the teacher a computer tool for solving problems.

Critical to the success of the project is an integrated program of teacher training and orientation under the guidance of Dr. Seymour Papert and his staff at M.I.T. and the establishment in Costa Rica of an IBM early education center to support the installations and implementation.

The teacher training program started with 12 Costa Rican teachers interning at Cambridge, learning LogoWriter and observing classes in a Boston inner city school where M.I.T. had been conducting its own pilot program. Some of these

teachers in turn run workshops in Costa Rica with the goal of having two teachers and a principal proficient in *Logo* for each school's computer lab. In 1988, 228 teachers received training in *Logo*.

The program's initial funding, $2.5M, came from the U. S. Agency for International Development (AID) and is administered through the Omar Dengo Foundation (FOD), a private non-profit organization whose primary goal is to improve the quality of education in Costa Rica by establishing computers in the elementary schools. FOD has also created a Teaching and Research Center and a collaborative program for the professional development of teachers. This means that teachers working towards a degree in Costa Rica can also take coordinated courses at the University of Hartford in work involving *Logo*, and educational technology.

While evaluation studies are underway, early results indicate that children are more creative and motivated in working with the computers and completing their daily assignments. Likewise, an improvement was noted in spelling and writing, which is attributed to the integration of computer projects with the various areas of the curriculum.

Due to the success of the program in the elementary schools, the Ministry of Education has asked FOD to look into the possibility of implementing a similar program for the secondary schools. Many of the elementary students have expressed concern that they will not have the opportunity to continue studying computer science in the advanced grades. At this time high school students have access to only 12 computer centers of the Ministry located in the capital city and

surrounding areas. FOD has established contacts with Apple, IBM, California Polytechnic Institute and MIT in order to explore alternatives. In addition, a pilot program of a primary and secondary school in the district of Mexico is under observation where *Logo* and *Pascal* courses are being taught at the high school.

Computer as Instructor--Writing to Read

Writing-to-Read (WTR) is a multi-sensory computer-based educational system designed to teach children how to write what they can say, and to read what they've written. This method builds writing and reading skills before a child has mastered the intricacies of spelling in the English language. Developed jointly by IBM and Dr. John Henry Martin, WTR is now being used in more than 6000 teaching labs in the U.S. The largest and most systematic adoption to date is the state of Mississippi which has put a WTR lab in every public school in the state. In the Asia/South Pacific area, the program has been introduced with great success in Australia, Singapore, Hong Kong, Malaysia, Thailand and the Philippines.

Based on the phonemic principle of the English language, WTR encourages children to focus on the 42 phonemes or sounds of the alphabet. By combining these phonemes, the children are able to form words and sentences. The phonemic methods works well as more than 85% of all English words are phoneme-based. In a typical implementation, the WTR program uses a specially equipped room in which children spend time learning a five "stations."

1. *Computer Station.* Here children get "hands on" experience with the computer. They work in pairs for peer interaction and peer tutoring. An IBM PC pronounces a single word and its phonemes through a voice card as the screen

shows a picture of the meaning of the word and its phonemic spelling.

2. *Work Journal Station.* Once the children have finished the computer station they go the work journal station where they listen, as they write, to a taped lesson about the sound of words they have just learned at the computer. At the same time, they mark their progress for the parents to review. This naturally invites parental involvement and galvanizes students to pay closer attention.

3. *Listening Library Station.* Children listen to recordings of selected children's literature as they follow the text. They begin to feel comfortable and familiar with words enabling them to match speech with written English. Additionally, children begin to appreciate good books and develop a reading habit.

4. *Writing/Typing Station.* This station comprises two areas: The typing area gives children a fast and easy method to express creative ideas. Children build speed in recognizing letters and concentrate on the typed message. Children can choose to use the typewriter or a primary editor which employs a simple word processing program. The writing area is a special place where children express themselves freely and creatively on paper. They have easy access to writing tools with which to experiment with the words they are making.

5. *Make Words Station.* Here children begin to expand their vocabulary by discovering their ability to recombine letters to form new words. They work with interesting games and tactile materials such as clay, sand and chalk.

Asia/South Pacific Projects

In comparison to the American experience, the WTR program is new in Asia but gaining wide acceptance. Assessment of its impact in the Philippines, Singapore and Hong Kong shows that the WTR method does lead to significant improvements in reading and writing skills. Originally designed for five year old pre-schoolers and six year old Grade I students in the U.S., the program could benefit older children in Asia. In Singapore, it was found to be more effective for six year olds, while in Thailand it had the more impact on students between six to nine years old. In Malaysia, three and a half year old children were found to have taken to the program without much difficulty. A *Get Set for Writing to Read* module is implemented in Thailand to help the younger children progress to the full program.

Singapore. There are four sites for the WTR program in Singapore. Two are part of the Yamaha Kindergarten which started a pilot project in mid-1987. The third is run by a government owned kindergarten at the Fengshan Community Center and the fourth at the Chao Yang Special School.

Yamaha Kindergarten offers classes for children aged four to six years. The youngest children are in the Nursery, while five year olds are in Kindergarten I (KI) and the six year olds are in Kindergarten II (KII).

Altogether 70 KII and 49 KI children took part in the pilot project which lasted 16 weeks. After ten months of project implementation, a preliminary study was conducted to evaluate the effects of WTR. It was found that children in the WTR program were superior in Reading and Writing to children not exposed to the program. WTR children were also found to be better than non-WTR children in

Spelling skills, even though the WTR program was not essentially designed for this.

Thailand. There are two pilot centers in operation today in Bangkok. The first site, at the Panaphan Vidhya School, opened in October. It is equipped with nine IBM PS/2 Model 30 PCs and can accommodate 25 students at a time.

Impact studies are going on now, with a control group of 25 students from another class in the same grade. Preliminary observations indicate that there have been significant improvements, with the students becoming more expressive in English and writing longer stories.

The other site where WTR was introduced a year ago is the Googkai Kindergarten. The teachers have developed additional instructional materials to supplement the WTR courseware. Vocabulary level was one example of a module written for localization. Experiences there should shed light on implementation issues of the WTR program in non-English speaking societies in the Asia/Pacific.

Malaysia. The pioneer of the WTR program in Malaysia is Ms. Nora Sulaiman, who is an Advisor to the Damansara WTR Center in Kuala Lumpur. The Center opened in March 1989 after six months of planning and preparation. Today it trains 28 children from the ages of three to seven years. For this age group, lessons are conducted three times a week for one hour per session. As in other comparison studies, the Center finds superior performance over traditional methods and cite teacher training as a central ingredient.[2] The Center plans to offer consultant and teacher-training services to other kindergartens and newly

[2]The history of instructional technology offers compelling evidence, that simply installing hardware systems without adequate staff and staff development, is a formula for failure.

established centers in Sabah and Sarawak.

Hong Kong. IBM Hong Kong launched the WTR program in Hong Kong in September 1988. It invited the Good Shepherd Primary School and Pooi To Primary School to take part in a two year pilot study. IBM is providing each school with 14 IBM PC Jr.s, WTR software and teacher training. Since the launch of the program, the number of students has grown from 270 to 340. The program is conducted in much the same manner as in other countries, except support materials have been localized. In the Listening Section, for example, IBM has prepared a selection of literature and tapes based on Chinese folk tales to which many of the Chinese students can relate.

Independent evaluators from the Baptist College Language Center are monitoring the children's progress with the WTR program and compare the results with students in conventional classrooms. The evaluation team plans to depart from the usual pre-test, post-test quantitative measurement study and place greater emphasis on qualitative procedures. That study should be completed with the next several months.

Philippines. The two WTR programs here are perhaps the most interesting of this listing since they are the result of a partnership between IBM and Innotech (a regional center for educational innovation and technology), one of two development centers of the Southeast Asian Ministers of Education Organization (SEAMEO) to improve the quality of education in Southeast Asia. This partnership may prove to be the model of choice to try in other regions since it helps ensure the full involvement of the member countries and the technology transfer for

innovation to work at the local level.

The installation at the Pinyahan School in Quezon City was started in 1986 and now represents three years of continuous use. A two year evaluation study is attached which indicates superior program performance with the experimental group regardless of sex, mental ability or educational background. As in previous studies, an unexpected result was the experimental group's superior performance in spelling, even though the WTR program does not specifically target spelling as a program goal.

Miscellaneous. Additionally IBM has WTR projects at the American School in Tokyo, Japan and St. Peters Anglican School in Campbelltown, Australia, however, details are lacking for a complete description.

Education Courseware Offerings

Reading/Language Arts. IBM offers a variety of courseware titles in this area in addition to the already referenced *Writing to Read* Program. The *Principle of the Alphabet Literacy System (PALS)* is not included in this discussion because of the expensive, at least by international standards, interactive videodisc delivery system required. This series covers a broad range of skills from letter and word recognition, to capitalization and punctuation, to spelling, grammar and vocabulary, to reading for meaning. These programs also include student reporting packages that teachers and students can use to track student progress through the programs. Included in the Series are: *Get Set for Writing to Read; Bouncy Bee* series for word recognition; *Primary Editor* (a simplified word processor in both

English and Spanish); *Listen to Learn* (talking text); *Touch Typing for Beginners; IBM Reading Comprehension Series;* and the *IBM Private Tutor Series.* For a full description of these programs, see pp. 6-21 of the *IBM Software for Education Catalog.*

Science. IBM's courseware offerings in science fall into three major categories: *Biology; Earth Science*; and *Physics Discovery Series*. In addition, there is a *Scientific Reasoning Series* that is designed to help students think and reason using scientific methods. This series can be used alone or in association with the three series referenced above. See pp. 22-31 of the *IBM Software for Education Catalog* for a full description of these programs.

Mathematics. The *IBM Math Concept Series* ranges from Level P (preschool and kindergarten) to Level IV (seventh and eighth grades). The Series teaches concepts of addition, subtraction, multiplication, division, fractions, decimals, and geometry at progressive levels of difficulty. Each package is self-paced and has a record keeping function that allows the student and teacher to monitor progress. *Exploring Measurement, Time and Money* is an integrated series for preschoolers to teach measurement and length of objects, how to tell time (includes a talking clock) and a computer simulated store that helps students learn to count money, read price tags, pay for items, and make change. Additional programs include *Bumble Games* (to teach spatial awareness and graphing concepts), and math practice exercises (*Monster Math, Rocky's Boots, Gertrude's Secrets, Adventures in Math, and Juggles' Butterfly).* See pp. 44-53 of *IBM Software for Education Catalog* for a full description and listing of programs.

In both the second and third tryouts, the experimental group showed remarkable achievement in the BEE-DECS Test and the Division Test as compared to the two control groups. Results of comparison are presented in Table 1. Mean scores of the experimental group on the two tests were significantly different from that of mean scores of the two control groups on both program tryouts. The differences were statistically significant beyond the 0.01 level in favor of the experimental group.

Likewise on the language skills: reading, writing a short story and spelling, the experimental group achieved significantly better than the two control groups in both program tryouts. (See Table 2). Particularly in the writing skills wherein 75 percent of the pupils in the experimental group were on the writing levels 3 and above as compared to only 2 pupils or about 2 percent in both the first control group and the second control group who are in the writing levels 3 and above during the second tryout. In the third tryout, 86 percent of the pupils in the experimental group were on the writing levels 3 and above as compared to only 4 in the first control group and only 3 in the second control group.

Another remarkable results obtained is in the spelling test. The experimental group in both program tryouts were way ahead in the spelling skills as compared to their counterparts in the two control groups. During the second program tryout, experimental pupils had a mean score in the spelling test of 6.10. This means that on the average, 6 out of 10 words were spelled correctly by the experimental pupils as compared to only one word spelled by the first control group and worst a mean of less than one by the second control group. This further means that most pupils in the second control group cannot even spell a single word correctly on the spelling test given. During the third tryout, almost the same results were obtained. The experimental pupils had a mean score of 5.46 while the first control group had a mean score of only 1.41 and the third control group had a mean score of 1.63. Test of significance yielded very highly significant results in favor of the experimental group.

Analysis of variance on the BEE-DECS Test and the Division Test for the experimental group only with variables sex, mental ability and educational background reveal that the WTR program is effective regardless of sex, mental ability and educational background on both program tryouts as shown in Tables 7, 8, 9 and 10. F-values obtained were not significant indicating that there were no significant differences in the mean scores of the experimental pupils when their sex, mental ability and educational background were taken into consideration in analyzing the effects of the WTR Program.

Table 1
Comparison of the Experimental Group with Two Control Groups on Outcome Measures

Second Tryout

BEE-DECS Test

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils					
(Experimental Group)	106	29.26	4.50		
Control Groups					
First Control Group	88	25.14	5.09	5.99**	
Second Control Group	78	22.11	4.53		17.05**

Q.C. Division Test

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils					
(Experimental Group)	112	27.22	3.83		
Control Groups					
First Control Group	104	18.11	3.97	17.43**	
Second Control Group	95	21.29	3.97		92.89**

Third Tryout

BEE-DECS Test

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils					
(Experimental Group)	87	25.75	5.07		
Control Groups					
First Control Group	88	20.64	5.60		10.14 **
Second Control Group	100	22.79	5.39	4.34**	

Division Test

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils					
(Experimental Group)	101	27.47	1.95		
Control Groups					
First Control Group	98	13.66	4.39		710.70**
Second Control Group	112	18.35	4.77	17.90**	

** - significant beyond 0.01 level

Table 2
Comparison of the Experimental Group with the
Two Control Groups on the Following Language Skills:
Reading, Writing A Short Story and Spelling

Second Tryout

Reading

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils (Experimental Group)	119	35.05	4.20		
Control Groups					
First Control Group	113	24.25	6.69	14.80**	
Second Control Group	97	16.88	4.55		693.81**

Writing a Short Story

Count
Exp. Value — Writing Levels

	0	1	2	3	4	5	6	Row Total
Exp. Group	0	5	24	35	19	20	13	116
	25.4	22.9	22.4	17.8	10.7	10.2	6.6	50.9
1st Control Group	50	40	20	0	2	0	0	112
	24.6	22.1	21.6	17.2	10.3	9.8	6.4	49.1
2nd Control Group	29	38	13	2	0	0	0	82
	12.0	17.8	15.3	13.3	7.9	8.3	5.4	41.4

X^2=159.33** (Experimental Group vs. First Control Group)

X^2=137.24** (Experimental Group vs. Second Control Group)

Spelling

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils (Experimental Group)	116	6.10	2.06		
Control Groups					
First Control Group	112	1.06	1.58	20.73**	
Second Control Group	77	0.82	1.43		315.98**

** - significant beyond 0.01 level

Third Tryout

Reading

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils (Experimental Group)	89	33.85	4.89		
Control Groups					
First Control Group	58	19.33	4.91		264.889**
Second Control Group	97	19.95	6.29	16.71**	

Writing a Short Story

Count
Exp. Value — Writing Levels

	0	1	2	3	4	5	6	Row Total
Exp. Group	1	7	5	16	22	25	20	96
	19.6	25.6	7.0	8.5	11.6	13.1	10.6	50.3
1st Control Group	38	44	9	1	1	1	1	95
	19.4	25.4	7.0	8.5	11.4	12.9	10.4	49.7
2nd Control Group	70	12	6	2	0	1	0	91
	34.6	9.2	5.4	8.3	10.7	12.7	9.7	48.7

X^2=134.84** (Experimental Group vs. First Control Group)

X^2=143.47** (Experimental Group vs. Second Control Group)

Spelling

	n	$\bar{X}$	sd	t-value	F-value
WTR Pupils (Experimental Group)	95	5.46	2.45		
Control Groups					
First Control Group	86	1.41	2.28		103.575**
Second Control Group	91	1.63	2.15	11.34**	

** - significant beyond 0.01 level

Second Tryout

Table 3
Analysis of Variance on the BEE-DECS Test by
Group, Sex, Mental Ability and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	3025.665	7	432.238	23.104**
Group	1735.002	2	867.501	46.369**
Sex	230.320	1	230.320	12.31**
Mental Ability	554.153	3	184.718	9.87**
Pre-school	101.148	1	101.148	5.407*
Explained	3025.665	7	432.238	23.104**
Residual	4621.017	247	18.709	
Total	7646.682	254	30.105	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

Table 4
Analysis of Variance on the Q.C. Division Test by
Group, Sex, Mental Ability and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	4246.604	7	606.658	46.38**
Group	3276.176	2	1638.088	125.235**
Sex	32.255	1	32.255	2.466
Mental Ability	349.351	3	116.450	8.903**
Pre-school	74.245	1	74.245	5.676*
Explained	4246.604	7	606.658	46.384**
Residual	3230.792	247	13.080	
Total	7477.396	254	29.439	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

BEE-DECS Test Cell Means:

Total Population

$\bar{X}$	22.80
n	255

Group:	Experimental Group	First Control Group	Second Control Group
$\bar{X}$	27.36	18.18	21.70
n	98	78	79
Sex			
male			
$\bar{X}$	27.04	17.18	21.85
n	45	33	36
female			
$\bar{X}$	27.62	18.91	21.55
n	53	45	43
Mental Ability			
Below Average			
$\bar{X}$	25.36	12.50	19.75
n	14	4	8
Average			
$\bar{X}$	27.55	17.95	21.73
n	77	61	66
Above Average			
$\bar{X}$	29.17	21.00	24.40
n	6	13	5
Superior			
$\bar{X}$	30.00	0	0
n	1	0	0
Pre-school Background			
With pre-school			
$\bar{X}$	27.33	19.27	22.54
n	78	33	35
Without pre-school			
$\bar{X}$	27.45	17.38	21.02
n	20	45	44

Q.C. Division Test Cell Means:

Total Population

$\bar{X}$	25.96
n	255

Group:	Experimental Group	First Control Group	Second Control Group
$\bar{X}$	29.23	25.60	22.27
n	98	73	79
Sex			
male			
$\bar{X}$	28.39	23.52	22.11
n	45	33	36
female			
$\bar{X}$	30.04	27.13	22.40
n	53	46	43
Mental Ability			
Below Average			
$\bar{X}$	27.50	18.25	16.25
n	14	4	8
Average			
$\bar{X}$	29.39	25.48	22.89
n	77	61	66
Above Average			
$\bar{X}$	30.67	28.46	23.60
n	6	13	5
Superior			
$\bar{X}$	33.00	0	0
n	1	0	0
Pre-school Background			
With pre-school			
$\bar{X}$	29.24	27.39	22.86
n	78	33	35
Without pre-school			
$\bar{X}$	29.20	24.29	21.80
n	20	45	44

Third Tryout

Table 5
Analysis of Variance on the BEE-DECS Test by
Group, Sex, Mental Ability and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	1702.603	7	243.229	10.404**
Group	846.858	2	423.429	18.112**
Sex	40.327	1	40.327	1.725
Mental Ability	383.873	3	127.958	5.473**
Pre-school	173.918	1	173.918	7.439**
Explained	1702.603	7	243.229	10.404**
Residual	5143.274	220	23.379	
Total	6845.877	227	30.158	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

Table 6
Analysis of Variance on the Q.C. Division Test by
Group, Sex, Mental Ability and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	7112.202	7	1016.029	67.816**
Group	6339.396	2	3169.698	211.566**
Sex	20.784	1	20.784	1.387
Mental Ability	72.933	3	24.311	1.623
Pre-school	164.831	1	164.831	11.002**
Explained	7112.202	7	1016.029	67.816**
Residual	3296.056	220	14.982	
Total	10408.259	227	45.851	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

BEE-DECS Test Cell Means:

Total Population

$\bar{X}$	23.10
n	228

Group:	Experimental Group	First Control Group	Second Control Group
$\bar{X}$	26.40	20.95	22.94
n	58	83	87
Sex			
male			
$\bar{X}$	26.88	19.22	22.95
n	34	36	43
female			
$\bar{X}$	25.71	22.28	22.97
n	24	47	44
Mental Ability			
Below Average			
$\bar{X}$	24.33	17.89	0
n	3	9	0
Average			
$\bar{X}$	26.05	20.76	22.21
n	38	55	71
Above Average			
$\bar{X}$	27.07	21.81	26.20
n	15	16	15
Superior			
$\bar{X}$	31.00	29.00	26.00
n	2	3	1
Pre-school Background			
With pre-school			
$\bar{X}$	26.26	23.05	24.02
n	35	37	47
Without pre-school			
$\bar{X}$	26.61	19.26	21.68
n	23	46	40

O.C. Division Test Cell Means:

Total Population

$\bar{X}$	19.11
n	228

Group:	Experimental Group	First Control Group	Second Control Group
$\bar{X}$	27.59	13.45	18.56
n	58	83	87
Sex			
male			
$\bar{X}$	27.26	12.97	18.81
n	34	36	43
female			
$\bar{X}$	28.04	13.81	18.91
n	24	47	44
Mental Ability			
Below Average			
$\bar{X}$	26.67	13.00	0
n	3	9	0
Average			
$\bar{X}$	27.58	12.98	18.49
n	38	55	71
Above Average			
$\bar{X}$	28.07	14.69	20.47
n	15	16	15
Superior			
$\bar{X}$	25.50	16.67	21.00
n	2	3	1
Pre-school Background			
With pre-school			
$\bar{X}$	27.89	14.16	20.28
n	35	37	47
Without pre-school			
$\bar{X}$	27.13	12.87	17.20
n	23	46	40

Second Tryout

Table 7
Analysis of Variance on the BEE-DECS Test
for the Experimental Group by Sex, Mental
Ability and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	145.863	5	29.173	1.423
Sex	74.169	1	74.169	3.620
Mental Ability	70.175	3	23.378	1.144
Pre-school	0.015	1	0.015	.001
Explained	145.863	5	145.863	1.428
Residual	1879.739	92	20.432	
Total	2025.602	97	20.882	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

Table 8
Analysis of Variance on the Q.C. Division Test
for the Experimental Group by Sex, Mental Ability
and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	94.876	5	18.975	1.477
Sex	5.971	1	5.971	.465
Mental Ability	86.717	3	28.906	2.251
Pre-school	2.532	1	2.632	.197
Explained	94.876	5	18.975	1.477
Residual	1181.624	92	12.844	
Total	1276.500	97	13.160	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

Total Groups

Table 9
Analysis of Variance on the BEE-DECS Test
for the Experimental Group by Sex, Mental
Ability and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	86.477	5	17.287	1.413
Sex	16.763	1	16.763	1.369
Mental Ability	65.729	3	21.910	1.791
Pre-school	2.078	1	2.078	.170
Explained	86.477	5	17.287	1.413
Residual	685.442	52	12.224	
Total	771.879	57	13.543	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level

Table 10
Analysis of Variance on the Q.C. Division Test
for the Experimental Group by Sex, Mental Ability
and Pre-school Background

Source of Variation	Sum of Squares	DF	Mean Square	F
Main Effects	31.503	5	6.301	1.472
Sex	3.429	1	3.429	.801
Mental Ability	15.678	3	5.226	1.221
Pre-school	12.291	1	12.291	2.872
Explained	31.503	5	6.301	1.472
Residual	222.566	52	4.280	
Total	254.069	57	4.457	

Due to empty cells or a singular matrix, higher order interactions have been suppressed.

* - significant beyond 0.05 level
** - significant beyond 0.01 level