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AUTHOR Schonberger, Ann K.
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ABSTRACT

A study was conducted at the University of Maine at Orono (UMO) to examine gender differences with respect to mathematical problem-solving ability, visual spatial ability, abstract reasoning ability, field independence/dependence, independent learning style, and developmental problem-solving ability (i.e., formal reasoning ability). Subjects included 27 females and 48 males from two-year programs at UMO who had finished or tested out of a developmental algebra course in 1980-81. Subjects received a multiple-choice test of algebraic concepts and paper and pencil tests assessing various abilities and characteristics. A three-stage analysis of the scores revealed the following: (1) males did better than females in the algebraic concepts test; (2) females had more independent learning styles; (3) although the three tests with a spatial or figural component were significantly correlated with problem solving, one of the tests showed no gender differences at all and the other revealed differences less than the differences on the problem-solving tests; and (4) tests of the level of formal reasoning ability tended to produce higher results among males. The study report details methodology, limitations, and findings; provides suggestions for further research; and considers implications for instruction. Data tables and sample test items are appended. (KL)

GENDER DIFFERENCES IN SOLVING MATHEMATICS PROBLEMS AMONG TWO-YEAR COLLEGE STUDENTS IN A DEVELOPMENTAL ALGEBRA CLASS AND RELATED FACTORS

By: Ann K. Schonberger

Presented at the Midyear Meeting of the American Education Research Association Special Interest Group on Women in Education
(Washington, D. C., October 17, 1981)

Dr. Ann K. Schonberger
Developmental Studies
Bangor Community College of the
University of Maine at Orono
Bangor, ME 04401

Gender Differences in Solving Mathematics Problems Among Two-Year College Students in a Developmental Algebra Class and Related Factors

One of the most important features of the last decade has been women's struggle for equal participation in all society's activities. As educators and researchers we have searched for barriers to such equal participation in the scientific and technical job market as well as in the activities of the informed consumer. Finding such barriers we have sought to understand them fully in order to know better how to eliminate them. One widely publicized barrier, or "critical filter" (Sells, 1973), is mathematical competence. In both the occupational and consumer arenas the ability to apply mathematics to problems is more valuable than computational skill.

Is it true that males are better solvers of mathematical problems than females? The generalization has been made that while females may do better at low level cognitive tasks in mathematics (computation), males excel at higher level tasks like problem solving (Jarvis, 1964; Maccoby, 1966). While much of the research on which that generalization was based can be criticized for lack of control of amount of mathematics studied or sex stereotyping in the content of the problems, and more recent studies of young adolescents show few, if any, gender differences in problem solving performance (Fennema and Sherman, 1978; Schonberger, 1978), there is some evidence to the contrary. In Swafford's (1980) study of over 600 secondary school students finishing a traditional first-year course in algebra, females performed as well or better on the algebra achievement test but males performed significantly better on 8 of 21 consumer problem solving items. There did not appear to be any sex bias in the problems. In the most recent National Assessment of Educational Progress in mathematics (Armstrong, 1980) and in Armstrong's own large-sample

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study where amount of mathematics taken was controlled, some gender-related differences in problem solving performance were reported among students in Grades 11 and 12. Since those differences which do appear are in the older adolescent population taking algebra or above, it seems important to see if they continue to appear in the college population.

Fully understanding such differences as may occur in problem solving ability suggests studying the correlates of this ability, especially correlates which have a history of reported gender differences themselves. Visual spatial ability, for example, has been a variable of interest in both problem solving research and gender difference research. Indeed the use of diagrams and graphs in solving many types of mathematic problems argues for the logic of connecting the two abilities. These connections have been empirically demonstrated, especially for three-dimensional tests of spatial visualization, in a number of secondary school studies reviewed by the author (Schonberger, 1979). However, with a few exceptions (Elmore and Vasu, 1980; Sweeney, 1953), research on the college population, especially those in developmental courses, has yet to be done.

One of the difficulties of establishing the mechanism of the relationship between solving spatial and mathematical problems is that subjects report both visual-movement and verbal-logical methods of solving spatial items (Barrett, 1953; French, 1965; Werdelin, 1961). There are cognitive abilities tests presenting figural stimuli with no movement implied which measure what has been called figural, nonverbal, or abstract reasoning ability. This ability, which has no history of gender differences, may be more closely related to solving mathematical problems than spatial ability is (Schonberger, 1979), but there is much less research in this area than in the spatial area.

The novel or nonroutine nature of verbal problems suggests that competent problem solvers are more independent in some way than people who are not good problem solvers. Two types of independence suggest themselves. One is at one end of the cognitive style quality called field independence/dependence. According to Witkin and Goodenough (1977), field independent students tend to do better in mathematics and science and are more successful at imposing structure on an unstructured setting than students at the other end of the continuum who are usually better at interpersonal skills. Gender differences have been reported. That this is a cognitive ability of a spatial nature rather than a cognitive style, has been convincingly argued by Sherman (1967). In any case, there is empirical evidence of its relationship to problem solving ability in college students (Berry, 1958, 1959; Blake, 1978). On the other hand, an independent learning style may be more important, especially since college courses often have sizeable self-instruction components.

Formal operational thought, in the Piagetian sense, which involves the ability to reason abstractly about propositions in hypothetical situations, seems to be important to success in mathematics at the early college level (Carpenter, 1980). Also students at this level appear to have problem solving processes available to them not available to students at lower levels (Days, Wheatley and Kulm, 1979; Watson, 1980). Although secondary school students should reach this level of thinking, according to Piaget and his followers, there is evidence that not all college students function at this level (Adi, 1978; Adi and Pulos, 1980). Analysis of data from a preliminary study suggested gender differences in favor of males.

Method

Subjects

Subjects for this study ($\underline{n}$ = 75) were all those from two-year programs at the University of Maine at Orono who finished a developmental algebra course taught by the author in the 1980-1981 academic year. Students were required to take the course because they had low scores on an admissions placement test or because they had failed a higher level course. A very few chose to take the course. The sample included 27 females and 48 males. This 40-60 percent ratio was the same as the female-male ratios of students entering the course or persisting past midterm. Most of the students were enrolled in the Community College of the University, although a few were in two-year programs of the University's other Colleges. All had either taken or tested out of a developmental arithmetic course. Their ages ranged from 17 to 39 but 75 percent were 21 or younger.

Instruments

All participants in the study took a two-part, teacher-constructed final exam: a multiple choice test of algebraic concepts and skills (each problem scored right or wrong), and a free response test of problem solving (each problem scored from 0 to 3). Because the final exam was offered several times during exam week each semester, two parallel forms of each test were used. To adjust for possible differences in the tests, scores were standardized with a mean of 50 and a standard deviation of 10 and the results pooled. In addition, pretest scores on a twenty-item test like the concepts and skills part of the final exam were available for 23 females and 34 males. (See Appendix A and Table 4.)

Besides providing data from the mathematics measures, the students took the following paper and pencil tests during the algebra class to provide measures of the variables discussed in the previous section.

Visual Spatial Ability: Space Relations from the Differential Aptitude Test (Bennett, Seashore, and Wesman, 1973).

Abstract Reasoning Ability: Abstract Reasoning from the Differential Aptitude Test.

Cognitive Style: Gottschaldt Figures Test modified for group administration (Crutchfield, 1975).

Learning Style: Student Learning Style Questionnaire (Pare, 1972). (see Appendix A.).

Piagetian Developmental Level: Equilibrium in a Balance Test (Adi, 1976). (See Appendix A.)

The last is a fifteen-item multiple choice test based on Piaget's balance tasks and designed to measure developmental level of reasoning about proportions. Adi considered it to be closely related to solving equations, an important tool used in solving algebra problems. This author derived five scales from Adi's instrument. The test is divided into three five-item parts (Equilibrium in a Balance 1, 2 and 3) with items at the late concrete, transitional and early formal levels of reasoning. Passing scores at the three levels are 4/5, 4/5 and 3/5 respectively. Adi's directions place a subject at a developmental level if (s)he passes that level and all those before it; this author placed the subject at the highest level passed, period. Equilibrium in a Balance Levels were assigned values from 1 (no levels passed) to 4 (the top level passed). In addition, Equilibrium in a Balance Total recorded the total number of items answered correctly from the three parts. To test a hypothesis that males excelled females on the Piagetian test because they were more familiar with the balance beam, the subjects were asked about their knowledge and experience with the apparatus. Their responses were noted on a seven-point scale called Equilibrium in a Balance Experience.

Analyses

Descriptive statistics were computed for each variable for the whole group and separately by gender, as were Pearson r correlation coefficients. T tests were performed on the mean scores received by females and males on each scale except the Equilibrium in a Balance Level and Experience scales which were judged not to be interval level data. For these two, gender by level and gender by experience crosstabulations were made and analyzed using the chi square test and Kendall's tau c which is a bit more powerful.

The two forms of the algebra problem solving test were subjected to a detailed item analysis for the whole group and for males and females separately. Item means were compared using the t test. Gender differences in the relationships of the problem solving test to the other variables were examined by using Fisher's r to Z tranformation and then testing the significance of the differences between the Zs for males and females.

Results

The first level of analysis which was the computation of descriptive statistics and the t tests on means for females and males (Table 1) indicated a significant difference ($p = .01$) in favor of males on Algebra Problem Solving. Females had a more independent learning style ($p = .02$) than males. Differences in favor of males were suggested on the Algebra Skills Pretest ($p = .08$), Space Relations ($p = .09$), Equilibrium in a Balance 2 ($p = .07$), and Equilibrium in a Balance Total ($p = .06$), but none of these were significant at the .05 level. Analysis of the crosstabulation (Table 2) of Equilibrium in a Balance Level by gender using Kendall's tau c yielded a significant ($p = .02$) difference in favor of males, although the chi square was not significant at the .05 level. That this difference was not a result of differences in knowledge or experience with the balance beam is indicated by the nonsignificance of both statistics computed on the Equilibrium in a Balance Experience by gender crosstabulation (Table 3).

Once this difference in the problem solving tests was identified, the second step in the analysis was to take a closer look at the problems themselves (Table 4). On Form A males did better on all problems, but the differences were minimal except on Problem 2A, a geometry problem ($p = .05$). The females' and males' means for the whole test were 7.15 and 9.74 respectively, a difference with significance value for p of .02. On Form B females did better, but not significantly so, on a geometry problem (5B) and, interestingly, on a car radiator problem (3B). Otherwise males did better--significantly so on 1B, a uniform motion problem ($p = .02$), and on 2B, a volume problem ($p = .006$). The females' and males' means for the whole test were 6.54 and 9.24 respectively, a difference with significance value for p of .02. Because performance on Item 2B was so different for males and females, means were computed for Test B without that item. They were 5.62 and 7.12 respectively; the t value of their differences was 1.41 which is no longer significant at the .05 level.

The third stage of the analysis was to look at the correlational data to see if it gave further clues to the source of the differences in problem solving performance. The obvious place to look is at the Space Relations correlations because two of the three problems on which the male/female differences were significant were geometry problems. Indeed among the correlates of problem solving in the whole group (Table 5) Space Relations has the second highest coefficient ($r = .324$). Given the fact that the males did marginally better on the spatial test, they may have used this ability to solve more problems. If this were the case, one would hypothesize a closer relationship between Space Relations and Algebra Problem Solving for males than for females. In fact, the reverse is true, although the difference between the rs for females and males is not significant at the .05 level. (See Tables 6 and 7.)

The same argument could be made for the Gottschaldt Figures test which had the highest correlation with problem solving for the whole group

(r = .341). The mean score for males was a point and a half higher than for females, and in a larger group this might have been significant. Could these more field independent males be better problem solvers? Again, if so, one would expect the problem solving-field independence correlation to be larger for males than for females. Instead the reverse is true, although the difference between the two rs is not significant.

In fact, the only pair of correlation coefficients of problem solving on which the male/female difference was significant was that with the Algebra Skills Pretest. Since the males did marginally better (p = .08) on the pretest one might suppose that they did better at learning problem solving in the course because they started out ahead (although their posttest scores were no better than the females' scores). Again, however, the direction of the pretest-problem solving coefficients deny this hypothesis: males' r = -.357, females' r = .255.

The last place to look for a source of the gender difference in the problem solving means is the measures of Piagetian developmental level of reasoning. The t test results indicated that the males did marginally better on Equilibrium in a Balance 2 (p = .07) and Total (p = .06). The Kendall's tau c analysis of the crosstabulation of Equilibrium in a Balance Level by gender showed a significantly (p = .02 higher level for males than for females. Looking at the correlates of problem solving for females and males one sees that one of the few measures on which the males' coefficient was higher than the females' was Equilibrium in a Balance 3, the five items which purport to test formal reasoning. This difference (males' r = .226, females' r = -.056) seems suggestive, if not statistically significant.

Discussion

One obvious limitation of this study was the size of the sample relative to studies such as Swafford's and Armstrong's with hundreds of subjects. The role that the number of subjects plays in both the t test and the test for the significance of the difference between two Pearson rs is important. With a larger sample some of the differences which were only suggestive might have been significant. This was why the author chose the questionable practice of reporting and discussing results with p values between .05 and .10. It should be noted, however, that enlisting the participation of college students, especially from the more transient community college population, is more difficult than getting secondary school subjects. On the other hand, the author observed each student in a small class for an entire semester, gaining a perspective on this data usually absent from larger studies.

One of the major purposes of this study was to investigate the argument that males' greater spatial ability is the cause of their greater problem solving ability. This was not substantiated. While it was true that two of three items on which males did better were geometry items, there were two more geometry items on which there was no difference. Although the three tests with a spatial or figural component (Space Relations, Abstract Reasoning, and Gottschaldt Figures) were significantly correlated with problem solving, one showed no gender difference at all and the other differences had p values substantially less than the problem solving test difference. Furthermore, these abilities were more closely related to problem solving for females than for males. This pattern has been observed in other studies (Schonberger, 1979). It seems that the spatial connection, if it exists, is much more complicated than simple cause and effect.

The only test that showed promise of explaining the gender differences in problem solving was the test of Piagetian developmental level, especially the items at the level of formal reasoning, although the author considers the evidence equivocal. It is not surprising that this test is important, because it is composed of written problems about numerical relationships. The fact that the last part, testing reasoning at the formal level, is closely connected with solving verbal problems, at least for males, is interesting.

According to Piagetian theory, one of the most fundamental properties of formal thought is the ability to construct all possible alternatives in a given situation. The author has noticed in teaching these students that although many topics in algebra are trainable (such as solving linear equations or adding and subtracting polynomials), the most difficult topics such as factoring and listing sets from descriptions require this consideration of all possible alternatives. Furthermore, Carpenter (1980) says that learning <u>general</u> problem solving strategies certainly appears to depend on formal reasoning. One of the characteristics of the cube problem on which the gender related difference was largest was that, in the author's opinion, it differed most from those problems the students had done in class. Another idea from the Piagetian tradition of research might help explain the fact of no difference in the skills test despite the difference in the problem solving test. Wohlwill (cited in Carpenter, 1980) suggests that cognitive development can be thought of an interaction between vertical and horizontal transfer. The more vertical steps a person takes to learn a concept, the more narrowly (s)he is able to apply it. Since problem solving involves broad transfer of algebra skills as well as putting them into new combinations, students who were at the formal level when they learned the skills are more likely to be successful problem solvers.

While the author realizes that this discussion goes far beyond the research reported here, it suggests directions for further research. More consideration should be given to instruments for measuring formal level of thought. Students who reason about proportions at the formal level may not be formal operational with other schema or vice versa. One of the strengths of Adi's instrument, in this author's opinion, is that it does appear to test reasoning in a general sense. Except for one item, it does not seem to require knowledge of the precise mathematical relationship between the weights and distances from the fulcrum. Some of the classical Piagetian tasks, however, appear to this author to require specific knowledge of physical science as well as reasoning ability. While the measurement problems may be difficult, they should be struggled with. It seems that this line of research may be at least as productive as delving deeper into the spatial realm.

To link developmental level of reasoning to the gender differences observed in solving mathematics problems is, in a sense, just moving the explanation to another plane. Why it should happen is still not explained. The adolescent years during which the transition to formal operational thought is supposed to occur are a time of intense peer pressure to conform to sex role stereotypes.

If girls are expected to solve social and personal problems while boys are expected to solve mathematical and scientific problems, it would not be surprising to find the performance differences noted here. The community college population, at least this sample of it, appears more conservative with respect to sex roles than the college population in general. That, however, is another study. Planning educational strategies to promote formal thinking is yet another step down the road toward full equality.

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Appendix A

Sample Items from Tests Not Copywrited

<u>Algebra Skills Pretest</u> and <u>Posttest</u>

A. $(5m - 2)^2$ equals which of these?

a. $25m^2 - 10m + 4$

b. $25m^2 - 4$

c. $5m^2 - 10m + 2$

d. $25m^2 - 20m + 4$

e. $25m^2 - 20m - 4$

B. Find the pair of numbers which simultaneously solves $x + y = 7$ and $3x - y = 5$.

a. (6,1)

b. (-1,-2)

c. (3,4)

d. (4,3)

e. None of these

<u>Student Learning Style Questionnaire</u>

A. When you have a complicated problem, it is best to ...

a. seek someone to remedy the situation.
b. consult with others but make up my own solution.
c. work the problem out myself without consulting anyone else.

B. When working in situations that require me to work in a team or group ...

a. I pretty much follow the way the group wants to go.
b. my partner(s) and I share the work.
c. I do most of the work, or I work alone, because I prefer it.

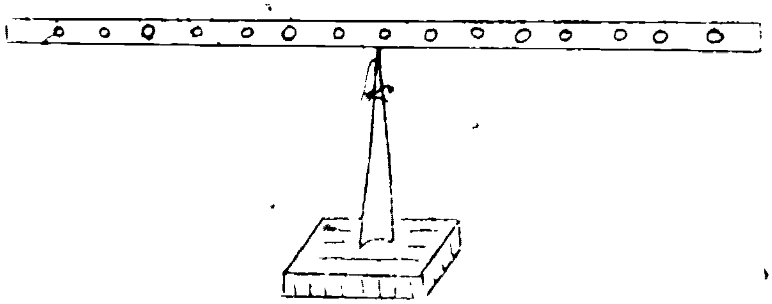
EQUILIBRIUM IN A BALANCE

INSTRUCTIONS:

1. The balance is said to be at equilibrium when the bar is at a horizontal position.

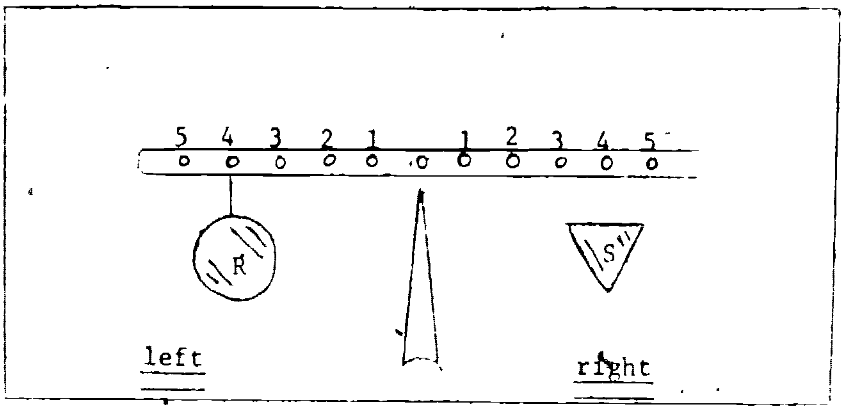
2. Holes on the bar of the balance are at equal distances from each other.

3. Only one object may be placed onto a hole at a time.

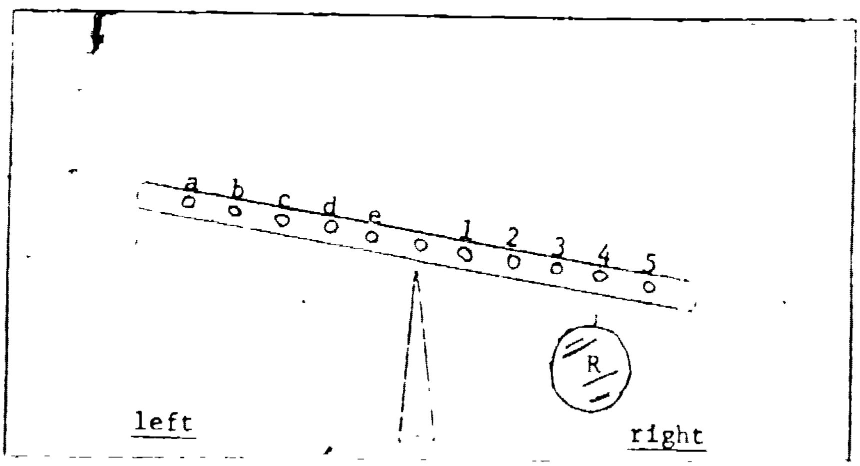


Do you have any questions on the above instructions?

3. Given a system at equilibrium:



If R were placed on the right side of the balance, then S should be placed at __________ to have the balance at equilibrium.



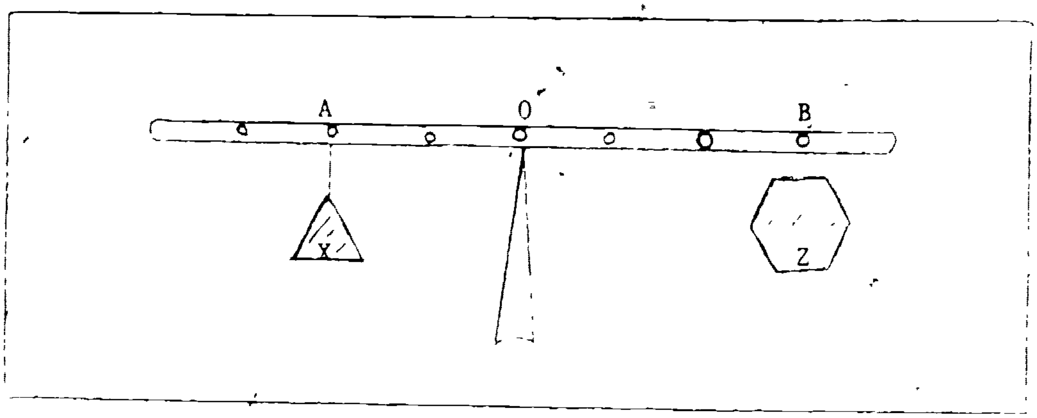
a) a

b) b

c) c

d) any of the above

8. Given a system at equilibrium:



The length of $\overline{OA}$ is shorter than the length of $\overline{OB}$. If we double the weight of X, then we should __________ the weight of Z, to maintain the equilibrium of the system.

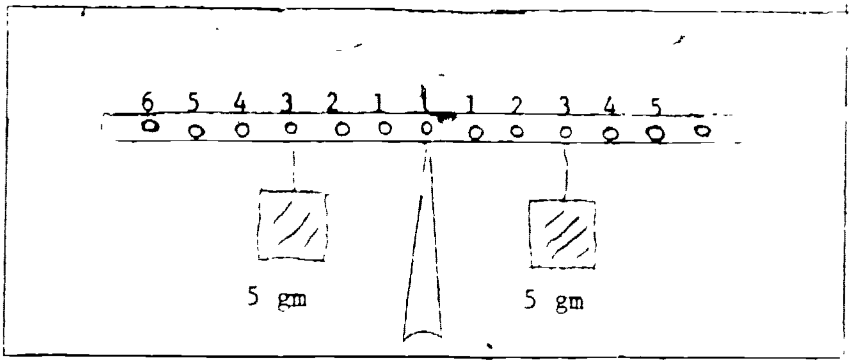
a) take half

b) keep as given

c) double

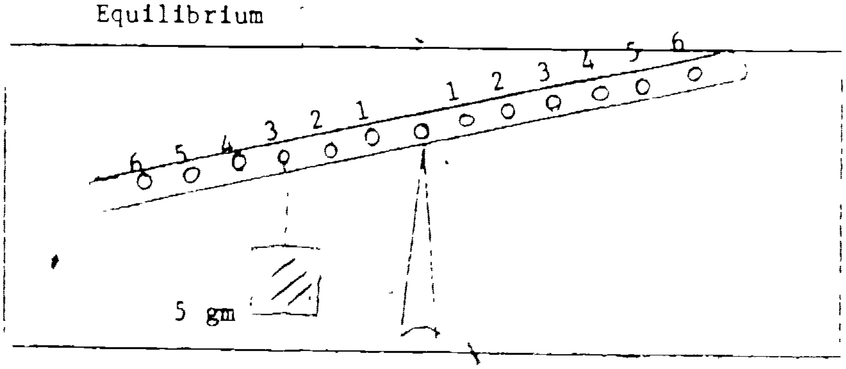
d) can't tell without knowing the original weights of both objects

14. Given:



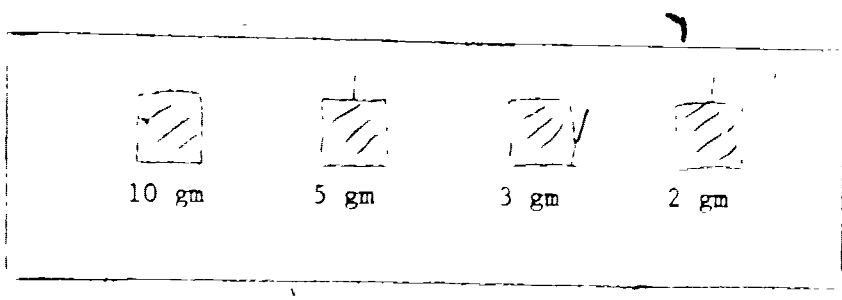
Equilibrium

then,



disequilibrium

Given:



To restore the equilibrium of the balance place the following weight(s) on the right hand side of the balance:

a) Any of the below

b) the 5 gm. weight in hole No. 1, and the 2 gm. weight in hole No. 5.

c) the 10 gm. weight in hole No. 6.

d) the 2 gm. in hole No. 1, and the 3 gm. in hole No. 3.

Table 1

Descriptive Statistics and t Tests Between Sexes

	Means	Standard Deviation	t	p
1. Algebra Problem Solving				
F	46.19	8.01	2.86	.01
M	52.13	8.96		
2. Algebra Skills Pretest				
F	4.91	2.02	1.76	.08
M	6.03	2.54		
3. Algebra Skills Posttest				
F	47.07	9.22	0.74	.46
M	48.81	10.00		
4. Space Relations				
F	33.92	9.74	1.70	.09
M	38.18	10.11		
5. Abstract Reasoning				
F	37.31	4.16	-.042	.68
M	36.78	5.56		
6. Gottschaldt Figures				
F	5.81	5.10	1.33	.19
M	7.48	5.29		
7. Learning Style				
F	55.38	4.63	-2.47	.02
M	52.29	5.11		
8. Equilibrium in a Balance 1				
F	4.26	.813	.41	.69
M	4.33	.724		
9. Equilibrium in a Balance 2				
F	2.56	1.50	1.83	.07
M	3.23	1.55		
10. Equilibrium in a Balance 3				
F	1.11	1.25	1.38	.17
M	1.52	1.22		
11. Equilibrium in a Balance Total				
F	7.93	2.50	1.89	.06
M	9.08	2.58		

Table 2

Crosstabulation of Equilibrium in a Balance Level by Gender

Equilibrium in a Balance Level

	1	2	3	4	Totals
Females	3	16	4	4	27
Males	3	17	17	11	48
Totals	6	33	21	15	

Chi Square = 5.93 with 3 df   Significance = 0.12
Kendall's tau c = -0.25   Significance = 0.02

Table 3

Crosstabulation of Equilibrium in a Balance Experience by Gender

Equilibrium in a Balance Experience

	1	2	3	4	5	6	7	Totals
Females	2	5	5	3	8	2	0	25
Males	3	2	11	8	11	8	1	44
Totals	5	7	16	11	19	10	1	

Chi Square = 6.33 with 6 df   Significance = .39
Kendall's tau c = -.017   Significance = .10

Table 4

Algebra Problem Solving A

Item Analysis

1. *A man and woman can paddle a canoe at a speed of 5 mph in still water. They make a trip up the river and then back down in a total of 10 hours when the river is flowing at 2 mph. How far up the river do they go before turning back?*

	Means	Standard Deviation	t	p
F	1.54	1.20	.96	.34
M	1.91	1.08		

2. *A rectangular plot of ground is 20 feet wide and 30 feet long. Across one of the shorter ends it is necessary to put a 5-foot walk. How much must the shorter dimension (the width) be increased in order to maintain the original area?*

	Means	Standard Deviation	t	p
F	.69	1.11	2.00	.05
M	1.52	1.24		

3. *A man is able to invest part of his $10,000 savings at 8 1/2% annual interest and the remaining amount at 6%. If his total earnings in one year are $700 how much was invested at each rate?*

	Means	Standard Deviation	t	p
F	.54	.66	1.25	.22
M	.87	.82		

4. *The hypotenuse (longest side) of a right triangle is 13 meters long. One leg is 7 meters longer than the other. Find the lengths of the legs (shorter sides). Then find the area of the triangle.*

	Means	Standard Deviation	t	p
F	2.38	.77	.29	.77
M	2.48	1.00		

5. *A woman and her Little League team went to a drive-in restaurant. She ordered 6 hamburgers and 4 hot dogs and paid $7.50. Two of hhe kids who had wanted hamburgers changed their minds and wanted hot dogs. The waiter changed the order and gave her $.50 more in change. What was the price for each sandwich?*

	Means	Standard Deviation	t	p
F	.77	.44	1.34	.19
M	1.17	1.03		

6. *On balance scales, a gold bar weighs as much as one third of a bar together with a one-pound weight. How much does the gold bar weigh?*

	Means	Standard Deviation	t	p
F	1.23	1.36	1.22	.23
M	1.78	1.28		

Items scored from 0 to 3 points each
Females = 13
Males = 23
Reliability: Alpha = .43

Algebra Problem Solving B

Item Analysis

1. *A train leaves a station and travels at 45 mph. Three hours later an express train leaves the same station traveling 75 mph. How far from the station will the second train overtake the first?*

	Means	Standard Deviation	t	p
F	.77	.83	2.42	.02
M	1.68	1.22		

2. *A cube has a surface area of 600 square cm. What is its volume?* (A picture of an unmarked cube accompanied this problem.)

	Means	Standard Deviation	t	p
F	.92	1.19	2.92	.006
M	2.12	1.20		

3. *If a radiator is filled with a 40% solution of antifreeze solution, how much must be drained off and replaced by pure antifreeze in order to get a concentration of 60%, assuming that the radiator holds 20 quarts when full?*

	Means	Standard Deviation	t	p
F	1.00	1.00	-0.33	.74
M	.88	1.09		

4. *Papa Baldacci went to the store to get 5 cans of tomatoes and 3 cans of tomato paste for his famous spaghetti sauce recipe. When he got there he found that the cost would be \$3.62. Since he had only \$3.50 in his pocket he changed the recipe. He bought 4 cans of each, and paid \$3.44. How much did each can cost?*

	Means	Standard Deviation	t	p
F	.85	.90	1.14	.26
M	1.20	.91		

5. *A park, 100 yds by 100 yds, is designed to have a road around the entire inside perimeter. How wide should the road be to preserve 6400 sq. yds of area for the park?*

	Means	Standard Deviation	t	p
F	2.46	.97	-.96	.35
M	2.08	1.25		

6. *A collection of nickels, dimes and quarters is worth \$4.20. If there are twice as many nickels as quarters, and the total number of coins is 37, how many nickels, how many dimes and how many quarters are there in this collection:*

	Means	Standard Deviation	t	p
F	.54	.97	1.73	.09
M	1.28	1.37		

Items scored from 0 to 3 points each
Females = 13
Males = 25
Reliability: alpha = .70

Table 5

Correlation Coefficients

Whole Group

	1	2	3	4	5	6	7	8	9	10
1. Algebra Problem Solving										
2. Algebra Skills Pretest	-.094									
3. Algebra Skills Posttest	.257**	.305***								
4. Space Relations	.325***	-.032	.079							
5. Abstract Reasoning	.300**	.075	.211**	.557***						
6. Gottschaldt Figures	.341***	-.060	.083	.412***	.280***					
7. Learning Style	.009	-.190*	.159**	.051	-.066	-.155				
8. Equilibrium in a Balance 1	.205**	.088	.055	.041	.108	.006	-.061			
9. Equilibrium in a Balance 2	.144	.276**	.267***	.367***	.405***	.021	-.076	.281***		
10. Equilibrium in a Balance 3	.173*	.201*	.242**	.170*	.113	.173*	-.097	-.110	.452***	
11. Equilibrium in a Balance Total	.229**	.300**	.292***	.313***	.324***	.097	-.111	.407***	.898***	.717***

* $p < .10$
** $p < .05$
*** $p < .01$

Table 6

Correlation Coefficients

Females

	1	2	3	4	5	6	7	8	9	10
1. Algebra Problem Solving										
2. Algebra Skills Pretest	.255									
3. Algebra Skills Posttest	.435**	.044								
4. Space Relations	.330*	-.015	.173							
5. Abstract Reasoning	.468***	.075	.133	.629***						
6. Gottschaldt Figures	.367**	.295*	.122	.455***	.362**					
7. Learning Style	.046	-.406**	.328*	.173	-.101	-.025				
8. Equilibrium in a Balance 1	.294*	-.068	-.054	.075	.336**	.105	-.080			
9. Equilibrium in a Balance 2	.141	.099	.052	.143	.142	.069	-.417**	.350**		
10. Equilibrium in a Balance 3	-.056	.261	.039	-.019	-.226	.130	-.047	-.294*	.396**	
11. Equilibrium in a Balance Total	.153	.170	.034	.101	.080	.141	-.302*	.389**	.915***	.644***

* $p < .10$
** $p < .05$
*** $p < .01$

Table 7

Correlation Coefficients

Males

	1	2	3	4	5	6	7	8	9	10
1. Algebra Problem Solving										
2. Algebra Skills Pretest	-.357**									
3. Algebra Skills Posttest	.156	.078								
4. Space Relations	.260**	-.115	-.002							
5. Abstract Reasoning	.282**	.094	.248**	.549***						
6. Gottschaldt Figures	.286**	-.292	.046	.363***	.268					
7. Learning Style	.135	.028	.137	.077	-.078	-.171				
8. Equilibrium in a Balance 1	.151	.193	.112	.001	.006	-.065	-.013			
9. Equilibrium in a Balance 2	.056	.307**	.357***	.436***	.541***	-.053	.185	.234*		
10. Equilibrium in a Balance 3	.226*	.125	.333***	.233*	.277**	.165	-.064	-.080	.454***	
11. Equilibrium in a Balance Total	.183	.310**	.403***	.374***	.451***	.028	.080	.418***	.882***	.774***

* p .10
** p .05
*** p .01