WATER RESOURCE MANAGEMENT SIMULATION EFFECTS ON ACQUIRED KNOWLEDGE AND WATER CONCERNS

E-035

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I. Problem

The Water Resource Management Simulator [WRMS] is an interactive computerized simulation of the major factors operating in a river basin. The computer models both surface and ground water supply. Demands are made by energy, municipal/industrial, livestock, and irrigation users of the water resource. In addition the model provides experience with management of a reserviour. USGS hydrologic data, and demand curves for various river basin types are programed into the computer. For each user category and the reservior a console is provided where up to 30 users can alter demand patterns technology, and ground or surface sources.

In prior studies of WRMS interaction on water resource knowledge and attitudes, data suggests that WRMS users more than a sample of non-users tended to agree that "nature can solve water supply problems before they get serious". Agreement with this statement according to Watkins [1] factor analysis study denotes a low level of concern for water related problems. The design of the WRMS was directed at increasing water related information dissemination capabilities and promoting a point of view conducive to wise water resource management. The current study attempts to gain insight to this anomally!

II. Objectives

The purpose of this study is to (1) determine if interaction with the WRMS computer model creates a lesser concern for water issues as measured by the Watkins Water Concern Scale. In addition the study addresses the following questions:

2. Does interaction with the WRMS model promote the negative notion that "Nature can solve water supply problems before they get serious"?

3. What level of water resource management knowledge and attitude exists among pre-service teachers?
4. What is the correlation between water knowledge scores and water concern scores.

III. Procedure

The Watkins Water Concern Scale and Water Knowledge Assessment Tests were administered as a pre-test to 61 pre-service teachers. Following the pre-test subjects received two hours of interaction with the WRMS model. The water concern and knowledge tests were readministered as post tests. Although this procedure is directed at the research problem it does deviate from the experimental design in the original proposal. Both human and material resources altered the intended procedure! Pre/Post means test scores and response correlations were analyzed by computer.

IV. Findings

1. Does interaction with the WRMS model lower concern for water issues?

   The following comparison of mean Pre/Post WRMS treatment attitude scores [Table I] is not statistically significant.

Table I

t-test Comparison of Total Pre vs. Post Water Concern Scores

Test	N	X	SD	t	P
Pre	56	14.4	3.1	-1.04	0.29
Post	52*	13.8			

*N varied due to failure of some subjects not responding to all items.

Although not statistically significant, after working with the WRMS the mean attitude score was lower.

2. Does interaction with the WRMS promote the notion that "Nature can solve water supply problems before they get serious"?

Pre/Post mean responses for each item on the concern scale were compared to identify where the variation in responses originated.

Table II shows pre/post WRMS mean responses for each item on the concern scale.

Table II

t-test Comparison of Mean Resource by Item on the Watkins Water Concern Scale

Question	Test	$\bar{X}$	t	P
#26 We really haven't thought about cutting down our use of water	Pre Post	2.5 2.2	-1.07	0.28
#27 Water Reclaimed from Waste is as good as any other water	Pre Post	3.44 3.05	-1.92	0.05
#28 Mankind has a right to free and unlimited use of water	Pre . Post	3.52 3.72	0.94	0.34
#29 Nature has a way to subdue water supply problems before they get serious	Pre Post	3.42 3.72	1.34	0.18
#30 It's the people who should do something about the water problem	Pre Post	1.68 1.42	-2.00	0.04

The population responding to the concern scale did not indicate a significantly different pre/post response to item #29. Post-test responses were slightly higher. However, significantly lower mean responses to question #27 and #30 resulted. This trend toward lower post WRMS mean is consistent with responses from previous studies [2].

To gain further insight to the responses shift, the number of subjects who's response showed a decrease, no change and an increase were identified. Table III shows the number of persons and the direction in which they shifted

their option following WRMS experience.

Table III

Comparison of Pre/Post WRMS Shift in Response

Frequency Distribution

Question	Decrease	No Change	Increase
26	16	19	13
27	26	10	11
28	8	26	12
29	8	17	21
30	16	23	7

On all water concern items, except #28 and #29 there was a shift to a lesser concern. In the case of test items #27 and #30 this negative shift was statistically significant. Previous data showed the greatest number of individuals shifting to a more negative score on the post-test for question #29.[2]

In fact, as shown in Table IV those 8 subjects with a negative shift on question #29 prior to WRMS had a significantly higher concern than did their peers. Yet following WRMS treatment scored lower on the post-test.

Table IV

Analysis of Response to "Nature has a way to Solve Water Supply Problems Before they get Serious"!

Response	N	Pre X	t	P	Pos X	t	p
Stable/Positive	43	14.09	-2.3	0.02	14.04	0.78	0.43
Decrease	8	16.75			13.0		

Comparison of the mean difference between Pre and Post responses for the two groups is shown in Table V.

Table V

Comparison of Mean Difference for Attitude

Decrease on #29	N	$\bar{X}$ difference	t	p
No	40	-0.1	2.8	0.006
Yes	8	-3.75		

3. What level of water resource management knowledge and attitude exists for pre-service teachers?

A. KNOWLEDGE

Subjects could score anywhere between 0 and 25 on either of the two tests. A high score on the knowledge test showed greater information and a high score on the attitude assessment showed a greater concern for water issues.

As shown in Table VI the mean entry level score for water resource knowledge was 11.36 of a potential score of 25. Approximately 45 percent of the items were answered correctly. Test

Table VI

Test	N*	$\bar{X}$	Range	t	p
Pre	61	11.36	3-19	3.4	0.0008
Post	55	13.40	5-18		

*N varies due to absenteism and unusable data.

items were constructed directly from the stated objectives for the simulator! The post-test increase although statistically significant represent only about an average of two additional questions answered correctly. The range of correct responses was reduced following WRMS treatment.

B. Attitude

Table I shows an initial mean attitude score of 14.4. The by item mean scores in Table II, if used to prioritize this groups disposition toward water from high to low they accept (1) the necessity of control over water exploitation and misuse, (2) that water reclaimed from waste is as good as any other water, (3) that nature cannot solve supply problems before they become serious, (4) having given considerable thought to the water problem and (5) that water resources are a problem that each person must concern themselves.

4. What correlation exists between water knowledge and attitude?

Although with WRMS treatment there was an increase in knowledge and a slight decrease in attitude score no significant correlation existed. A significant positive correlation [p=.003] did exist between pre WRMS knowledge scores and post WRMS knowledge scores. The same relationship existed between Pre and Post WRMS attitude scores [p=.006].

DISCUSSION

In previous investigations using the computerized Water Resource Management Simulator evidence was gathered that pointed to substantial knowledge gains for users, but a trend for teacher populations toward lower attitudinal scores with WRM use. [2]

The study under discussion here has shown that for pre-service educators. Knowledge gains are occurring while there is a slight general drop in attitude score following the WRMS experience. The lower post-test scores are not due primarily to question #29 responses, but to other components of the concern scale as well. There was rationale to suspect that because the computer simulation compressed time it fostered the negative assumption that "Nature has a way to solve water supply problems before they get serious." The pre/post

positive shift for this item provides rationale to reject this idea. The negative post response is more general and for the population under study as shown in Table II does not involve question #29. In fact those who respond negative on #29 actually had a higher mean score than their peers. Although the response patterns is different, this population, as have others, did respond with less concern [Table IV] on water following the use of the WRMS. Although this difference was not statistically significant the significance of having an information dissemination tool that, contrary to desired outcomes, lessens the concern for water resources is significantly counter productive. Those responding negative to #29 did have a significant mean difference in pre/post WRMS concern score [Table V]. It can be inferred that the significant decrease for this sub sample was a function of WRMS interaction.

The knowledge scores of the college students were initially low but increased. The increase from 45% correct to 55% correct is not impressive considering the effort and time put into the treatment. The following comparison shows the pre-service teacher mean score relative to other populations. [3]

Population	$\bar{X}$ Knowledge Score
13-15 year olds	9.60
16-18 year olds	9.86
Pre-service college 20 year olds	11.36
*22 years and older	14.14

*This population included Corps of Engineers, Water Managers, Science Teachers, League of Women Voters subjects.

There appears, as would be expected, to be a progressive increase in ability to respond correctly to the Water Knowledge Test.

Concern for water resources was lower on the post-test! The decrease in attitude score is not a function of question #29!

The relationship between the increasing knowledge scores and the lower concern scores was not significant. This anomally is in need of further study using a more powerful treatment and followed up by a professional attitude assessment.

The last word on the viability of the WRMS as an information dissemination tool has yet to be spoken. The relationship between knowledge and attitude will require additional study.

REFERENCES

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3. Mills, Terence J., "A Study of the Relationship Between Information and Attitude for Users and Nonusers of Computerized Water Resource Management Simulation." Monograph in Environmental Education and Environmental Studies. (Ed.) Arthur B. Sacks, Vol. 1, ERIC/SMEAC, Columbus, OH, 1984, pp. 151-171.