Studies of Children in an Underground School*

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INTRODUCTION

IN SEPTEMBER, 1962, the Abo Elementary School, Artesia, New Mexico, opened its doors. The school is an earth covered structure, capable of serving as a fallout shelter. To the best of my knowledge this was the first school constructed in this manner. Because of the uniqueness of the structure it has been twice studied in an attempt to determine the effect of such a structure on the children who attend school in the facility. Of particular note is the fact that not only is this structure an earth covered elementary school but is also designed, designated, named, publically labeled and well-known by community and pupils alike as a nuclear fallout shelter. Thus there has been a major concern with the effect of this constant reminder of the possibility of nuclear disaster that daily confronts the pupils attending the school as well as their parents and the general community.

THE FIRST ABO PROJECT

From January, 1963 to January, 1964, a research team headed by this author established residence in Artesia, N.M. and engaged in an intensive study of the effects of the above mentioned structure [1]. From my present bias this study should have been much more dependent on anthropological field methods than it was. It was psycho-statistically oriented. The following briefly reviews that first research study.

THE COMMUNITY SETTING

The Abo Elementary School is located in Artesia, New Mexico, a community of approximately 15,000 people in the southeastern corner of the state. Major industries include the production of cotton, alfalfa, and livestock, processing and trading cotton and the production and refining of gas and oil. As in many small towns, public education is one of the major industries of the community in terms of dollars spent and people employed in the community.

The town is geographically divided, or if you will, defacto segregated into two socio-economic class groups. Unskilled and welfare families generally live on the north side of town, east of the country club. The rest of the town is composed of middle and upper-middle class families. It was in this latter area that the four schools involved in our two studies were located. Some pupils from the north side were bussed into all four schools in the study. In general the social class composition of the pupil population was not different across the four schools and did not affect the results of the study.

DESIGN AND INSTRUMENTATION

The problem of this study was to discover if any differences in school related variables could be attributed to the effect of the earth-covered facility.

Sample — Four elementary schools were selected for data collection. All schools were in the Artesia School District. The first, involved the experimental treatment (of an underground — earth covered structure, designed and designated as a fallout shelter). The second school was an above ground windowless, and air-conditioned school (differing from Abo only in the fact that it was not an earth covered structure and not designated as a fallout structure). The third school was a conventional structure and air-conditioned (differing in the fact that it also had windows). The fourth school was a conventional structure (differing in that it was not air-conditioned). All pupils in the fourth, fifth and

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sixth grades in each school composed the pupil sample with the exception that any parent could request that their child not participate in the data collection and some pupils were not available for testing due to absence during scheduled testing periods. Ninety-seven percent of all fourth, fifth, and sixth grade pupils participated in the data collection.

INSTRUMENTS
The Stanford Achievement Test was administered in October, 1962, and again in May, 1963. The spring achievement scores were combined with the Octobers, 1962 scores, IQ scores, and anxiety scores (using multiple regression techniques) to produce residual gain achievement scores. This process had the effect of holding previous achievement, intelligence and school anxiety constant and allowing achievement to vary independently of these factors.

Measures of pupil classroom behavior were achieved by administering portions of the Morey Pupil Classroom Behavior Questionnaire [2]. Areas of Group Process, Learning, and Pupil Adjustment were assessed in all fourth, fifth and sixth grades.

Of particular concern was the possibility of the generalization of general and/or school anxiety in earth covered structure. In order to assess this area of concern, Sarason's Test Anxiety Scale for Children and General Anxiety Scale for Children [3] were administered. These scales produced a "scale" score that was co-varied with both general and school anxiety scores as a measure of pupil anxiety.

We were also concerned with the effect of the environments on the teachers working in these schools. Taylor's "A Personality Scale of Manifest Anxiety" [4] "Holmesen's Teacher Attitude Scale," [5] and Moeller's "Teacher's Sense of Power Scale," [6] were used to assess this aspect of the study.

Parent opinion of the earth covered facility was obtained from a questionnaire administered to a stratified random sample of parents of first, fourth and sixth grade pupils in each of the four sample schools. A total of 991 parents were interviewed.

Finally, data concerning the effect of school environments on pupil health was collected under the direction of the medical consultant to the project.

DATA ANALYSIS
Pupil Achievement
An analysis of variance design was used to determine if total residual achievement was different across school structure types. The F ratio of 1.21 was not significant at the .05 level. There were significant differences among schools based on specific achievement areas such as spelling, arithmetic computation and arithmetic reasoning. The differences did not favor a single school, however. For instance, the areas of spelling and arithmetic reasoning were significantly selected as most of our memory oriented learning as opposed to process oriented learning. Abo school ranked first in arithmetic computation and last in spelling achievement while another school that ranked first in spelling ranked last in arithmetic computation. Apparently achievement depended more on teacher or school emphasis than upon structural environment.

Pupil Anxiety
An analysis of variance of raw anxiety scores in both school and general anxiety showed significant differences among schools. This difference was contributed to by the lower raw anxiety scores of pupils in the earth covered structure. When co-varied with the "life scale" scores these differences disappeared. It therefore can be stated that the earth covered school structure adversely affect the anxiety of the pupils attending that school.

Teacher Attitudes
No significant F ratio was produced by the four analyses of variance performed in this area. Therefore it can be concluded that structural types did not affect teacher attitudes or anxiety.

Parent and Teacher Opinions
The specific opinion surveys as well as the pupil observer data collected during a year of active participation in the community evidenced overwhelming support for and acceptance of the earth covered structure. Exceptions were related to what might appear to be more extreme political or psychological bases of individuals.

Pupil Health
An examination of pupil absences and an analysis of a survey of the entire medical personnel serving the Artesia area produced no evidence that the structure type affected the health of the pupils.

CONCLUSIONS OF THE FIRST STUDY
Briefly stated, there was no evidence that the structure type affected in any adverse way any of the variables with which this first study was concerned. On the basis of this data there is no reason to reject the notion of earth covered structures as elementary schools or the designation of such structures as fallout shelters.

THE SECOND ABO PROJECT
Data collected in the first study were of course limited to the effect of the structural types (with particular reference to the earth covered structure) over a single year's period. Therefore we were asked to do a brief follow-up study during the school year 1971-72 [7]. There was no period of residency in Artesia in this study except for one week during final data collection. All data were collected by the school system, the original medical consultant and the original researcher to the research team. This study was of necessity less complicated than the original. Essentially the same variables were of concern in this second study, however.

ACHIEVEMENT
During 1963-64 the fourth grade pupils in Artesia were part of our original sample. Some of these pupils were still in the Artesia Schools as twelfth graders. These achievement comparisons were made. The first group was the ninth grade and arithmetic achievement of these remain- twelfth grade students as the ninth grade was the last standard achievement score for all students. IQ was co-varied with reading achievement and IQ and reading with arithmetic achievement. An analy- sis of co-variance was calculated to determine if there were any significant differences among pupils who had attended the four types of structures in 1963.

The second (Comparison B) concerned a randomly selected sample of fourth grade class attending Abo since its opening in 1963. These pupils were compared on the same variables, using the same statistical design as Comparison A, with similar groups of pupils from each of the fourth grade classes from the original three schools in the study.

The third (Comparison C) consisted of the same samples and the same design except the sample was composed of all sixth grade pupils attending the four schools during 1969-70 and 1970-71. Who had attended the same schools for their entire elementary school careers. Thus, three comparisons of the effect of the structural types on elementary achievement were made. Comparison A looked at the effect on the original fourth grade pupils five years later, when they were in the ninth grade. Comparison B looked at the structural effect on achievement on all fourth graders for eight years after holding schools constant and grade constant but allowing pupils to vary. Comparison C allowed grades to vary but held pupils constant. These pupils were not subject to the Hawthorne Effect (of the original study) but had spent five years in the same schools. None of the F ratios (in Comparisons A, B or C) were significant at the .05 level or below confirming our original finding that structural type had no adverse effect on school achievement of elementary pupils.

ANXIETY AND MENTAL HEALTH
Pupil anxiety was the variable of major concern in the original study. A standardized measure of anxiety was used to do this var. The admin- istration of that type measure has stired up community controversy again. Without the on-site presence of the study team it was deemed surwise to proceed in that manner. There- fore a secondary measure of anxiety was agreed upon. It was assumed that any exceptional anxiety on the part of elementary pupils would result in abnormality and excessive absence and/or overt be- havioral problems in school. Absence data for all pupils in Comparisons A, B and C were compared by analysis of variance. In addition, all names of these pupils were submitted to a panel of six informed educational professionals from the Artesia School. They were asked if any of these pupils were or had been behavior prob- lems. Of 495 pupils classified by the entire panel, 44 were classified as behavioral problems. These data were analyzed by Chi Square. The obtained Chi Square of .25 was considerably less than the 9.35 required for significance. Thus we must conclude that the structural type did not produce differing psychological effects resulting in pupil behavior classified as behavioral problems. Absence data in each of the three comparison groups were analyzed in a variety of designs. Comparison B (all fourth grades since Abo began to operate) showed significant differences at or below the .01 level indicating a lower absence rate in Abo fourth graders attending the earth covered structure. Comparison C (all pupils attending the schools for their entire elementary careers) showed the same tendency but due to the small sample in these groups the results reach no significance. Thus we conclude, based on data from both studies that there seems to be a slight positive effect of structure type affecting the general physi- cal and mental health of pupils attending the earth covered structure. At the very least these data lend no support to the contention that earth covered structures adversely affect the mental and physical health of elementary pupils attending such a school.

MEDICAL OPINION
All medical personnel attending patients in
Artesia were again surveyed by Owen C. Taylor, M.D., the project's medical consultant, Dr. Taylor reported in part the following:

The three physicians attending the majority of children were most impressed with the beneficial effects of the filtered ventilation air system. The psychological factor of the school being windowless and underground apparently was not felt to be significant ... (the school psychologist) felt the windowless underground school was theoretically a good environment for elementary children and his experience here with disturbed children supported this opinion ... The school nurses felt there was a noticeable difference in the general demeanor and behavior in the children in Abo (the earth covered structure). They felt they were a bit calmer and seemed less prone to respiratory diseases.

Thus the data collected by medical staff serving the community not only suggests that the earth covered structure has no ill effects on the physical or mental health of its pupils but they are overwhelmingly convinced that it has some favorable effects.

MAINTENANCE AND OPERATION DATA

There are in our last report five to six pages of data and remarks about cost maintenance and operation of an earth covered elementary structure as compared to other structures. I prefer not to report them here. Most of you can make better guesses about this area than these data provide. We report, "Judgments as to whether or not to utilize school-shelter construction in a particular school (or other earth covered constructions) cannot be made on cost data above. To begin with our data are inconclusive. They may be used to whatever advantage or bias one wishes."

IMPLICATIONS

I quote here from our "Abo Revisited" report.

Our original study concluded that the Abo Elementary School and Fallout Shelter was operating as an effective elementary school environment. Our present study confirms this finding.

1. The ABO School has been operating as an effective elementary school in Artesia, N.M. since it opened its doors in 1966. It continues to be an effective school and there is no evidence that the fact that it is underground and could serve as a fallout shelter and is so marked, designated, and named has had any detrimental effect on pupils attending that school.

FUTURE RESEARCH

Obviously additional research is needed on methods, initial cost, maintenance cost, energy conservation and investment return on earth covered structures. But such data will not convince people to build or utilize such structures. In my view sufficient research has been done to establish that the people within the normal range of the population will suffer no adverse psychological effects from living or working in earth covered structures. Where additional research is needed if earth covered structures are to be utilized to any great extent, is designs that provide information about the conditions under which such buildings are accepted and/or desired. Two general categories appear useful here. One concerns the political and cultural acceptance or acceptance on a general level. The second might define the specific individual conditions under which an individual will decide to build and use an earth covered structure. Each of these categories can be divided into public and private, industrial and personal use.

REFERENCES


