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REACHING HIGHER LEVELS OF COGNITION USING PUBLICATIONS

Kristina M. Boone, Assistant Professor
Kansas State University

Larry E. Miller, Professor
The Ohio State University

Larry C. Brown, Professor
The Ohio State University

Abstract

Publications are used extensively by adult and rural educational organizations, including Extension, to educate people when face-to-face contact is not possible or when adjunct instruction is necessary or useful. Yet, very little research has been conducted regarding the level of cognition that is achieved after reading publications. Using the Newcomb-Trefz Model of Cognition, an experiment was designed to determine the effect of two, four-page publications on Extension clientele's cognition. Results demonstrated that the subjects learned from Extension publications and achieved higher-levels of cognition. Cognition was not highly correlated with education level. Higher correlations were seen between cognition and education level for the control groups than for treatment groups. With the tremendous amount of information available via the information superhighway, Extension should concentrate on producing media that have an educational edge in enhancing cognition.

Publications are used extensively by adult and rural educational organizations, including Extension, to educate people when face-to-face contact is not possible or when adjunct instruction is necessary or useful. Yet, very little research has been conducted regarding the level of cognition that is achieved after reading publications. Studies that have been conducted have dealt with classroom texts and publications, not media used in nonformal education. While Extension is a strong leader in adult and continuing education (Prawl, Medlin, & Gross, 1984), no studies have focused on cognition or retention achieved from reading Extension publications.

While nonformal educational publications have not been studied, instructional media has a long history of interest from researchers. However, the body of research is riddled with weaknesses, including poor research questions, poor methodology, insignificant results, and lack of a unifying conceptual framework (Grabowski, 1988). Part of the problem with instructional media research stems from its boom and bust nature. Researchers rush to work with new technologies as they are introduced, seeing a new medium as a panacea for all previous media's instructional ills. Initially, gains are demonstrated when using the new media, because of the novelty effect and generally high quality materials are produced to accompany the media. As the gains decrease and the field becomes disenchanted with the medium, the tide of research wanes to a trickle (Clark & Salomon, 1987). While research in this field has weaknesses, interest still exists in determining cognition from media. Media and cognition have been studied together for two basic reasons, according to Clark and Salomon (1987). First, there is always concern about how media effects children. The other reason is that learner performance may be enhanced by media.

While some research on instructional media has employed Bloom's Taxonomy of Educational Objectives (Bloom, Engelhart, Furst, Hill & Krathwohl, 1956), no research has applied it to publications directed toward non-formal adult learners, such as those reached through Extension. Yet, this hierarchical model of thinking still influences Extension education and is considered a canon in the field.

Based on review of studies critical of Bloom's Taxonomy, Newcomb and Trefz (1987) developed the Newcomb-Trefz Model to assess cognitive level of questions used in examinations and student assignments. The Newcomb-Trefz Model condenses three levels of Bloom's taxonomy into one level and renames the other levels to better describe the activities of the level. Figure 1 illustrates the combination of the Bloom's Taxonomy levels with the Newcomb-Trefz Model levels. The Newcomb-Trefz model has four hierarchical levels of cognition. The learner moves through the lower levels to achieve higher levels of cognition. The lower levels in the model are remembering, followed by processing where some higher cognition begins. The higher levels include creating and evaluating, the highest level.

In this study, the Newcomb-Trefz model was used to determine the cognitive level achieved by residents in Scioto County, Ohio, after they read two publications that described the water resources in that county. These publications were produced by the Scioto County Extension agent through the Ohio Water Resources Education Project, one of Ohio State University Extension's projects related to the USDA-Extension Service's national educational water quality initiative (Boone, Ricker, & Brown, 1996).

Purpose and Objectives

The purpose of this research was to determine whether cognitive change was accomplished after rural adults in Scioto County, Ohio, read water-related publications. The objective of the study was to determine differences in levels of cognition after subjects in the treatment groups read the publications. Treatment groups were compared to control groups to determine cognition. Subsequent hypotheses were:

1. Participants in the treatment groups will answer significantly greater numbers of questions correctly on the posttest exams than the control groups.

2. Participants in the treatment groups will achieve significantly higher levels of cognition on the Newcomb-Trefz Model than control groups.

3. The pretest/posttest treatment group will demonstrate significant gains in overall

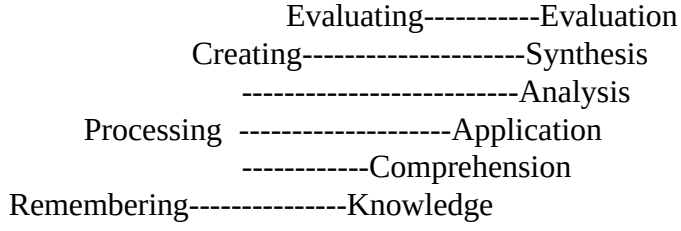

Figure 1. Bloom's Taxonomy of Educational Objectives in the Cognitive Domain (right) Related to Levels of the Newcomb - Trefz Model (left)

cognitive scores and scores at each cognitive level when comparing performance from the pretest to that on the posttest. The control pretest/posttest group will not demonstrate significant gains.

4. Greater numbers of correct scores and operation on higher levels of cognition will positively correlate with education level.

Procedures

This study used a Solomon Four-Group experimental design (see Figure 2), which controls all threats to internal validity and the external validity threat of interaction of testing and treatment (Campbell & Stanley, 1963). The external validity threat of interaction of selection and treatment was controlled through random selection of subjects from the client group. Reactive effects of experimental arrangements was controlled by random assignment of subjects to groups.

R	O	X	O	(Pretest-Posttest Treatment Group)
R	O		O	(Pretest-Posttest Control Group)
R		X	O	(Posttest-only Treatment Group)
R			O	(Posttest-only Control Group)

Figure 2. Soloman Four-Group Experimental Design (Campbell & Stanley, 1963)

The study participants were selected from a list of persons actively involved with production agriculture and clients of the Ohio State University Extension, Scioto County office. From this list of 338 people, a simple random sample of 60 persons was drawn, which was not large enough to generalize to the mailing list. However, the paucity of this type of research allowed for greater emphasis on understanding the phenomenon and on internal validity, and lesser concentration on generalization and external validity (Fraenkel & Wallen, 1989).

An instrument, using multiple-choice items, was written to measure hierarchical levels of educational objectives and learning using descriptors taken from work by Newcomb and Trefz (1987). To capture remembering and processing, five questions were written for each level. Four questions were written for the creating and evaluating levels. A panel of experts from agencies participating in the Ohio Water Resources Educational Project and The Ohio State University established content and face validity.

For reliability, 17 agricultural Extension clients in Richland County, Ohio, piloted tested the instrument, resulting in a Cronbach's Alpha internal consistency reliability coefficient of 0.60, an marginally acceptable reliability for research at this stage. An alpha level of 0.10 was set *a priori* and was selected because of the early stages of this type of research. Data were gathered with the pretest groups in July and August 1993 during face-to-face encounters, although a few participants requested that the instrument be mailed to them. Posttest examinations were conducted during August with all participants, also through face-to-face encounters.

The treatment was two publications describing the surface- and ground-water resources in Scioto County. The purpose of the publications was to increase knowledge of Scioto County residents about their county's water resources and provide background for future water quality questions. These publications included learning objectives in the first paragraph of each and utilized maps of the county as graphics and tables to present water quality data. Members of the treatment groups were asked to read the publications and not to take the posttest until they had done so. The control groups also completed appropriate pretests and posttests but did not read the two publications

during the experiment. They were mailed copies of the publications following the experiment.

Analysis of Data

Data were analyzed using the personal computer version of the Statistical Package for the Social Sciences (SPSS[x]). Descriptive and inferential statistics were calculated on the data. T-tests for independent groups were used to determine pretest effects; the posttest scores of the treatment group that took the pretest and posttest were compared to the treatment group taking only the posttest. A similar comparison was made between the control groups' posttest scores. No significant differences were found between the posttest scores of the treatment groups or the control groups, indicating that pretest effects were negligible and the groups could be collapsed into two umbrella groups of treatment and control. Thus, further comparisons were made between the control and treatment groups using t-tests.

Calculated t-values based on a pooled error variance was used when the greater variance resulted from the group with the greater number of subjects, and separate error variance was the basis when greater variance resulted from the smaller group. Spearman-rank correlation coefficients were calculated for associations among the variables of cognitive score and education level.

Results

Forty-three people participated in the study. The 60 people in the sample were contacted and, of those, 17 people refused to participate, citing a variety of reasons, including lack of time (most frequent), recent family tragedy, and distrust of government entities. The participants in this study were farmers, averaging approximately 25 years in farming. The average age was 49, and the mode for education level was "some college." One participant in the pretest/posttest control group was functionally illiterate, and the instrument was read to this person.

Overall, on the posttest, the participants answered an average of 60 percent of the questions correctly. The treatment group answered 73 percent of the questions correctly, while the control group's mean was 47 percent correct.

Treatment groups scored significantly higher than control groups for total cognition and at the cognitive levels of remembering, processing and creating in the Newcomb-Trefz model (Table 1). At the remembering and processing levels, the treatment group scored means of 4.05 and 3.86, respectively, out of a total possible of 5.0 (five questions at each level); while the control group scored 2.43 and 1.67, respectively (four questions at each level). At the creating and evaluating levels, the treatment group scored means of 3.18 and 2.09, respectively, out of a total possible of 4.0; while the control group scored 2.29 and 2.11, respectively. From the total possible of 18.0 from all cognitive items, the treatment groups' mean was 13.18, while the control groups' was 8.48. At the cognitive level of evaluating, significant differences were not found among treatment and control groups. Differences between treatment and control groups in mean scores at the processing level were greatest, indicating that the publications operated most effectively at the processing level.

The treatment group showed significant gains at each cognitive level (Table 2), according to t-test results, with its greatest gain from the pretest scores to the posttest scores at the processing level. The control group, on the other hand, did not score significantly greater at any cognitive level or in total cognition on the posttest when compared to the pretest. Because the authors were evaluating gains in scores on cognition, the differences in scores from the pretest to the posttest were analyzed. Thus, only the scores from the pretest-posttest groups were analyzed for this hypothesis and the posttest-only groups were excluded.

Table 1. Differences Between Treatment (n = 22) and Control Groups (n = 21) Totally and at Each Cognitive Level

Cognitive Level	Group	$\bar{X}$	s.d.	Calculated t-values	Estimated Error Variance used
1 Remembering	Treatment	4.05	1.13	4.36*	Separate
	Control	2.43	1.29		
2 Processing	Treatment	3.86	0.83	8.83*	Pooled
	Control	1.67	0.80		
3 Creating	Treatment	3.18	0.80	3.45*	Separate
	Control	2.29	0.90		
4 Evaluating	Treatment	2.09	1.02	-0.01	Separate
	Control	2.11	1.18		
Total	Treatment	13.18	2.58	5.87*	Separate
	Control	8.48	2.68		

*p<0.10

The average education level of subjects in this study was "some college" with a mean of 12.9 years of formal education. This study found a negligible to moderate association between cognitive levels and previous education when evaluating all participants. The associations increased somewhat as cognitive level increased, particularly between the cognitive levels of processing and creating, where higher-order cognitive levels begin. Correlations between cognition and education level for the treatment group were low to moderate, again increasing slightly between the processing and creating levels.

The associations between education level and cognitive score were greater for the control group than those for the treatment group though. The correlations were low to substantial, with an association of 0.54 at the evaluating level and 0.50 for total cognitive score. Table 3 presents these data.

Conclusions and Recommendations

Results of this study support acceptance of the first and third hypotheses. In addressing the first hypothesis, the treatment group answered significantly greater numbers of questions correctly than the control group. The treatment group taking both the pretest and posttest scored significantly higher on the posttest than the pretest at all cognitive levels and in total cognition, whereas no significant differences were found between pretest and posttest scores for the control group; supporting the third hypothesis of this study.

The authors also accept the second and fourth hypotheses to a degree. In support of the second hypotheses, the treatment group scored significantly higher than the control group on the cognitive levels of remembering, processing, and creating, but no significant differences were found at the evaluating level. In relation to the fourth hypothesis, patterns of correlations between education level and cognitive performance were

Table 2. Gains in Posttest Scores Compared to Pretest Scores for the Pretest/Posttest Control (n = 11) and Treatment Groups (n = 10) (Excludes Posttest-only Groups)

Cognitive Level	Group	Test	$\bar{X}$	s.d.	Calculated t-value
1	Treatment	Pretest		2.20	1.32
4.64*					
Remembering		Posttest	4.40	0.70	
(Scale 0-5)					
	Control	Pretest		2.00	1.18
1.17					
		Posttest	2.64	1.36	
2	Treatment	Pretest		1.70	0.82
5.39*					
Processing		Posttest	3.80	0.92	
(Scale 0-5)					
	Control	Pretest		1.91	0.94
0.72					
		Posttest	1.64	0.81	
3	Treatment	Pretest		2.40	1.26
1.99*					
Creating		Posttest	3.30	0.68	
(Scale 0-4)					
	Control	Pretest		2.45	1.04
0.96					
		Posttest	2.09	0.70	
4	Treatment	Pretest		1.60	0.52
1.74*					
Evaluating		Posttest	2.30	1.16	
(Scale 0-4)					
	Control	Pretest		2.27	0.91
0.18					
		Posttest	2.36	1.36	
Total	Treatment	Pretest		7.90	2.73
4.99*					
(Scale 0-18)		Posttest	13.80	2.57	
	Control	Pretest		8.63	2.38
0.09					
		Posttest	8.73	3.04	

*p <0.10

inconclusive, although correlations were greater in magnitude among control group members at the evaluating cognitive level and in total cognition than treatment group members.

This indicates that education was a greater contributing factor to performance at higher cognitive levels and in total cognition when no treatment was used, whereas the publication reduced the contribution of previous education to cognitive performance.

Time has recorded many who have been critical of the efficacy of Extension publications in really educating clientele. This study contradicts that common notion that Extension publications do not contribute to learning. Undoubtedly, publications function more effectively if introduced and followed by interaction with an educator. However, this empirical study evidences clients can learn and achieve higher levels of cognition from reading these Extension publications.

Table 3. Correlations Between Education Level and Cognition

Level	Group	Correlation with Education Level (r_s)	Description of Association*
1	Treatment	-.10	Low
Remembering	Control	.23	Low
	Combined	.09	Negligible
2	Treatment	.03	Negligible
Processing	Control	.34	Moderate
	Combined	.16	Low
3	Treatment	.42	Moderate
Creating	Control	.14	Low
	Combined	.29	Low
4	Treatment	.19	Low
Evaluating	Control	.54	Substantial
	Combined	.35	Moderate
Total	Treatment	.17	Low
	Control	.50	Substantial
	Combined	.29	Low

* Davis, 1971; Treatment n = 22; Control n = 21; Combined n = 43

Publications can be used to achieve higher order cognition and may be able to improve cognitive abilities as well as knowledge because readers with a greater store of knowledge and accessing abilities tend to learn more efficiently from text (Cote, Goldman, Gjellstad, Keeton, & Millican, 1995; Taraban, Johnson, & Shufeldt, 1995). With the vast quantity of information that is becoming accessible to many citizens through the information superhighway, Extension must continually focus on ensuring that its information and media communicate to and educate clientele.

Extension is the leading educator of rural adults (Barker, 1985) and will continue expanding to other audiences with subject matter and technologies that are not traditional to Extension (Prawl et al., 1984). Thus, publications should be in the forefront of increasing cognition with clientele groups. Extension is a leader in education, and the information it provides must be competitive in delivering the greatest educational opportunities for its clients. To advance the level of educational quality, Extension should draw on research in the area of cognition and text and utilize elements in publications found to enhance cognition, such as graphic organizers, learning objectives, and adjunct questions (Anderson & Pearson, 1984; Stewart, 1989).

Further, the publications using these elements should be studied further with clientele groups. Extension publications also should be written to help learners move through all the Newcomb-Trefz levels, bearing in mind that cognition on the evaluating level may be difficult to attain.

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