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An Experimental Study of the Influence of the Educational Comic Upon Content Achievement and Retention

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AN EXPERIMENTAL STUDY OF THE INFLUENCE OF THE EDUCATIONAL COMIC UPON CONTENT ACHIEVEMENT AND RETENTION

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CHAPTER I

THE PROBLEM, EXPERIMENT LIMITATIONS, AND DEFINITIONS

The problems of education are numerous and varied. One area of problems that has received a great amount of attention from many sources is reading. It is an essential part of all grade levels and of all academic areas in the school and it is becoming a greater necessity in the world of occupations. With all this attention, criticism, and research, one aspect of reading has been relatively neglected: the use of the educational comic in the subject-matter classroom.

I. THE PROBLEM

Statement of the problem. The purpose of this study was to determine (1) whether educational comics influence subject-matter learning, (2) whether this influence is related to sex differences, and (3) whether this influence is related to reading achievement.

Importance of the study. Since reading achievement is closely related to subject-matter achievement, students with low reading achievement, in most cases, will have content achievement

below their potential, regardless of their level of capability in other areas of endeavor (21). The range of reading achievement of students in junior high grades is usually six to eight grade levels. A teacher is seldom able to obtain materials for so wide a range of readability (10). Materials of similar content, with different levels of readability are limited in number and those materials that are available are expensive; thus it is difficult for a district to provide these in sufficient quantities. This problem has increased with the recent emphasis given individual study, wherein reading becomes an even more important activity (44). Here the question may be asked: would free educational comics be a partial solution to this problem?

Industry invests large sums of money, annually, in the production of free and inexpensive educational materials. So numerous were the requests for educational materials this fall (1962), the General Electric Company responded by stating only teachers' requests would be considered. Some companies are discontinuing the educational comic, while others are increasing their lists of educational comics. Again, certain questions are raised: Is this investment of money, personnel, and time educationally justified? Should the educational comic be continued or discontinued?

The comic book is the most popular form of literature with students. Approximately 86,000,000 copies are purchased by children

every month (39). Several reasons for this popularity have been hypothesized and tested (45). The question here is can this high interest in comic books be successfully harnessed for educational purposes?

The major portion of pertinent research reported deals with the comic book and with its social and moral implications. Results of these studies have been contradictory and controversial (42, 54, 58). Some research has related comics to the hygiene of reading, and in these studies comic books have generally received unfavorable ratings (43, 45, and 58). In the light of this, we again ask a question: does the comic format have educational value?

It is the general intent of this study to determine the feasibility of a wider use of the comic format for educational purposes.

II. LIMITATIONS OF THE STUDY

The conclusion formed from this study was limited by factors related to each of the basic elements in the experiment: (1) Sample Population, (2) materials, and (3) procedures.

Sample Population. Due to the small Primary Population (320 students), the selection and matching techniques, and the absences, the Sample Population contained only 216 for the Achievement Post-test. This number was further reduced to 153 Selected Participants for the Retention Post-test by later absences. The lower

level of reading achievement suffered the greater percentage of absences in both Experiment Periods.

A second handicapping factor was the atypical characteristics of the Sample Population's distributions of reading achievement and intelligence scores.

Materials. Three problems related to reading materials were encountered. First, there was a large amount of subject-matter in each reading material that did not meet the selective criteria for the experiment yet had to be read by the students. Second, few questions could be developed for the Post-tests from the small amount of subject-matter that was common to the two reading materials.

Another limiting factor, related to materials, was representation. There was not sufficient time to analyze other science texts and other educational comics to determine if the selected samples were typical of similar materials.

Procedures. Two procedural problems were (1) the Experiment Periods were administered by several different teachers and (2) the teachers were not experienced in administering the Experiment Period activities. Experiment control of these problems was attempted by the experimentor through an orientation meeting with the teachers and printed, detailed instructions. No measure of

differences of students' performances, between classrooms, related to teacher differences in administering the Experiment Periods could be made. Due to classroom assignment by ability grouping it was not possible to match students among classrooms.

Because of these handicapping factors, conclusions could be made only to this specific study and its elements. The elements of the study could not be considered typical nor the data sufficient and significant for the conclusions to be generalized.

III. DEFINITIONS OF TERMS USED

Terms Related to Experiment Personnel

Primary Population. All eighth grade students in Park Junior High School, Kennewick, Washington.

Secondary Population. All students from the Primary Population who had received both the California Achievement Test and the California Test of Mental Maturity on the dates scheduled by the school district.

Sample Population. Those students in the Secondary Population who could be matched to two other students (from the Secondary Population) by sex, reading achievement, and intelligence.

Participants. To maintain classroom control and rapport, all students present participated in the Experiment Period activities.

Selected Participants. Those students who were members of the Sample Population and participated in the Experiment Period activities.

Participating Teachers. Teachers of the common learnings classes in which the Experiment Periods were conducted.

Experiment Group. A group of the Sample Population, or Selected Participants, who used the same reading material. The group included males and females, the full range of reading achievement in the Sample Population, and students from each classroom.

Experiment Group 'T'. The Experiment Group that read the textbook chapter only.

Experiment Group 'C'. The Experiment Group that read the Educational Comic only.

Experiment Group 'TC'. The Experiment Group that read both the textbook chapter and the Educational Comic.

Sex Sub-group. A male or female portion of an Experiment Group. This sub-group included the full reading range of the particular

sex in the Sample Population and representatives of all classrooms.

Achievement Sub-group. Males and females of an Experiment Group representing the low, middle, or high one-third of the reading achievement range of the Sample Population. Each sub-group contained three consecutive stanine scores of reading achievement.

Experiment Control Group 'A'. A group of Selected Participants who participated in the morning. This group was matched by sex, reading achievement, intelligence, and Experiment Groups to afternoon participants.

Experiment Control Group 'P'. The Selected Participants who participated in the afternoon and were matched to members of Experiment Control Group 'A'. Comparison of mean scores was made between 'A' and 'P' to determine if there was any difference due to communication between students or daily fatigue.

Reading Achievement. Grade-level reading ability as measured by the California Achievement Test and identified as "Total Reading."

Intelligence. Intelligence as measured by the California Test of Mental Maturity.

Daily Fatigue. The reduction of energies during the day as a result of activities performed earlier in the day.

Terms Related to Experiment Material

Comics. Any material having cartoon-type illustrations in sequential order, with dialogue-text in the illustrations.

Comic books. Comics purchased at magazine counters with entertainment their primary purpose.

Comic strips. Comics found in newspapers.

Educational comics. Materials having comic format, produced for educational purposes.

Experiment Period I. The two-hour period in which students read their assigned experiment materials and answered the Achievement Post-test.

Experiment Period II. The fifteen-minute period, five weeks after Experiment Period I, in which the Retention Post-test was administered.

Achievement Post-test. A test of thirteen recall questions covering subject matter common to both the textbook chapter and the Educational Comic. This test was administered during Experiment

Period I, as soon as the student completed his reading assignment, to measure subject-matter achievement.

Retention Post-test. The same test as the Achievement Post-test, administered five weeks later to measure subject-matter retention.

Balloon. A printing term identifying the area outlined by curved lines within a cartoon, in which dialogue is printed.

Insert. A small, bordered area in a cartoon box, containing text related to the cartoon, but not a part of the dialogue, usually in the top, left, or the bottom, right areas of the cartoon box.

Font. Printing term referring to the style of type, i.e., Italic font, or Spartan font.

Pica. A printing term referring to size; it is one-sixth of an inch and contains twelve points.

Point. The basic dimension unit in printing, it is one-twelfth of a pica or one-seventy-second of an inch.

Ink-blend. The printed color is a result of blending of colored inks before printing.

Ink-overlay. The printed color is a result of printing one colored ink and then printing a second color over the same area. Under a magnifying glass, dots may be seen of the different original colors.

CHAPTER II

REVIEW OF RELATED LITERATURE

There is no available literature that reports studies similar to this experiment. It was necessary to make an outline of the problems and influences that may be related to the elements of the experiment and to that part of the reading problem that this study is directed: the subject-matter classroom. From this basic outline, the experimentor selected research that was felt significant in three areas: (1) the classroom reading problem, (2) the reading student, and (3) the comic format.

The first discussion describes the reading problems that occur in the subject-matter classroom. This is followed by a description of the student as a content reader and as a comic book reader. Finally, research pertinent to the educational comic is presented. Some of the research is directly related to the comic, and some is applicable to the educational comic by the elements of the comic format.

I. THE CLASSROOM READING PROBLEM

Reading achievement and subject-matter achievement. Bertha Smith (41:493-509) constructed four reading skill tests to

determine the correlation of student's reading ability and the subject achievement grades recorded by the student's teachers. The four tests were: (1) problem solving, (2) paragraph comprehension, (3) informative detail, and (4) narrative. Correlations were run between the student's test scores and their grade averages of all subjects, except drawing and manual arts. Problem solving had a correlation of .46; paragraph comprehension was .54; informative detail, .51; and narrative was .40. In the breakdown, to specific subject areas, each correlation increased and decreased depending upon subject area. Smith concluded: (1) not reading in general, but specific reading skills applicable to a study area will have high significant correlations, (2) more studies, similar to hers, must be conducted to generalize, and (3) these correlations were sufficient to consider a basic achievement necessity in each subject area.

In a paper presentation, Leo Fay mentions several similar studies and concludes, reading achievement, in some cases, may have greater influence upon subject-matter achievement than the particular knowledge and skills of the subject (19:36-37). Although the majority of situations are not of this nature, the influence of reading must be of constant concern to the subject-matter teacher. In addition, the student's subject-matter achievement is becoming a greater responsibility of the reading teacher.

Reading range in the classroom. In preparing populations for other studies, Fay found that the reading range in junior high classrooms most frequently began at the fourth grade level and extended to two years above the particular grade used (19:36-37). Yoakam (60:134) reports the average range of student reading achievement in the junior high is five years.

Readability and availability of classroom materials. Mallinson (31:536-540) conducted a study wherein the Flesch readability formula was applied to ten three-book series of science texts and two two-book series (seventh and eighth grade). A sample was prepared at one-hundred page intervals and then selected by a random number system. Each text had at least five samples. The conclusions, regarding the eighth-grade texts were: (1) there would be no difficulty for the better students, (2) the average level of readability was low seventh grade or slightly lower, and (3) there was no provision for development of reading abilities during the year. This same study was repeated with intermediate grade texts. The related conclusion was that the intermediate texts, on the average, were higher than grade-placement, more so than in junior high.

Faison (18:43-51) applied the Flesch formula to basic text series and to teacher-selected texts in five subject areas, in the fifth, sixth, seventh, and eighth grades. The eighth grade basic texts scored

67 Reading Ease, eighth to ninth grade level, and the teacher-selected texts scored 75 Reading Ease, seventh grade level. The Human Interest scores for the basic and the teacher-selected texts were 30 and 28, respectively, which is similar to Time magazine. In comparison to the texts of the other four subject areas, the science text was second most difficult among the basics and fourth most difficult among the teacher-selected texts. The science text was the least interesting among the basic texts and second least interesting of the teacher-selected texts.

In his research of diagram techniques, Malter used samples from math and science material (32:102). He concluded: (1) the students will have difficulty understanding without personal, descriptive explanations and (2) the procedure for reading the diagrams had to be indicated, if present practices of diagram presentation, by authors, were to continue.

Yoakam states that the extending of readability of the materials by the use of multi-level texts will not be satisfactory for the effort involved. Instead, the use of differentiated material and several media should be encouraged (60:16).

Leo Fay, in speaking to a reading conference (19:37) reported that a wide variety of material existed among all reading media, but not within each. The problem was to find lists and sources and to evaluate the material.

Growth of the classroom reading problem. Davis (16:541) reports that in the schools studied, the greater reading achievement ranges occurred where grade promotions were one-hundred per cent or above average and where student enrollment tenure was highest. Yoakam (59:22-24) cited the New York City report that related increasing reading range in the classroom to social promotion and to schools having organized, developmental reading programs for all reading abilities.

Spache identified the seven most agreed upon types of reading skills: (1) understanding and interpreting content, (2) understanding organization, (3) development of specialized vocabulary, (4) critical evaluation, (5) collecting materials, (6) recalling and applying, and (7) interest exploration (44:158-159). He then had teachers rate these as to relative importance and necessity to subject areas. In the problem-centered and integrated curriculum programs (core-type), which are increasing in the junior high, there was greater demand upon these skills, especially the first two and last three, than in previous years. He concluded that the newer curriculum organizations placed greater emphasis upon reading as an immediate learning tool.

To determine if these needed reading skills could be taught and developed, Howell designed an instructional and measurement study

for the fourth through the sixth grade (26:277-282). He then applied his results to results of previous similar studies among older students. His conclusions were: (1) the instruction of study-reading skills in the intermediate grades was successful, (2) there was no measurable success with similar instruction in junior high through junior college, (3) this could be the result of the subject-matter teachers not being sufficiently concerned with reading achievement, and (4) more research was needed with variations.

With increasing reading ranges and more demands upon reading skills in the subject areas, Yoakam writes that failure to meet this problem will cause increased frustration of the "low readers" and boredom of the "high readers" (60:13-14).

II. THE READING STUDENT

Reading interests of the student. In one of the early studies with comic books, Anderson (3:258-260) found the leisure-time reading preferences of 686 seventh and eighth graders. Boys preferred comic books, animal stories, fiction, and westerns, while girls preferred fiction, comic books, biography, animal stories, in that order. Applying her findings to the conclusions reached by others, she concluded the dissimilar results of similar studies may be due to the variety of lists of literature forms used by the experimentors.

Vandament, recognizing this problem, found that most preference lists mixed media, literature-types, and subjects (50:467-470). Therefore, to find out if there were trends in fantasy preferences, he made separate title lists of the three most popular media: (1) story books, (2) comic books, and (3) magazines. He classified each selection as to one of the three fantasy types: (1) social, (2) aggressive, and (3) achievement. These three lists were given to 1034 sixth and tenth graders who numbered their five favorites in each list, by preference. The girls preferred social fantasy and the boys preferred aggressive fantasy. There were no differences between the grades.

Witty (56:274 and 58:501-506) concluded, from his own studies and those of others, that the most popular story forms of junior high students are action and adventure, followed by fantasy and the most popular media is the comic book. Lyness used 1418 fifth, seventh, ninth, and eleventh graders to measure popularity of the comic strip (30:454). He found that: (1) the comic strip was the most popular area of the newspaper in the fifth, seventh, and ninth grades; (2) its popularity decreased through the grades; and (3) it was not always more popular with the boys than with the girls. Boys preferred sports and crime, generally, while girls preferred humor and comedy; both preferred action.

Witty cites Alice Williams' study of students' responses toward thirty-five popular science materials found in a school library. The findings, pertinent to this study, were that students dislike: (1) personification of content, (2) introductory essays eulogizing inventors, and (3) adult-child conversation structure.

Reading comprehension: experience and vocabulary. Betts lists 22 areas for reading comprehension, in order of importance (8:94). First, on the list is background of experience and second is vocabulary. Chall developed a test design to measure influence of previous knowledge and experience upon reading achievement (13:225-230). A pre-test was administered to two-hundred sixth and eighth graders. This was followed by a fifteen passage test with four questions after each passage. A comparison of passage test scores was made between the high pre-test score group and the low pre-test score group. The "pre-test high group" mean was higher than the mean of the "low group," with a difference significant at the 1 per cent level. As a control measure, the two groups' Stanford reading grade equivalent means were compared and there was no significant difference. She concluded that previous experience does aid comprehension.

Artley ran correlations between test scores of 200 eleventh grades from the Cooperative Test of Reading Comprehension and the Cooperative Test of General Proficiency in the Field of Social Studies.

There were no significant correlations except with the vocabulary scores to the social studies scores and to several of the reading skill factors. Artley formed two conclusions: (1) the several reading skill factors are related but not significantly correlated to say efficient performance in one assures the same in another and (2) vocabulary is highly influential for academic success when reading comprehension is involved (5:58-60).

However, Serra (40:80) concluded from several studies that: (1) simplifying vocabulary has less influence than simplifying structure and (2) comma punctuation fails to facilitate comprehension.

Students' differences related to reading. Anderson compared ages of starting to read and rates of reading progress of high, average, and low intelligence groups (4:493). The significant characteristics of the three groups were:

High intelligence group--started reading earliest, reading improvement progressed rapidly, and no sex differences

Middle intelligence group--girls started reading earlier than boys, high variability of starting age and improvement rate, and no sex differences in improvement rate

Low intelligence group--started reading latest, slow development rate, high variability of starting age and improvement rate, and boys start later, but develop faster than girls.

Neville (34:195-197) and Burks (11:489-493) conducted similar studies of retarded and non-retarded readers, with similar intelligence, and their WISC performances. Burks sought to find those areas of intelligence tests in which poor readers would score lowest and Neville sought to identify consistent patterns of retarded readers in the Wechsler Intelligence Scale for Children. The results of both studies were consistent with each other. The retarded readers scored significantly lower in the Coding, Information, and Arithmetic sections than the non-retarded readers. The retarded readers also scored significantly higher in Composition, Block Design, Picture Arrangement and Picture Completion than they had in the other sub-tests. Neville related these results to scholastic and non-scholastic type tasks, and Burks related his results to concrete, structured stimuli and abstract, symbolic stimuli. Burks also had a difference, wherein the retarded readers scored higher than the non-retarded readers in Picture Arrangement; however, the difference was not significant. He tentatively hypothesized that the non-retarded readers had not developed the necessary skills as they were less dependent upon pictures for reading comprehension.

Altus extended the scope of these studies by using students described as having severe reading difficulty (2:155). These were students performing at levels two years or more below expected level

of performance as predicted by the WISC Full-Scale Intelligence Test. Mean intelligence of the group was 98.6. The performance scores on the sub-tests were arranged identically as in Neville's study (34:195-197). Significant differences were found between the high and the low sub-test scores (2:155).

Bliesmer formed pairs of students, one from third or fourth grade and the other from eighth or ninth grade, with mental ages of 10.7 to 12.6 (10:324). The younger students were identified "bright" and the older "dull." He administered portions of two tests: Durrell Analysis of Reading Difficulty and Iowa Tests of Basic Skills. From his results, he concluded: (1) the bright student is superior in locating main ideas, grasping inferences, and forming conclusions, (2) the bright student has higher listening performance, (3) the bright and dull students will have the same reading rates when there is comparable degree of understanding of the material, and (4) the two groups are alike in word recognition and word meaning.

Relating intelligence differences to interest differences, Norvell found the high intelligence groups needed wider variety of subject matter (35:5) and there was no difference of context preference between high and low intelligence groups (35:25-27).

Witty (52:43-45) studied the reading habits of high and low intelligence groups and determined that in the high intelligence group

time spent reading increases with age, (2) girls still read more than boys, (3) peak reading interest is at seventeen years rather than thirteen, (4) the low intelligence group has the same preferences as the high regarding subjects, but there is less popularity of the mystery, to some degree.

Anderson found no relationships of age differences to rate of reading development and age of learning to read to reading development (4:485). Norvell, using studies by himself and others (35:39-46) found of the controlled differences observed, intelligence, sex, socio-economic, age was second to intelligence in influence upon the measured difference, reading interest.

In discussing reading problems, Betts lists three major sex differences and three possible influences: (1) boys comprise sixty to eighty percent of the population in the retarded reading programs, (2) girls excel boys in vocabulary and pronunciation, (3) girls read more than boys for recreation, (4) there is some evidence that girls are promoted at lower standards than boys, (5) reading materials in schools are predominantly female oriented, and (6) these may be overemphasis of sex differences when contrasted to differences within the sexes (8:137).

Anderson conducted a six year longitudinal study of reading achievement of two-hundred nine students, to determine sex differences.

He found that girls read sooner, but both boys and girls improve their reading at the same rate, and there is greater range of reading achievement within a sex than between the sexes (4:481-488).

Several sex-differences related to reading interests have already been discussed in a previous section (pp. 16-17). The results of Norvell's studies are sufficient here. He has concluded that junior high boys and girls equally like adventure and animal stories and equally dislike the descriptive. The biggest difference occurs where boys like sports stories and girls like love and family stories. The boys have a slightly higher preference for the comic book over other media than do the girls (35:25-28). The peak interest in science is in adolescence with the boys' slightly higher than the girls' (52:36-37).

Stroud conducted studies measuring sex differences related to performance on the Iowa Tests (46:661-665). The science area showed the greatest sex difference of all the subject areas tested. In the skills there was no significant difference of reading achievement in the eighth grade population, between the sexes.

III. THE COMIC FORMAT

Popularity of the comic book. Witty cites the results of a survey to determine the popularity of comic books made by Market Research Company of America (58:503). The question was: What

percentage of those interviewed read comics regularly (at least once a week)? Figures presented were:

AGE	MALES	FEMALES
6 - 11 yrs	95%	91%
12 - 17 yrs	87%	81%
18 - 30 yrs	41%	28%
31 plus yrs	16%	12%

Anderson (3:260-265) reported seventy-four per cent of the boys and sixty-eight per cent of the girls interviewed in the seventh and eighth grades selected comics as first choice. In the list of newspaper elements, eighty-two per cent of the boys and ninety-three per cent of the girls selected the comic strip sections first.

Witty and Coomer were interested in extending the data reflecting comic book popularity into the high school (55:346-353). They distributed a questionnaire to 480 ninth, tenth, eleventh, and twelfth graders. In comparison to junior high, there is some lessening of popularity, but the comic book maintains its first place ranking. The largest difference between junior high and senior high comic popularities is the popularity of the comic strip. The degree of popularity and the number of comic strips is greatly increased, Witty reports.

In research studies to determine the popularity of the comic book in comparison to other media and forms, only the Vandament and Thalman study (50:468) was found to not rank the comic book in first

place. That the results of Vandament's study are inconsistent with the majority of literature is borne out in Witty's summary of several years' research by himself and others (58:501-506). Witty concludes that the comic has been the most popular medium since the significant studies began (1930's) and its popularity has continually increased.

Butterworth and Thompson (12:71-96) combined literature classification lists from several authorities and used the most frequently occurring identifications. They then compiled a list of popular comic books and had 202 students from the sixth through the twelfth grade indicate their favorite titles. It was their purpose to identify age-grade and sex trends in comic book popularity. There was consistent increasing popularity of humorous animal fantasy stories (Mickey Mouse, Donald Duck, etc.) at each grade-level, but it was not significant. They concluded there were no significant age-grade differences of popularity. There were identical differences of popularity in all grades between the sexes. The boys preferred adventure, violence, and sports; the girls preferred feminine adolescent heroines and romance. These differences were significant in all grades.

Witty (57:303-308) analyzed data from some of his previous studies in the fourth, fifth, and sixth grades to measure negro-white differences of comic book popularity. He concluded there were no differences of popularity ranking of the comic book or of titles of comic

books. There were differences in amount of reading: (1) the negro average was eighteen comic books a week; the white children read an average of thirteen a week, and (2) the negro children averaged eight different titles read regularly; the whites averaged three. In his summary, Witty states he would relate these differences to home and school environment differences and further research is needed in this specific problem.

To determine why comic books were popular, Strang used interviews and written reports from 180 students in all twelve grades (45:336). She then categorized the responses and ranked them according to frequency. The five categories with the most frequent responses, in order, were: (1) heroism, a consistent hero, had elements of folklore appeal, (2) adventure, role playing situations, (3) mental catharsis of feelings of inadequacy and frustration by identification, (4) enjoyable reading experience for the low reader, and (5) new vocabulary and experiences not found in other literature.

Reynolds conducted approximately 120 informal interviews, during one school-year, with his students and other students in the school to determine reasons for the comic book's popularity. Three of the nine most frequently given reasons are not intrinsic to the comic book (37:17).

(1) Easy to read but not "babyish" Reynolds
as other easier reading materials

(2) Amusing, adventurous with danger, an escape by fantasy

(3) Exciting content and illustrations

(4) Like the pictures

(5) Cheap

(6) No other reading experience

(7) Fun to collect and trade

(8) "Everyone else does" Reynolds

Frank concluded from her studies of the favorite comic books that vocabulary was a key element for selection and the vocabulary of the more popular comics was contemporary, colloquial and easy (20:221-222).

DeLara conducted a questionnaire study of 319 sixth, seventh, and eighth grade students' magazine preferences (17:45-46). She then ranked the magazines by the percentage of format devoted to pictures. There was a significant correlation of popularity and percentage of picture content. The first four selections in both lists were: (1) comic books, (2) Life, (3) Saturday Evening Post, and (4) Calling All Girls. The results of this study are reinforced by an earlier study conducted by Anderson (3:260-265). The top half of Anderson's popular selection magazine list is almost identical. The most notable difference is the addition of Reader's Digest, in fourth place.

Bender related her work experiences and studies in the use of drawings and puppets for mental therapy to the appeal of comic books (6:223-231). She concludes that the comics' drawings are related to the child's drawings as releases of fantasies and that fantasy is less threatening than the real, despite the inferred violence.

Influence of the comic book. Several writings have been published that hold the comic book partially responsible for the increasing juvenile delinquency problem; the one most often referred to is Seduction of the Innocent, by Frederic Wertham (51). Research has tended to explode the theories of these critics. Blakely formed two groups of students, totalling 323, one group had a high rate of comic books read and the other group consisted of students who did not read comic books (9:291-301). He found no differences between the two groups of the variables alleged to be affected by the comic book: (1) reading achievement, (2) language and spelling, (3) general school achievement, (4) behavior problem status, and (5) behavior traits as observed by teachers. He strengthened his findings by citing Witty and Heisler who found no differences of school achievement, adjustment, and personality between comic book readers and non-readers under conditions similar to Blakely's study.

Witty and Coomer conducted the same comparison in their high school study of comic book reading, discussed earlier (55:346-353).

They report only two differences were found: (1) those comics listed "Objectionable" were most frequent with girls who had personality problems, but not so with the boys, and (2) comic book readers read more library books.

To find a relationship between comic books and juvenile delinquency, Lewin formed three matched groups of twenty-five boys in each (28:46-48). One group had high comic book interest, the second group had low comic book interest, and the third had a high ability to interpret content (cause-effect, influences, characterization). Lewin found no differences between the high and low interest groups in delinquent behavior, truancy, and school conduct. The third group (high interpretative ability) had less personality problems in school. Lewin extended the study into an eighteen-month longitudinal design and still found no differences that could be related to total exposure. He concluded: Comic book reading can not be held responsible but can be considered a symptomatic scale of maladjustment.

Readability: content and style. Dale and Chall define readability (15:23):

> . . . readability is the sum total (including the interactions) of all those elements within a given piece of printed material that affects the success that a group of readers have with it. The success is the extent to which they understand it, read it at an optimum speed, and find it interesting.

In their survey of studies to determine what makes books readable, they identified four areas of influential elements: (1) content, (2) style, (3) format, and (4) organization. This also is the order of most influence upon readability as judged by librarians, publishers, and teachers; however, high school students and adults reversed the order of content and style as to what most influenced their reading selections (15:19-20).

From several of his studies, Frank concluded that some of the readability elements contributing to the comic book's popularity were: (1) fast moving stories, (2) the cause-effect relationship was easy to grasp, (3) the illustrations replaced long passages describing setting, (4) dialogue was easy to identify by the balloons, thus no confusion of characters, and (5) the simple context and illustrations prevented difficulty with the wide vocabulary (20:221-222). To compare the influences of concept load, vocabulary, and punctuation upon readability, Serra (40:77-81) constructed several variations of a printed material. One variation was basic in vocabulary, concept load, and punctuation, and was called "control." The eight other variations were harder or easier than the "control" in one of the three variables. Comparisons of the students' post-test scores led her to conclude: (1) concept load is more influential than vocabulary load, (2) simple vocabulary does not facilitate comprehension, and (3) commas between series of unmodified nouns and clauses do not aid readability.

Serra conducted another similar study with simplifying the vocabulary and sentence structure as the two variables. She concluded that simplifying the vocabulary was less influential than simplifying the sentence structure (40:80).

Klare (27:287-295) designed an experiment to measure influences of style elements upon retention and acceptability. The varied elements were percentage of short familiar words, average sentence length, percentage of simple sentences, ratio of abstract to concrete words, and ratio of active to passive passages. Three variations were formed and identified as "Easy" (seventh-eighth grade readability), "Present" (eleventh-twelfth grade readability), and "Hard" (sixteenth grade readability). The "Hard" material was read slowest, but not significantly, and despite the instructions, the subjects judged the material for acceptability by content as well as style. The retention measurement placed the "Hard" at the lowest rank and the "Easy" at the highest. All differences were statistically significant. A second retention test was given and the relative positions remained the same although the significances of the differences were reduced.

Aldrich found no relationships between vocabulary differences and magazine popularity rankings and no relationships between students' vocabulary power and magazine preferences (1:368).

Readability: format. Smith and Dechant in discussing legi-

bility write, "Legibility and visibility are determinants of the ease and speed with which the sensory phase of the reading act may be accomplished" (42:255).

Tinker (47:395) conducted a study to measure differences of influences upon legibility between type points and type fonts. He concluded that different type fonts will cause more difficulties than will different sizes of type.

Another study by Tinker, with the assistance of Paterson, was concerned with colors of letters and background. Black letters on white background facilitated reading speed most, followed by green on white, blue on white, and black on yellow, in that order (49:471-478).

Reports of several other studies pertinent to this experiment were not available. However, these same studies by Tinker, and Paterson and Tinker are well detailed by Smith and Dechant (42:257-262).

Tinker's procedures are consistent throughout all of his experiments. The subjects are first "neutralized" by performing for a period of time under identical conditions. The performance is sometimes related to the performance from which the measurements will be made. A control base of the measured variables is always established, such as a common type size or type font. All measurements are related to this base variable and are in reading speed

quantities (48:453-460).

Tinker and Paterson found that when upper-case type, capital letters, is used entirely reading speed and number of words per eye fixation are reduced 12.5 per cent. They also determined that bold-faced, heavy and dark, type similarly reduces reading speed. Ten-point type with two-point leading is optimal, and fourteen to thirty-one pica length lines are equally efficient. No large variance of type point, type font, amount of illumination, line length, or line leading makes any significant differences individually, but when two or more of these are combined there is a very significant cumulative effect upon reading speed (42:257-262).

Readability of the comic book. Frank and Strauss evaluated one-hundred current, popular comics (21:112-116). The pertinent results of their study were: (1) language varied widely, with the heroes above reproach, (2) the samples displayed a wide range of quality in the drawings, (3) colors varied from harsh and garish to bright and pleasant, or clashing to monotonous, (4) a large number had scattered, undelineated, or illogical sequence of picture arrangement, and (5) type was usually slanted, close, narrow form, upper-case, and much of it printed on dark backgrounds (21:112-116).

The influence of visual media upon learning. Miller used approximately six-hundred first, second, and third graders in a study

to find if pictures increase comprehension (33:676-682). He formed two matched groups and identified them as "picture group" and non-picture group. Three non-fiction stories were used with one set of the books having the pictures covered. The test was recall, sentence completion, and story event sequence content with individual, oral administration. The "non-picture group" did as well as the "picture group" and Miller concluded the pictures did not increase comprehension.

Halbert conducted an experiment similar to Miller's with an added variable and group: (1) story and illustrations, (2) story only, and (3) illustrations only. He also constructed a three-level design of the population: (1) low readers, (2) middle readers, and (3) high readers. The students read the selection and then orally discussed what they remembered of the story with the experimentor. Three scores were recorded: (1) number of total separate ideas, (2) number of relevant ideas, and (3) number of irrelevant ideas. The group reading the story with the illustrations scored highest. Halbert concluded that pictures (1) are more stimulating, (2) produce more irrelevant ideas, and (3) contribute to memory (24:43-44).

During World War II, Witty assisted the United States military in developing reading material for several purposes. In conjunction with this, he was able to conduct many experiments.

Relevant to this study is his work with comic strips (53:246). The comic strip was used for morale, security, and safety instruction in several media: magazines, posters, "pass-outs," and manuals. In the studies he conducted, the comic strip was the favorite area of the magazines, especially those comic strips having consistent characters in all issues and information presented in the comic strips was remembered more and longer than that presented in other forms.

Investment in the comic book. Spache writes that 86,000,000 copies of comic books are read each month by children (43:173). Witty and Bricker reported 1951 sales were over 900,000,000 with more than four-hundred titles (54:3) and in 1950 over 100,000,000 special purpose comics were distributed for educational, political, and public relations purposes. The General Electric Company distributed more than 3,000,000 copies of "Adventures in Electricity" in 1950.

In comparison to the last figure above, the General Electric Company distributed 1,738,000 copies of six titles in 1962. Although a much smaller number than the one of 1950, this last figure represents a large investment (38).

It has been the purpose of this chapter to (1) create an understanding of the classroom need for an additional medium similar to the comic book, (2) to describe the high student interest in the comic book, (3) to discuss elements of printed media and their influences upon

reading and how they appear in the comic book, and (4) to describe the investment in the comic book by various industries.

CHAPTER III

ANALYSIS OF POPULATIONS AND MATERIALS

The design of this study included three basic elements: (1) personnel, (2) materials, and (3) procedures. The procedures are described and discussed in Chapter IV. In this chapter, personnel and materials will be discussed by their characteristics that are pertinent to this study and to the studies cited in Chapter II.

I. POPULATIONS

Primary Population. The Primary Population for this study was the 316 eighth-grade students attending Park Junior High School, Kennewick, Washington, in March, 1963. This population contained 152 girls and 154 boys. Enrollment stability of the class was approximately ninety-two per cent.

Secondary Population. The Secondary Population consisted of the 286 students from the Primary Population who had received the California Achievement Test and the California Test of Mental Maturity on the dates scheduled by the school district.

Sample Population. The Sample Population contained 108

boys and 108 girls. These were the students from the Secondary Population who could be matched to two other students by sex, reading achievement and intelligence.

Reading achievement characteristics of the Sample Population, as measured by the California Achievement Test, differed from national norms (See Appendix A). Actual grade-placement at the time of test administration was 8.2. Mean and median of grade-level reading achievement were 11.05 and 9.9 respectively, and the two modes were 9.8 and 12.3. Range of distribution was 6.5 to 12.9 with a standard deviation of 1.65. National norms, presented in the California Test Bureau's 1957 Technical Report on the California Achievement Tests (214:24) were 8.1 mean, median, and mode at 8.1 actual grade placement with a standard deviation of 1.8. The standard error of measurement was 0.4.

Intelligence scores of the Sample Population, measured by the California Test of Mental Maturity, had a mean of 107.4, a median of 107.7 and a mode of 111 (Appendix A). Distribution ranged from 75 to 137 and the standard deviation was 12.1. Standard deviation in the national norm was 25.5 as reported by the California Test Bureau.

Due to absences and withdrawals, 88 boys and 108 girls, from the Sample Population, participated in the Achievement Post-test. Additional absences reduced the number of Selected Participants to

72 boys and 81 girls for the Retention Post-test.

II. MATERIALS

Educational Comic Sample. The educational comic used in the experiment was The Story of Light, distributed by the General Electric Company (Appendix B). Grade-level readability of the comic was 7.9 by the Flesch formula (15:1-24) and 8.5 by the Dale formula (15:1-24). Vocabulary load was 913 different words with a total word content of 2952. Two hundred sixty-five words, with a frequency of 450, were not on the Dale list of familiar words.

The basic physical format of each page was three horizontal rows with two cartoon-boxes in each row. The size of the page was 7.0 inches wide and 10.2 inches high, with a .3 inch inner margin and .8 inch outer margins. Height of the cartoon-boxes varied from 2.0 to 3.6 inches, with no two rows the same height on any page. Cartoon-box widths were from 1.2 inches to 5.9 inches (full page type width). The most frequent box widths were 2.5 to 3.5 inches. No two rows of cartoons, on the same page, had the same cartoon-box widths.

Most of the subject-matter material was in "balloons" in the cartoons. The remainder was printed in the more common format style, in separate boxes or in insets, in the cartoons. The context was hand-lettered, seven-point, all upper-case. Bold-face was used

for important vocabulary words and for emphasis of key facts.

In the balloons, line length averaged 6.6 picas (1.1 inches), was most often 4.5 picas (.75 inches), and varied from 9 points to 15.65 picas (.125 to 2.875 inches). Line length in the text boxes and in the inserts varied from 1.5 to 34.5 picas (.25 to 5.75 inches), was predominantly 26.25 picas (4.375 inches), and averaged 10.15 picas (1.71 inches). Spacing between words was mostly three-point and line-leading was two-point.

The colors were pure red, blue, yellow, ink-blends, and ink-overlays. Predominant colors were the pure red and pure yellow, except the front and back pages which were blue. All detail and shading were created in the drawing in black. Text material was printed on white or yellow background. The paper stock was 32-pound newsprint.

Textbook Sample. The textbook sample selected for the experiment was Science: A Story of Observation and Experiment. The textbook was written by Ira C. Davis, John Burnett, and E. Wayne Gross, and published in 1954 by Henry Holt and Company. The material used in the experiment was pages 95 to 99, from Chapter Four: "What Is Light and How Do You Use It?"

Grade-level readability of these pages was 7.5 by the Flesch formula (15:1-24) and 7.2 by the Dale formula (15:1-24). Total word

frequency was 868. There were 62 words not on the Dale list of familiar words with a frequency of 101.

Page format was two-column text, with .7 inch margins and a .2 inch column-divider margin. The pages were 6 inches wide and 8 inches long. All material used was in common text format. A Roman style font was used in twelve-point type. Headings were set in the columns, with twelve-point, bold-faced Gothic font, for contrast. Line length was fourteen picas (2.3 inches). Word spacing averaged four-points and line-leading was six-point.

All six illustrations, in the selected material, were black and white; three were pen-and-ink sketches, the other three were photographs. No color was used in the material. A 50 pound weight, light clay-surfaced, sulphite paper (newsprint) was used.

Post-test. The post-test consisted of thirteen recall (fill-in) questions developed from the subject-matter found in both the Educational Comic and the textbook sample (Appendix A). The questions were related to specific facts in the subject-matter.

An item-analysis was made of the Post-test with twenty-two students from the pilot-study (Table I, page 42). In the discrimination evaluation, five questions were found to have a mid-level of discrimination capability. All other questions performed at lower levels. In the measurement for difficulty, nine questions measured low difficulty;

TABLE I

DISCRIMINATION AND DIFFICULTY OF TEST QUESTIONS

	Discrimination		Difficulty	
Question	Pilot Test	Achievement Test	Pilot Test	Achievement Test
1	0	.06	1.00	.97
2	.09	.14	.77	.83
3	.36	.18	.45	.47
4	.18	.48	.44	.58
5	.45	.62	.59	.53
6	.45	.32	.77	.68
7	.64	.38	.59	.69
8	.09	.30	.32	.53
9	.18	.04	.91	.89
10	.27	.24	.77	.78
11	.45	.34	.32	.25
12	.18	.46	.18	.37
13	.45	.36	.32	.26

three, medium difficulty; and one at high difficulty. Due to the small content-source for questions, revision of question content was not possible. Some revisions were made in the questions to assure understanding by the student. Question number one had no discrimination value nor level of difficulty; however, it was left in the test as a motivating factor for the students. Since a few students did miss the question, in the experiment, it was also included in the scoring.

A second series of these measurements were made from the Achievement Post-test scores. The top twenty-seven per cent of Selected Participants was compared to the lowest twenty-seven per cent. Sex and Experiment Groups were equally represented. These measurements were then compared to those from the pilot-study. The test appeared to have more discrimination and less difficulty after the minor revisions.

Format for the Post-test was a typed, ditto processed, single page. At the top was a line for the student's name and the code to mark indicating the material read by the student. Directions were separated from the questions by box-lines to prevent confusion. Single-spacing was used within the questions and double-spacing between the questions. The "fill-in" lines were 1.5 to 2.5 inches long, determined from evaluations after the pilot-study.

CHAPTER IV

EXPERIMENT PROCEDURES

The first portion of this chapter will describe the preparation of data and materials for the experiment. This will include a description of the prepared materials. This will be followed by a description of the pilot-study. The experiment operation will be discussed within chronological sections, and will include experimentor, teacher, and student activities. The procedures of data analysis are organized in the same order as the presentation of data in a later chapter.

I. PREPARATION

Student data. An alphabetical listing of all eighth grade students was obtained from the school. This list of students constituted the Primary Population. The following additional data was recorded on the list: sex, intelligence score, reading achievement score, and room number of student's common-learnings class.

The school scheduled dates for administration of the California Achievement Test and the California Test of Mental Maturity in the Fall of 1962. Those students who did not participate in all of the

testing on the scheduled days were removed from the list. The remaining students constituted the Secondary Population and were assigned an identification number according to their order on the list.

A "Unisort" data card (Appendix A) was prepared for each student with the following information written and program-punched on the card:

Identification number

Initial letter of last name

Common learnings classroom number

Sex

Intelligence score

Reading achievement score

The data cards were sorted into male and female groups. Each of the groups was arranged in order of increasing reading achievement scores. Cards with identical reading achievement scores were placed in order of increasing intelligence scores. Within the male group and female groups, maintaining the order of achievement scores, the cards were separated into sets of five months reading range (7.0 to 7.4, 7.5 to 7.9, etc.), for ease of handling. Those cards with the least similar reading achievement scores or with the most inconsistent intelligence scores within the set, were eliminated. If necessary, one or two cards were also eliminated from each set so that the final number of cards in each set was a multiple of three.

Three student Experiment Groups were formed and identified as 'T', use of text only; 'C', use of educational comic only; and 'TC', use of both text and educational comic. The cards from each set were individually assigned to the Experiment Groups in alternating order: T, C, TC, TC, C, T. The assignment of the first card of a set was the same as the assignment of the last card of the previous set. When the assignment of the cards was complete, each Experiment Group (T, C, TC) had an equal number of boys at each five month range of reading achievement and an equal number of girls at each range. For any particular student, there was a student in each of the other two Experiment Groups, matched by sex and similar reading achievement scores. The Experiment Group assignment was recorded and punched on the student's data card.

These students, who had been matched and assigned to an Experiment Group, were identified as members of the Sample Population.

Experiment materials. The textbook used in the experiment was Science: A Story of Observation and Experiment, by Ira C. Davis, John Burnett, and E. Wayne Gross. The book was published in 1954, by Henry Holt and Company. Two-hundred copies of the text were available and the students had had no known exposure.

Samples of free, educational comics were obtained from the

General Electric Company. These comics contain content common to the text, but not taught in the seventh and eighth grade science classes at this school. The comics were compared to the chapters in the textbook, by counting facts found in both the text chapters and the educational comics. The educational comic, The Story of Light, and the text chapter, "What Is Light and How Do You Use It," pages 95 to 99, had the most content in common and were selected for the experiment. Two-hundred copies of the selected educational comic were then obtained for the experiment.

The selected educational comic was evaluated by criteria established in previous research in the areas of interest, reading hygiene, vocabulary, and content. The Flesch and Dale reading formulas were applied to the selected textbook chapter and the educational comic. However, in assessing the comic, no positive validity nor reliability could be established since such material was not used in constructing the formulas.

Using only the subject matter common to the selected chapter and educational comic, a subject-matter test was constructed using the recall ("fill-in") form. This test was used in identical form for both the Achievement and the Retention Post-tests. The test-form was identified as "Question Sheet" (Appendix A).

Administrative materials. A descriptive brief, "Introduction of Experiment," was prepared for orientation of the participating teachers; describing the purpose of the experiment, what preparations they were to make, what controls were necessary, and listing the inventory of necessary materials.

Directions for the Experiment Period were in the pamphlet "Experiment Period Directions I" and included procedures and dialogue to be used by the teachers. Similar directions for the Retention Posttest were in "Experiment Period Directions II."

A sample "Question Sheet" was included in each teacher's kit. The words "fluorescent," "incandescent," and "filament," in the test questions were circled in red. It was assumed that different explanations of these words, given by the several participating teachers, could influence test results. An explanation was developed for each word and printed at the bottom of the "Question Sheet" sample. This sample was titled "Master Question Sheet."

A list of students in each classroom was made on the form, "Materials Assignment List," and identified by room number and morning or afternoon time of meeting. By the names of the students, marks were placed indicating what material each student was to receive, according to Experiment Group assignment, i.e., the text, the educational comic, or both. Material assignments to those students who were not Selected Participants (not assigned to an

Experiment Group), were made by random selection. There was no indication on the "Materials Assignment List" as to which students were and which students were not Selected Participants (Appendix A).

II. PILOT STUDY

A pilot-study of the experiment was conducted in three science classes at the Ellensburg, Washington, Junior High School. The same procedures were employed as planned for the larger group. Based upon observations by the experimentor and comments by the teachers, several changes were made in the administrative materials to eliminate chance of procedural errors. An item-analysis was made of the subject-matter achievement test and minor modifications in sentence structure were made to simplify understanding of the questions (Table I, page 42).

III. OPERATION OF EXPERIMENT

The Experiment Periods were administered by the teachers of the eighth-grade common-learnings classes. These teachers were identified as Participating Teachers. It was the purpose of the experimentor to not upset classroom and school procedures any more than absolutely necessary in conducting the experiment. By using the several teachers, it was possible to conduct each Experiment Period in one day. It was necessary to use

the common-learnings classes (social studies and language arts) as they were two hours in length and one hour was not sufficient time for Experiment Period I to be completed.

Orientation of Participating Teachers. The experimentor met with the Participating Teachers two days before Experiment Period I. Administrative materials for Experiment Period I ("Introduction of Experiment"; "Experiment Period Directions I"; "Materials Assignment List"; "Master Question Sheet") were distributed to the teachers and discussed.

Experiment Period I. On the morning of Experiment Period I, the experimentor delivered to the participating classrooms the texts, educational comics, and "Question Sheets" that would be used by the students. During the day, the experimentor remained in the school's central office and did not enter the participating classrooms.

Each teacher began the Experiment Period by reading the instructions to the students from "Experiment Period Directions I." The teacher then referred to "Materials Assignment List" and distributed the proper reading material to each student. For classroom rapport, all students participated in the experiment activities, whether they were Selected Participants or not. No indication of which students were Selected Participants was made by the experimentor to anyone.

In each classroom, some students received the text, some received the educational comic, and some received both.

After all questions from the students had been answered, the teacher directed them to begin reading. Individual help from the teacher, with the reading materials, was limited to pronouncing words. When a student finished reading, the teacher removed the reading material and gave the student a "Question Sheet." The student wrote his or her name on the sheet and circled 'T', 'C', or 'TC' depending upon the material they had read. When giving individual assistance to the students with the "Question Sheet," the teacher was allowed to pronounce the words and give explanations according to the directions on the "Master Question Sheet." When the student was finished, the teacher collected the "Question Sheet" and the student proceeded with some individual, silent activity. During the Experiment Period, no communication between students and no movement around the room by the students were allowed. After all students were finished, the teacher then read the instructions asking them not to discuss the experiment during the remainder of the school-day. Two hours were provided for the Experiment Period; however, one and one-half hours proved to be sufficient for the students to finish. At the end of the school-day, all materials were collected by the experimentor to assure greater experiment control. Names of those

students who were absent were marked on the "Materials Assignment List."

Experiment Period II. Experiment Period II was conducted five weeks after Experiment Period I. The students had received no prior information regarding this period. Experiment control procedures were the same as during Experiment Period I. The experimentor delivered the materials to the Participating Teachers in the morning. The teacher read the instructions from "Experiment Period Directions II" to the students and distributed the second copies of the "Question Sheet." There was no reading of materials at this time. Those students who were absent during Experiment Period I circled the letter 'A' in the identification area. Based upon experience in the pilot-study, a time limit of fifteen minutes was set and all students were able to finish in that time. Again, students were asked not to discuss the activity until the school-day was ended.

Scoring and Recording of Tests. The "Question Sheets" from Experiment Period I were arranged in alphabetical order by students' last names and separated according to Experiment Groups. These "Question Sheets" were identified as the Achievement Post-test. The "Question Sheets" from Experiment Period II were prepared by the same means and identified as the Retention Post-test. Those "Question

Sheets" not belonging to Selected Participants were removed from both the Achievement and the Retention Post-tests.

Each Experiment Group had its own answer sheet. Correct answers were determined by what was presented in the assigned reading material, not by what was scientifically correct. No changes were made in the answer sheets between the Achievement Post-test and the Retention Post-test.

Each question had a value of one point and the maximum possible score was thirteen. When all of both tests were corrected, both scores were then recorded on each student's data card.

The student data cards were sorted according to Experiment Groups and sex, and were arranged according to reading achievement. The cards were then laid out so that those cards of the Selected Participants, matched between Experiment Groups, were next to each other. The cards belonging to Selected Participants who were absent from Experiment Period I and the cards of their matched Selected Participants were removed. The scores from the Achievement Post-test were punched into the remaining data cards.

The data cards with the Achievement Post-test scores program punched were again sorted and arranged as before. The three cards of matched Selected Participants were removed where there was one or more absences from Experiment Period II. The scores of the Retention Post-test were punched into the remaining cards.

This processing made it possible to eliminate absent Selected Participants, and their matched partners, while arranging the other Selected Participants by their test scores for data analysis. No master-sheet of scores and frequencies was necessary, since the data cards could be sorted and arranged by any criteria desired for data analysis.

IV. ANALYSIS OF DATA

Analysis of data was based on comparisons of the mean scores between the several groups. The significance of the differences was measured by the t-test for independent means. The formulas used were the following presented by Gage.[1]

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\Sigma x_1^2}{k_1(k_1-1)} + \frac{\Sigma x_2^2}{k_2(k_2-1)}}} \qquad \Sigma x^2 = \Sigma X^2 - \frac{(\Sigma X)^2}{k}$$

The .05 level of significance was selected as necessary for data to be presented as bases for conclusions. The .25 level of significance was chosen as the selective criteria for data used in the presentation of problems for further study. For the reader's interest, tables were prepared showing differences of means in all comparisons that were made and the levels of significance for each (Chapter V).

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[1]Dr. Gerald Gage, presented in class lecture, Introduction to Graduate Study, October, 1963.

Experiment control. All morning groups started experiment activities at the same time as did the afternoon groups. As a measure of experiment control, mean scores were compared between several of the morning and afternoon participants in the three Experiment Groups. Participants were matched between morning and afternoon classes by sex, reading achievement, and Experiment Group membership. Those participants who could not be matched were not included in this comparison. This procedure was to eliminate influences upon differences of means due to the ability grouping of students. The groups were identified as Experiment Control Group 'A' (morning) and Experiment Control Group 'P' (afternoon). The difference of mean scores of the two groups was computed and interpreted for conclusions regarding influence of student communication and daily fatigue upon test results.

Educational comic influence upon content achievement. The mean of the Achievement Post-test scores was found for each of the experimental groups. The means of the experimental groups were then compared for difference. The differences were then interpreted in terms of .05 level of significance for conclusions regarding influence of the educational comic upon content achievement.

Educational comic influence upon content retention. The mean of the Retention Post-test scores was found for each of the

experimental groups. The mean scores of the experimental groups were then compared for differences. The differences were then interpreted in terms of .05 level of significance for conclusions regarding influence of the educational comic upon content retention.

Relationship of reading achievement and educational comic influence. Reading achievement scores (from the California Achievement Test) of the selected participants were converted to stanine scores based upon the distribution of the whole experimental population (7:228-229). Each of the three experimental groups (T, C, TC) were divided into three levels of reading achievement. Each level of reading achievement contained three consecutive stanines. The cut-off points between the levels, in terms of grade-level reading ability, were 8.4 and 11.2. Comparisons of the achievement and the retention means of the three experimental groups were made, as in the two above designs, within each reading achievement level. The significant differences of means between the experimental groups in each reading achievement level were then compared with the similar and significant differences of means found in the other levels. From these comparisons, conclusions were made regarding influence of the educational comic upon content achievement and content retention as related to reading ability.

Relationship of sex differences and educational comic influences. Each of the three experimental groups (T, C, TC) was divided into sex sub-groups: male and female. The mean of the Achievement Post-test scores of the boys was computed in each experimental group. These means were then compared for significant differences between the experimental groups. These procedures were repeated with the female sub-groups. The significant differences of means of the experimental groups among the males were compared to the similar and significant differences among the females. From these comparisons, conclusions were made regarding influence of the educational comic upon content achievement as related to sex differences. All above procedures were repeated with the Retention Post-test scores. From the final comparisons, conclusions were drawn regarding the educational comic's influence upon content retention as related to sex differences.

Data for consideration of future study. The designs in number three and number four were combined for the purpose of organizing data for consideration of future related studies. The male and female sub-groups were divided into the three levels of reading achievement. The mean achievement score of the male sub-group was computed for each experimental group within each level of reading achievement. Differences between mean scores of the experimental group's males were found in each level. The mean scores and their

differences were recorded with the levels of significance of the differences and the degrees of freedom in the table, in Appendix C. These procedures were repeated with the female sub-groups and then with the retention data. From these tables, problems may be developed for future study.

CHAPTER V

RESULTS AND CONCLUSIONS

All discussion of results in this chapter is presented together with the pertinent table. Each table includes the Mean scores of the three Experiment Groups, the differences of the Mean scores, the levels of significance of the differences, and the degrees of freedom. Titles of the tables identify the measurement (achievement or retention) and the selective criteria (total Experiment Group, sub-group, or level of reading achievement).

The Mean score of Experiment Group 'T' is listed twice to aid in showing the 'T' to 'C' and 'TC' to 'T' comparisons. Levels of significance were obtained from tables presented by Lillian Cohen (14), H. E. Garrett (22), Franklin Graybill (23), Paul Hoel (25), E. F. Lindquist (29), and Bernard Ostle (36).

The summary will review the major points of the discussions of the results and relate these to the problems presented in the discussion of a final conclusion in terms of the original hypothesis.

From the limitations and discussions of the results, Several questions and suggestions for further study will be presented.

These will be concerned with the original hypothesis, and serve to alleviate the limitations encountered with this specific experiment.

I. RESULTS AND DISCUSSION

Educational comic influence upon achievement

The data presented in Table II was used to determine if the Educational Comic influenced subject-matter achievement. Mean scores were computed from the test scores of all the Selected Participants within each Experiment Group. The mean score of Experiment Group 'TC' was the highest at 7.96, Experiment Group 'T', with a mean score of 7.85, was .11 lower. Experiment Group 'C' had a mean score of 7.53. This was .43 less than the 'TC' mean score and .32 less than the 'T' mean score. None of the differences of means was statistically significant to make tenable conclusions that there was influence of subject-matter achievement by the Educational Comic.

TABLE II

EXPERIMENT GROUP DIFFERENCES OF MEANS OF ACHIEVEMENT

Experiment Groups:	T	C	TC	T
Means	7.85	7.53	7.96	7.85
Differences		.32	.43	.11
Levels of Significance		.50	.30	.80

(df = 142)

From the data, the following questions occur: Is the lower 'C' mean score a result of more familiarity with textbook study-reading rather than comic study-reading? Is the lower 'C' mean score a result of the large amount of subject-matter and reading content read by the students, but not included in the experiment?

Educational comic influence upon retention

Table III contains the data used for measuring the influence of the educational comic upon subject-matter retention. Mean scores were computed from the Retention Post-test scores of the complete membership within each Experiment Group. Experiment Group 'T' had the highest mean score of 6.18; Experiment Group 'C' was second highest with a mean score of 5.61; and Experiment Group 'TC' had a mean score of 5.45. Differences of means were: (1) T to C, .57; (2) C to TC, .16; and (3) TC to T, .73. None of the differences was statistically significant to form conclusions regarding the educational comic's influence upon subject-matter retention.

The data does present a question for further research: Are the theories of using supplementary materials for reinforcement of subject-matter learning valid, especially under the conditions of this experiment?

Comparing the mean scores of achievement and retention, Experiment Group 'TC' had the greatest performance loss, 2.51;

Experiment Group 'C' was second with a loss of 1.92; and 'T' had a loss of 1.67. This further emphasizes the question of the retention value of the Educational Comic, presented earlier. Two additional and similar questions, related to this particular experiment, may be asked: (1) Is the greater loss in group 'TC' a result of extraneous subject-matter exposure (this group read the greatest amount of material not included in the measurement techniques)? (2) Are the large performance losses a result of the comic format or a result of lack of study-reading experience with the comic format?

TABLE III

EXPERIMENT GROUP DIFFERENCES OF MEANS OF RETENTION

Experiment Groups:	T	C	TC	T
Means	6.18	5.61	5.45	6.18
Differences		.57	.16	.73
Levels of Significance (df = 100)		.30	.75	.20

Relationship of reading achievement and educational comic influence

Subject-matter achievement. To determine if reading achievement affected the educational comic's influence upon subject-matter achievement and retention, Tables IV through X were prepared. Table IV contains subject-matter achievement data of the three Experiment

Groups within the top reading achievement level. Experiment Group 'TC' had a mean score of 9.95 and Experiment Groups 'T' and 'C' had mean scores 9.47. The difference of means was .48, not statistically significant to draw conclusions.

TABLE IV

EXPERIMENT GROUP DIFFERENCES OF MEANS OF ACHIEVEMENT WITHIN THE TOP READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means	9.47	9.47	9.95	9.47
Differences		0	.48	.48
Levels of Significance (df = 36)			.50	.50

Data from the Achievement Post-Test within the middle reading achievement level is presented in Table V.

TABLE V

EXPERIMENT GROUP DIFFERENCES OF MEANS OF ACHIEVEMENT WITHIN THE MIDDLE READING ACHIEVEMENT LEVEL

Experiment Groups	T	C	TC	T
Means	8.08	7.25	7.64	8.08
Differences		.83	.39	.44
Levels of Significance (df = 70)		.20	.50	.50

Experiment Group 'T' had the highest mean of 8.08, the 'TC' mean score was 7.64, and the 'C' mean score was 7.25. None of the differences of means (T - C, .83; C - TC, .39; TC - T, .44) was statistically significant for formation of conclusions.

Table VI contains data obtained from the comparison between Experiment Groups of achievement mean scores within the bottom reading achievement level. Experiment Group 'TC' had a mean score of 6.41, Experiment Group 'C' had 5.94, and Experiment Group 'T' had 5.53. Differences of means were: T - C, .41; C - TC, .47; and TC - T, .88. From previous research, cited in Chapter II, these differences were anticipated; however, none of the differences were statistically significant to draw conclusions.

TABLE VI

EXPERIMENT GROUP DIFFERENCES OF MEANS OF ACHIEVEMENT WITHIN THE BOTTOM READING ACHIEVEMENT LEVEL

Experiment Groups	T	C	TC	T
Means	5.53	5.94	6.41	5.53
Differences		.41	.47	.88
Levels of Significance		.60	.50	.30

(df = 32)

Upon comparing the three achievement data tables, IV, V, and VI, three observations can be made. There was no overlapping

of mean scores between reading achievement levels. Experiment Group 'TC' had the highest mean score except in the middle reading achievement level. Experiment Group 'C' did as well as 'T' except in the middle reading achievement level. This may be an indication that the educational comic has a detrimental effect upon the average reader, both as a basic and as supplementary material. The question to consider is: Is the middle reading-achievement reader more capable of understanding the text than the bottom-level reader and less capable of adapting to the educational comic than the top-level reader? Thus, there is no reliance by the student upon the educational comic or any reinforcement of text presentation by the educational comic.

Subject-matter retention. Table VII contains data from the comparisons of retention mean scores within the top reading achievement level. Experiment Group 'T' had a mean of 7.82, Experiment

TABLE VII

EXPERIMENT GROUP DIFFERENCES OF MEANS OF RETENTION WITHIN THE TOP READING ACHIEVEMENT LEVEL

Experiment Group	T	C	TC	T
Means	7.82	6.76	7.06	7.82
Differences		1.06	.30	.76
Levels of Significance (df = 32)		.30	.75	.40

Group 'TC' had a 7.06 mean, and Experiment Group 'C' had a mean of 6.76. None of the differences (T - C, 1.06; C - TC, .30; and TC - T, .76) were sufficiently significant for formation of conclusions.

Data for measuring the educational comic's influence upon subject-matter retention, within the middle reading achievement level, is presented in Table VIII. Mean score of Experiment Group 'T' was 5.84; 5.48 for 'C'; and 4.80 for 'TC'. Differences between means were: 'T' to 'C', .36; 'C' to 'TC', .68; and 'TC' to 'T', 1.04. None of the differences were significant for formation of conclusions.

TABLE VIII

EXPERIMENT GROUP DIFFERENCES OF MEANS OF RETENTION WITHIN THE MIDDLE READING ACHIEVEMENT LEVEL

Experiment Groups	T	C	TC	T
Means	5.84	5.48	4.80	5.84
Differences		.36	.68	1.04
Levels of Significance (df = 48)		.60	.25	.20

Table IX includes the data from the Retention Post-test measurements, within the bottom reading achievement level. The 'TC' mean score was 4.22, the 'T' mean score was 4.00, and the 'C' mean score was 3.78. None of the differences was statistically significant for formation of conclusions.

TABLE IX

EXPERIMENT GROUP DIFFERENCES OF MEANS OF RETENTION WITHIN THE BOTTOM READING ACHIEVEMENT LEVEL

Experiment Groups	T	C	TC	T
Means	4.00	3.78	4.22	4.00
Differences		.22	.44	.22
Levels of Significance (df = 16)		.90	.75	.90

Three observations are drawn from the three retention data tables, VII, VIII, and IX. There is no overlapping of mean scores between the reading achievement levels. Experiment Group 'T' scored higher means in all three levels of reading achievement than did Experiment Group 'C'. Group 'TC' had higher means than Group 'C', except in the middle level. These observations seem to indicate that: (1) the text may be more effective than the comic in assuring high retention performance, (2) the educational comic may be more effective as supplementary material, and (3) any use of the comic is less effective with the middle reading achievement level reader. Two questions can be raised: Is the comic less effective for retention or is this a result of the comic having the greater amount of material and content not measured? Is the middle reading achievement level most susceptible to this subject-matter congestion because

of possible differences from the other levels as suggested in previous questions regarding achievement?

Performance loss. A final discussion in this area concerns performance loss. The differences between achievement and retention scores of each Experiment Group, within each reading achievement level, were found and recorded in Table X, page 69. Experiment Group 'TC' had the greatest difference in all three levels. 'T' had the least loss in the top and bottom levels. In the middle level, Experiment Group 'C' had the least performance loss. Comparing the least lost scores of the three levels, the 'C' loss in the middle level was most. Except for the 'T' performance loss, the bottom reading achievement level had the least performance losses.

The first observation may reinforce the previous stated question: Does the use of both materials, causing congestion of non-tested subject-matter have detrimental effect at all levels? The second observation may be in contrast to previous observations regarding the middle level, 'C' Experiment Group. However, this apparent small loss may be larger in proportion to original achievement performance. This consideration of proportionate performance loss also applies to the final observation regarding the whole bottom level of reading achievement.

TABLE X

ACHIEVEMENT-RETENTION PERFORMANCE LOSS OF THE THREE EXPERIMENT GROUPS WITHIN THE THREE READING ACHIEVEMENT LEVELS

Reading Achievement Level	Experiment Group	Performance Loss
Top	T	1.65
	C	2.71
	TC	2.89
Middle	C	1.77
	T	2.24
	TC	2.84
Bottom	T	1.75
	C	2.16
	TC	2.19

Relationship of sex differences and educational comic influence

Subject-matter achievement. Achievement mean scores within the male sub-groups are recorded in Table XI. Sub-group 'TC'

TABLE XI

EXPERIMENT GROUP DIFFERENCES OF MEANS OF ACHIEVEMENT AMONG THE MALE SUB-GROUPS

Experiment Groups	T	C	TC	T
Means	8.25	8.28	8.44	8.25
Differences		.03	.16	.19
Levels of Significance		.975	.80	.75

(df = 70)

had a mean of 8.44; sub-group 'C' had a mean of 8.28; and sub-group 'T' had a mean of 8.25. Differences of means were: (1) 'T' to C, .03; (2) 'C' to 'TC', .16; and (3) 'TC' to 'T', .19. No tenable conclusions could be drawn from the data.

Achievement mean scores of female sub-groups in Table XII are 7.47 for 'TC'; 7.44 for 'T'; and 6.78 for 'C'. Differences of means were: (1) T - C, .66; (2) C - TC, .69; and (3) TC - T, .03. Conclusions regarding influence of the educational comic upon achievement among the females could not be formed. The differences were felt significant to indicate that the educational comic may have detrimental effect for girls when used alone and minimal reinforcement effect when used with the text.

TABLE XII

EXPERIMENT GROUP DIFFERENCES OF MEANS OF ACHIEVEMENT AMONG THE FEMALE SUB-GROUPS

Experiment Groups	T	C	TC	T
Means	7.44	6.78	7.47	7.44
Differences		.66	.69	.03
Levels of Significance (df = 70)		.30	.25	.975

The differences between the female sub-groups had greater significance than those of the male sub-groups, except in the case of

the female 'TC' to 'T' comparison. All male mean scores were higher than any of the female mean scores. The latter contrast may be related to two sex-difference factors: (1) science interest and sex-differences, and (2) comic popularity and sex-differences. The question for further study here is: Does the comic have equal educational achievement values for the boys as does the text, and at the same time detrimental achievement value for the girls?

Subject-matter retention. Retention mean score data of the male sub-groups is in Table XIII. Group 'T' had a mean of 7.33; Experiment Group 'C' had 6.75; and the Experiment Group 'TC' had 5.71. The difference of the 'T' to 'C' comparison was .58 and the 'C' to 'TC' comparison was 1.04. The difference of 1.62 between 'T' and 'TC' was the only statistically significant difference found in the whole study. This comparison, with the identical comparison within the middle reading achievement level (Table V:6), appears to dominate the same retention comparison of the complete Experiment Groups in Table V:2. This difference is statistically significant to conclude that the use of the text is more educationally valid than the use of the text and educational comic, together, when considering retention among males. Although not statistically significant for conclusions, the C - TC difference is significant to indicate the same trend as the T - TC comparison. This again presents the question: Does the supplemental

TABLE XIII

EXPERIMENT GROUP DIFFERENCES OF MEANS OF RETENTION AMONG THE MALE SUB-GROUPS

Experiment Groups	T	C	TC	T
Means	7.33	6.75	5.71	7.33
Differences		.58	1.04	1.62
Levels of Significance (df = 46)		.50	.20	.02

use of the Educational Comic cause subject-matter congestion (among males in this case) that is detrimental to retention performance?

The mean scores of retention among the female sub-groups show no significant differences in Table XIV for the formation of conclusions. The 'TC' mean was 5.22, 'T' mean was 5.15, and 'C' mean was 4.59. Differences of means were: (1) T - C, .56; (2) C - TC, .63; and (3) TC - T, .07.

TABLE XIV

EXPERIMENT GROUP DIFFERENCES OF MEANS OF RETENTION AMONG THE FEMALE SUB-GROUPS

Experiment Groups	T	C	TC	T
Means	5.15	4.59	5.22	5.15
Differences		.56	.63	.07
Levels of Significance (df = 52)		.40	.40	.95

Comparison of retention data between the male and female sub-groups presents the following: (1) all of the male retention scores are higher than the female retention scores, (2) Groups 'T' and 'C' have the same relative positions in the male and female sub-grouping, and (3) the females are not similarly affected by the use of both materials as are the boys. The significances of these differences have not been measured; however, there is indication to present the question: Does the educational comic have less educational value than the text for girls and less value for girls than for boys?

Performance loss. Performance loss of the sex sub-groups is presented in Table XV. Experiment Groups 'C' and 'T' maintained their relative positions of loss, between the sex sub-groups. The position of 'T', as least loss in the males and greatest loss in the females may appear to contradict previous data. However, the problem of performance loss in proportion to original achievement is involved and the data is apt to be misleading. All three Experiment Groups, in the females, had a large performance loss. This could be related to the subject-matter and sex-differences related to subject-interest. The question then proposed: Would similar reading material with subject-matter other than science provide different results, in regard to sex differences?

TABLE XV

ACHIEVEMENT-RETENTION PERFORMANCE LOSS

OF THE THREE EXPERIMENT GROUPS

WITHIN THE SEX SUB-GROUPS

Sex Sub-groups	Experiment Groups	Performance Loss
Male	T	.92
	C	1.53
	TC	2.73
Female	C	2.19
	TC	2.25
	T	2.29

Summary of discussion. Only one specific conclusion could be drawn in this chapter: Among the males, the textbook had greater retention value than the textbook-educational comic combination. None of the other measured differences were statistically significant to form tenable conclusions.

A large number of the comparisons presented have had similar differences, although not statistically significant. These differences could be interpreted as indications of possible trends that should be studied further. The use of the text and educational comic appeared to have the most productive influence upon achievement; however, the data also hints this combination may have negative

influence upon retention. This may be an effect of the large proportion of subject-matter in both reading materials that was not in the measurements. The use of the text, only, may best assure subject-matter retention. Since the text had the least amount of extraneous subject-matter, this may be another aspect of the trend described previously.

The students in the middle level of reading achievement may be detrimentally affected by the educational comic in both achievement and retention. This may be due to differences of the students from those within the top and bottom reading achievement levels. The top reading achievement level may receive a very slight amount of help from the educational comic. The greatest help from the comic may be with the below average reader.

There was some indication that the educational comic may have had negative influence for the girls. This could also be related to sex differences as related to subject-matter interests.

II. HYPOTHESIS AND CONCLUSION

The hypothesis tested in this study was: There is no significant difference in subject-matter achievement among groups of students who use educational comics, basic textbooks, or both.

From the results of this study, the experimentor does not reject the hypothesis. The limitations of the experiment and the apparent trends in the data cause the experimentor to not extend the

conclusion beyond this particular study.

III. RECOMMENDATIONS AND PROBLEMS FOR FURTHER STUDY

From the data obtained and the conclusion drawn, no recommendations could be presented in regards to using the educational comic in the classroom and justification of industry's investment in the comic format.

The data from this experiment has exposed several problems that indicate a need for further study and a need for modifications if this study is to be continued or studies of similar nature conducted.

1. The experiment needs a larger population for the breakdowns into sub-groups. This could be done by repeating the experiment and combining the data from the two studies.

2. A more typical Sample Population is needed. Several Sample Populations could be developed within the lower levels of reading achievement, making the distribution more typical.

3. The population should be extended, that is, repeat the study in other grades.

4. The amount of extraneous subject-matter (not measured) should be reduced and the amount of common subject-matter (in both materials) increased. This could be done by two methods: (1) Copy the content from the educational comic into text format or (2) Remove

the content from the balloons in the comic and insert the content from the text sample.

5. The reading load should be equalized between Experiment Groups 'T' and 'C'; this does not include vocabulary.

6. Different subject-matter should be used to better measure influence of sex differences.

7. The elements of the educational comic that may have detrimental effect should be controlled and measured. This includes paper, type-font, type-case, color, etc.

8. There is a need for study of sex differences within the levels of reading achievement and their composite influence upon the educational comic's influence.

SUMMARY

The purpose of this study was to determine (1) if the educational comic influenced subject-matter achievement and retention and (2) if there was influence, to determine if it was related to sex or reading achievement differences. It was hoped that from the conclusions of this study recommendations could be made regarding the use of the educational comic in the classroom and industry's investment in this medium.

Two-hundred-sixteen eighth graders were separated into three groups matched by sex and reading achievement. One group read

an educational comic sample, another read a portion of a science textbook sample, and the third group read both. After the students had finished reading they were given an achievement test, which was followed by a retention test five weeks later. The three groups were compared by their mean scores from both tests.

No statistically significant differences were obtained from the data, except in one instance: the textbook had more retention value than the textbook-educational comic combination among the males. There were some trends to indicate that the greatest help from the educational comic may be with the below average readers, the above average readers may receive very slight help, and there may be a detrimental effect upon average readers from the educational comic. Also, girls may receive no benefit from the use of the educational comic.

No recommendations could be presented regarding classroom use of the educational comic nor investment in the educational comic by industry. The experimentor recommends that the study be repeated with several modifications: (1) increase the population, thus increase the number of cases in the various sub-group breakdowns, (2) make the Sample Population more representative, (3) control the materials to decrease the differences in content and increase the identical content, and (4) determine if one or more of the elements of the educational comic may have detrimental effect upon the whole comic's influence.

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APPENDIXES

APPENDIX A

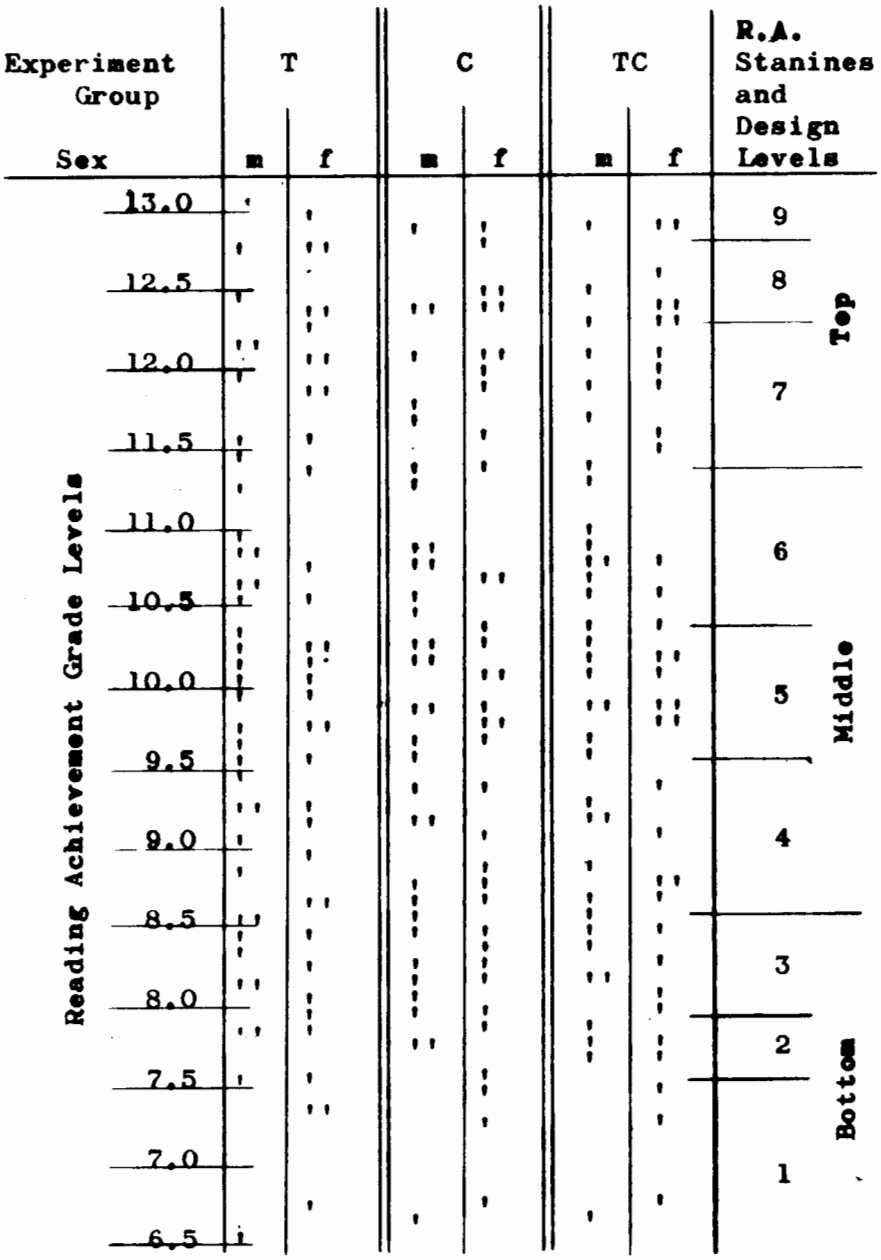

FIGURE 1

EXPERIMENT DESIGN WITH READING ACHIEVEMENT DISTRIBUTIONS OF THE SAMPLE POPULATION IN THE EXPERIMENT GROUPS

APPENDIX A (continued)

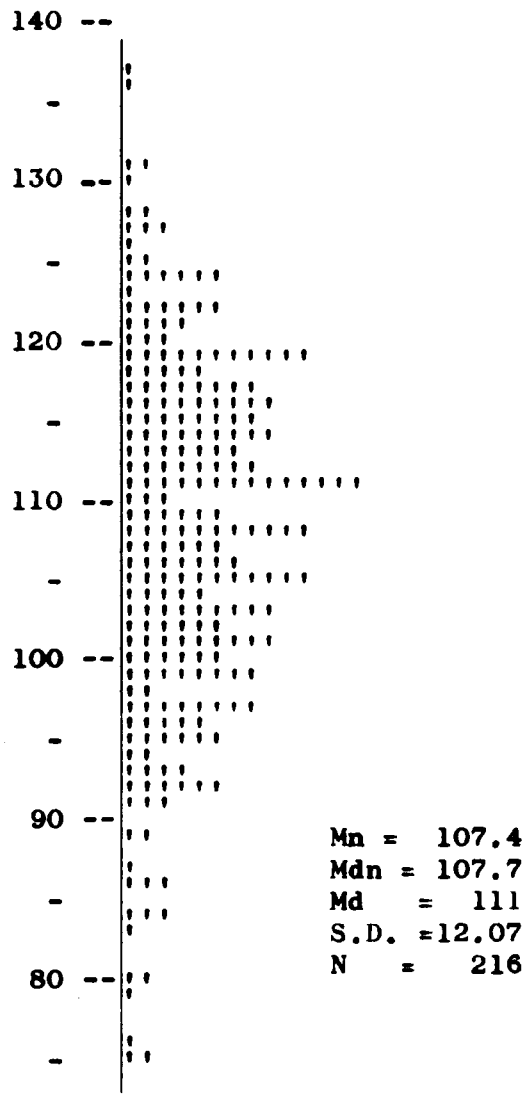

FIGURE 2

DISTRIBUTION OF INTELLIGENCE SCORES OF THE SAMPLE POPULATION

APPENDIX A (continued)

TABLE XVI

DISTRIBUTION CHARACTERISTICS OF ACHIEVEMENT AND RETENTION POST-TEST SCORES OF THE EXPERIMENT GROUPS

	ACHIEVEMENT			RETENTION		
Experiment Group	T	C	TC	T	C	TC
Mn	7.85	7.53	7.96	6.18	5.61	5.41
Mdn	8.05	7.41	7.93	5.75	4.88	5.19
Md	9.00	8.00	8.00	4.00	4&5	4.00
S.D.	2.63	2.33	2.52	2.71	2.56	2.27
R	1-13	3-12	3-13	2-12	1-12	1-11
f	72	72	72	51	51	51


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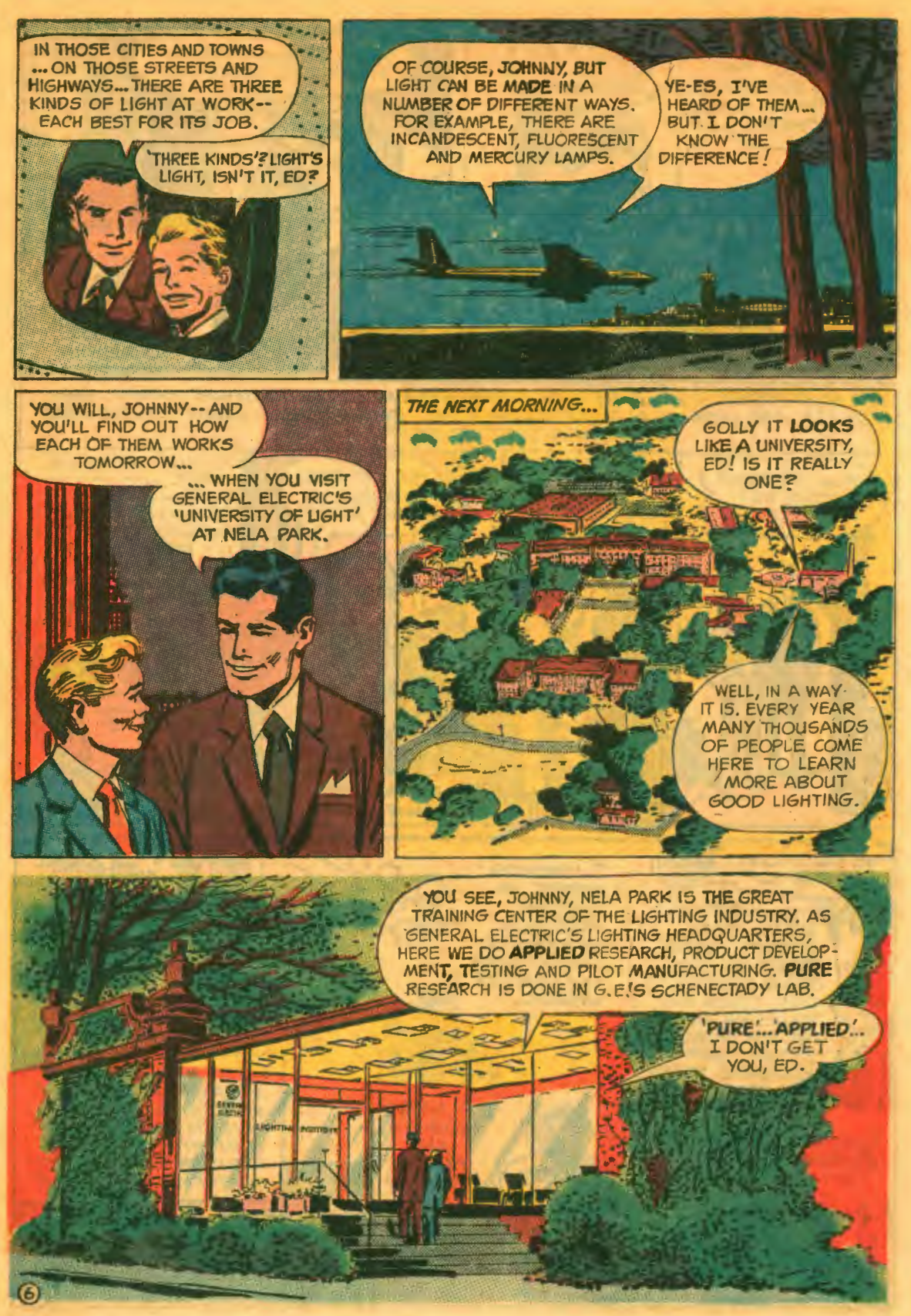
WITH FIRE, MANKIND FOUND WARMTH...
AND USED IT FOR PROTECTION, TOO!
... AND LIGHT!...
IT WASN'T UNTIL CENTURIES LATER, MAN LEARNED TO FLOAT A WICK IN OIL... AND FOUND A BETTER LIGHT.
MORE CENTURIES PASSED BEFORE HE LEARNED TO PUT A WICK IN HARD TALLOW. HIS CANDLE WAS AN EVEN BETTER LIGHT.
THEN CAME THE GAS FLAME, STILL WEAK AND FLICKERING. AND THEN...
CANDLES AND IMPROVED VERSIONS OF THE "FLOATING WICK" LIGHTED THE WORLD FOR CENTURIES.
2


...LESS THAN A HUNDRED YEARS AGO, THE ELECTRIC LIGHT WAS BORN... AND THE WHOLE AGE OF ELECTRICITY BEGAN!
THAT'S THE STORY OF LIGHT, JOHNNY... UP TO A POINT!
SURE, I'VE LEARNED SOME OF THAT IN SCHOOL. BUT I STILL DON'T KNOW EXACTLY HOW ELECTRIC LIGHT WORKS... OR WHY!
WELL, LET'S START WITH THE **INCANDESCENT** BULB... THAT MEANS 'GLOWING WITH INTENSE HEAT.'
FIRST, RUB YOUR FINGER RAPIDLY ON YOUR SLEEVE. THE HEAT YOU FEEL IS CAUSED BY **FRICTION**.
SURE, ED.
AS YOU KNOW, FRICTION CAUSES HEAT... AND MANY MATERIALS, WHEN THEY ARE MADE HOT ENOUGH, WILL GLOW WITH LIGHT. A BLACKSMITH'S FORGE IS A GOOD EXAMPLE...
AH, THE SWORD GLOWS BRIGHTLY ENOUGH TO BE READY FOR THE HAMMER.
NOW, AN ELECTRIC CURRENT IS BASICALLY A STREAM OF ELECTRONS MOVING THROUGH A WIRE... LIKE A GROUP OF PEOPLE MOVING COMFORTABLY THROUGH A BROAD HALLWAY.
IF YOU MAKE THE WIRE MUCH THINNER... LIKE MAKING THE HALLWAY MUCH NARROWER... YOU CROWD THE ELECTRONS, AND CAUSE MORE **FRICTION**. THE FRICTION CAUSES HEAT... AND ENOUGH HEAT CAUSES THE THIN WIRE TO GLOW WITH LIGHT!
3


EARLY SCIENTISTS EXPERIMENTED WITH THIS PRINCIPLE. EDISON STUDIED THEIR WORK...
IN 1802, SIR HUMPHREY DAVY FORCED A GREAT AMOUNT OF ELECTRICITY THROUGH A THIN STRIP OF METAL... AND MADE IT GLOW BRIEFLY BEFORE IT MELTED.
AND THEN TOM EDISON, WITH A GREAT MANY INVENTIONS TO HIS CREDIT, FELT HE HAD FOUND THE ANSWER.
IN 1820, DE LA RUE RAN A CURRENT THROUGH A THICK PLATINUM WIRE IN A GLASS TUBE... AND MADE IT GLOW A BIT MORE BRIGHTLY, BUT IT ALSO MELTED.
IN 1840, SIR WILLIAM GROVE TRIED A THICK COIL OF WIRE UNDER A WATER GLASS... WITH THE SAME RESULTS.
AND IN THE MID-1870'S THE WORK BEGAN...
THE METALS THOSE FELLOWS USED MELT TOO FAST. NOW, PERHAPS A THIN, CARBONIZED FILAMENT... LIKE ONE OF YOUR HAIRS--
IMAGINE A HAIR... EVEN A RED ONE LIKE MINE... GLOWING!
BUT SOON...
BY GOLLY, MR. EDISON, IT DID GLOW FOR A MOMENT! BUT WHY?
BAKED IT IN AN OVEN UNTIL IT TURNED TO CARBON. BUT WE MUST TRY OTHER MATERIALS TO MAKE A STRONGER FILAMENT.
EDISON TRIED LITERALLY HUNDREDS OF THINGS...
THIS FAN HAS A BAMBOO BINDING. LET'S TRY THAT...
PERHAPS THIS PIECE OF PHILIPPINE HEMP...
NOW WHAT DO YOU THINK YOU'RE DOING?
WHAT ARE YOU LOOKING FOR, TOM?
JUST WANT TO BORROW A PIECE OF THREAD.
4

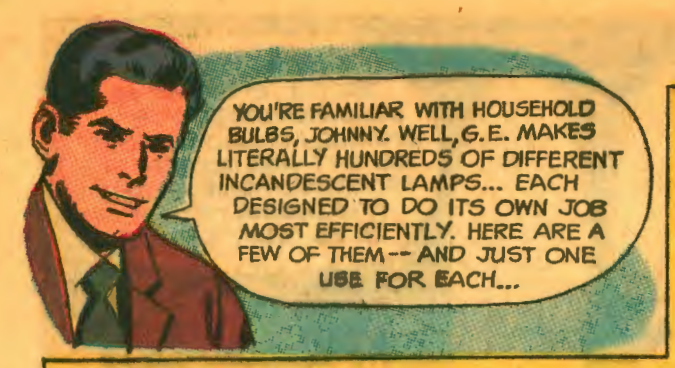

THAT LASTED A BIT LONGER, BUT THE THREAD BURNED, TOO ...EVEN THOUGH IT WAS CARBONIZED.
AH, BUT IF WE PUT IT IN A VACUUM!...
WHY A VACUUM? WHAT'S THAT GOT TO DO WITH IT?
IN ORDER FOR ANYTHING TO BURN, IT MUST HAVE OXYGEN. NO OXYGEN... NO BURNING.
AND SO IT PROVED TO BE. A PIECE OF THREAD FROM MRS. EDISON'S SEWING BASKET... CARBONIZED, AND GLOWING IN A PARTIAL VACUUM... BECAME THE FILAMENT FOR THE FIRST SUCCESSFUL ELECTRIC LIGHT!
WELL, IT'S BRIGHT ENOUGH! BUT WILL IT LAST?...
12 HOURS LATER...
THE VACUUM HELPS THE CARBONIZED THREAD HOLD UP WELL, MR. EDISON!
WE MAY HAVE IT, JOHN... WE JUST MAY!
AND THE HOURS BECAME A DAY...
FINALLY... 40 HOURS LATER...
CARBONIZED THREAD IN A VACUUM IS THE ANSWER, MR. EDISON. IT'S BEEN BURNING 40 HOURS!
IF IT BURNS FOR 40, I CAN MAKE IT LAST 100!
SO THAT'S HOW IT ALL STARTED!
YES, BUT IT WAS ONLY A START, JOHNNY. TO MAKE PRACTICAL USE OF THE ELECTRIC LIGHT, EDISON HAD TO DESIGN AN ENTIRE ELECTRICAL SYSTEM. OVER THE FOLLOWING YEARS CAME...
"...A PARALLEL CIRCUIT, SO THAT ONE BULB COULD BE TURNED ON AND OFF WITHOUT AFFECTING OTHERS..."
"...BIG GENERATORS, LATER NICKNAMED 'LONG WAISTED MARY ANNS' POWERFUL ENOUGH TO LIGHT HUNDREDS OF BULBS..."
"...METERS, TO MEASURE CURRENT USED BY EACH CUSTOMER..."
"...FUSES, TO PROTECT AGAINST OVERLOADS..."
"...MATED SOCKETS AND BULBS, TO ALLOW FOR QUICK, EASY CHANGES..."
"NEEDS LIKE THESE DEMANDED A WHOLE NEW INDUSTRY. SO THE EDISON GENERAL ELECTRIC COMPANY WAS FORMED. AND, IN 1892, IT BECAME THE GENERAL ELECTRIC COMPANY."
5


IN THOSE CITIES AND TOWNS ...ON THOSE STREETS AND HIGHWAYS...THERE ARE THREE KINDS OF LIGHT AT WORK-- EACH BEST FOR ITS JOB.
'THREE KINDS'? LIGHT'S LIGHT, ISN'T IT, ED?
OF COURSE, JOHNNY, BUT LIGHT CAN BE MADE IN A NUMBER OF DIFFERENT WAYS. FOR EXAMPLE, THERE ARE INCANDESCENT, FLUORESCENT AND MERCURY LAMPS.
YE-ES, I'VE HEARD OF THEM... BUT I DON'T KNOW THE DIFFERENCE!
YOU WILL, JOHNNY-- AND YOU'LL FIND OUT HOW EACH OF THEM WORKS TOMORROW...
... WHEN YOU VISIT GENERAL ELECTRIC'S 'UNIVERSITY OF LIGHT' AT NELA PARK.
THE NEXT MORNING...
GOLLY IT LOOKS LIKE A UNIVERSITY, ED! IS IT REALLY ONE?
WELL, IN A WAY IT IS. EVERY YEAR MANY THOUSANDS OF PEOPLE COME HERE TO LEARN MORE ABOUT GOOD LIGHTING.
YOU SEE, JOHNNY, NELA PARK IS THE GREAT TRAINING CENTER OF THE LIGHTING INDUSTRY. AS GENERAL ELECTRIC'S LIGHTING HEADQUARTERS, HERE WE DO APPLIED RESEARCH, PRODUCT DEVELOPMENT, TESTING AND PILOT MANUFACTURING. PURE RESEARCH IS DONE IN G.E.'S SCHENECTADY LAB.
'PURE'...'APPLIED'... I DON'T GET YOU, ED.

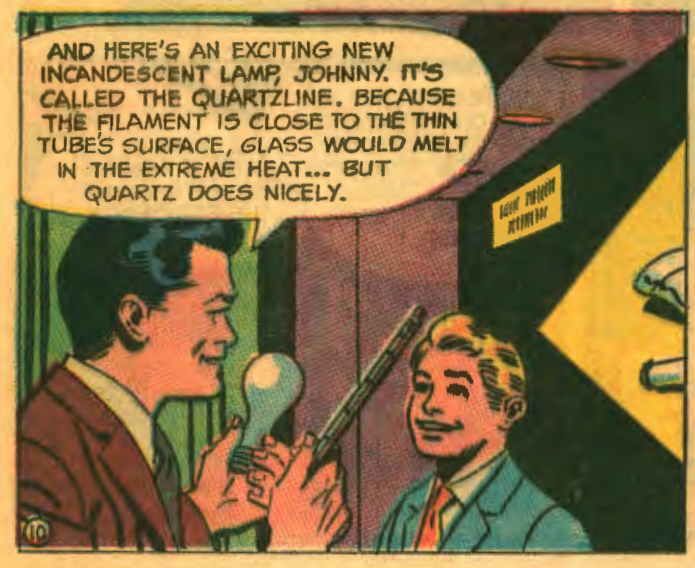

"GOOD QUESTION. WELL... PURE RESEARCH IS LEARNING JUST FOR THE SAKE OF KNOWING."
I WONDER WHAT WILL HAPPEN IF...
APPLIED RESEARCH IS USING THE THINGS WE LEARN.
IF I CAN MAKE IT PRACTICAL, IT WILL HELP THOUSANDS OF PEOPLE.
DO YOU 'GET' ME NOW, JOHNNY?
I THINK SO. BUT, IF EDISON INVENTED THE ELECTRIC LIGHT, WHY DO WE NEED MORE LIGHTING RESEARCH NOW?
C'MON, YOU REALLY KNOW BETTER. WHY, GENERAL ELECTRIC HAS MADE HUNDREDS OF IMPROVEMENTS ON EDISON'S FIRST LAMP. TAKE JUST A FEW EXAMPLES:
"IN 1905, DR. WILLIS WHITNEY DEVELOPED AN IMPROVED HEAT-TREATED FILAMENT, WHICH REDUCED BULB BLACKENING AND INCREASED BRIGHTNESS. IN 1912, DR. WILLIAM COOLIDGE FOUND A WAY TO TURN POWDERED TUNGSTEN INTO DUCTILE TUNGSTEN --A FINE WIRE FILAMENT WHICH WITHSTOOD SHOCK AND VIBRATION.
DR. IRVING LANGMUIR LATER DEVELOPED THE COILED FILAMENT, WHICH ADDED TREMENDOUSLY TO THE BRIGHTNESS. AND DR. LANGMUIR ALSO FOUND OUT THAT ARGON GAS, INSTEAD OF A VACUUM, ADDED GREATLY TO THE LIFE OF THE BULB.
AND THEN... IN RAPID SUCCESSION... CAME THE NON-SAG FILAMENT ... THE TIPLESS BULB ... THE INSIDE-FROSTED BULB ... THE COILED-COIL FILAMENT FOR GREATER LIGHT ... THE VERTICAL FILAMENT FOR EVEN MORE LIGHT ... ALL-WHITE BULB TO AVOID HOT SPOTS ... AND MANY MORE!"
7

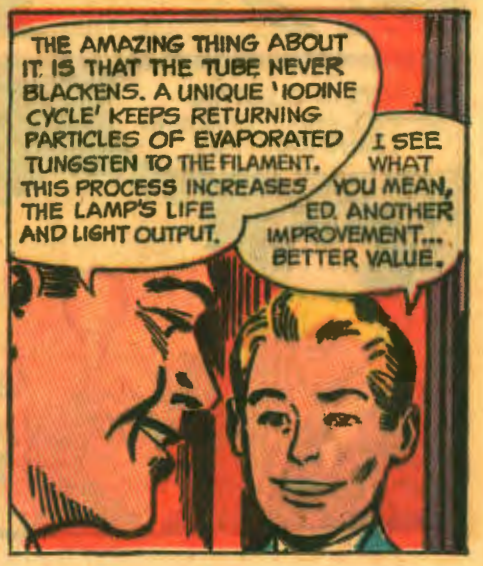

WOW! WHAT A LOT OF WORK FOR JUST A LITTLE "WIRE IN A BOTTLE"!
'WIRE IN A BOTTLE?' IT'S A LOT MORE COMPLICATED THAN THAT. LET'S TAKE A CLOSER LOOK AT A MODERN G-E BULB.
"THE SPECIAL-FORMULA GLASS BULB HAS AN INSIDE ETCHED FROSTING. SOFT WHITE LAMPS ARE COATED INSIDE WITH A SILICA 'SMOKE'...
"THE DOUBLE-COILED FILAMENT WIRE IS ABOUT AS THIN AS A HUMAN HAIR...
"THERE'S A CEMENTED BASE, WITH SOLDERED POSITIVE AND NEGATIVE ELECTRICAL CONNECTIONS...
"LEAD-IN WIRES ARE OF ONE METAL IN THE BULB, A COMBINATION OF METALS IN THE GLASS STEM, AND A THIRD METAL IN THE BASE...
"SUPPORT WIRES ARE PRECISION-MADE, AND PRECISION-SHAPED, TO HOLD THE FILAMENT..."
NOT SO SIMPLE, JOHNNY. BEFORE A TYPICAL G-E 100-WATT LAMP IS SHIPPED, IT'S PUT THROUGH 480 DIFFERENT INSPECTIONS, TESTS AND CHECKS.
OOPS! I APOLOGIZE. I DIDN'T REALIZE--
MOST PEOPLE DON'T. AND THEY DON'T REALIZE THAT WHILE PRICES OF EVERYTHING ELSE HAVE SOARED, THIS TREMENDOUSLY COMPLICATED 100-WATT BULB ACTUALLY COSTS NO MORE THAN IT DID IN 1933! NO MORE THAN AN ORDINARY CLAY FLOWERPOT!
8


AND SINCE ELECTRIC CURRENT MAKES UP 7/8 OF THE COST OF LIGHT, IT'S IMPORTANT THAT WE GET AS MUCH LIGHT AS POSSIBLE OUT OF EACH WATT.
A PHOTOMETER, LIKE THIS ONE, IS THE WAY WE MEASURE LUMENS. FOR EXAMPLE, A G-E INCANDESCENT 100 WATT BULB MOUNTED IN THE CENTER WILL REGISTER 1750 LUMENS OF LIGHT ON THE INSIDE SURFACE.
AND WHAT'S MORE, JOHNNY, HOUSEHOLD BULBS TODAY ARE 12 TIMES MORE EFFICIENT THAN MR. EDISON'S INVENTION. THAT IS, THEY GIVE 12 TIMES AS MANY LUMENS PER WATT!
LUMENS PER WATT? YOU'VE LOST ME FOR GOOD THIS TIME, ED.
WELL, A LUMEN IS SIMPLY THE UNIT USED FOR MEASURING LIGHT. A WATT IS THE UNIT USED FOR MEASURING ELECTRICAL ENERGY. SO, 'LUMENS PER WATT' IS A WAY OF SAYING HOW MUCH LIGHT IS PRODUCED FOR EVERY WATT OF ELECTRIC ENERGY CONSUMED.
A WATT IS ELECTRIC IN-PUT, AND A LUMEN IS LIGHT OUT-PUT.
THINK OF IT THIS WAY --IF YOU FIGURE OUT A WAY TO GET MORE RESULTS FROM LESS EFFORT, YOU'RE WORKING MORE EFFICIENTLY.
I THINK I GET IT. LUMENS PER WATT MEASURES THE EFFICIENCY OF A BULB.
9



"SOFT WHITE LAMPS, FOR COMFORT IN THE HOME ...CLEAR BULBS, FOR BRILLIANT DISPLAY LIGHTING ...COLORED BULBS, FOR ADVERTISING DISPLAY SIGNS ... SPOT-LIGHTS, FOR DRAMATIC EFFECTS ... FLOODLIGHTS, FOR NIGHT SPORTS EVENTS ... PHOTOFLOODS, FOR STUDIO PHOTOGRAPHY. ... PHOTOFLASH, FOR BETTER PICTURES DAY OR NIGHT ... INFRA-RED, FOR HEATING PEOPLE AND INDUSTRIAL HEATING PROCESSES ... MINIATURE LAMPS, FOR FLASH-LIGHTS AND INSTRUMENT PANELS ... PROJECTION LAMPS, FOR MOTION PICTURES ... SEALED-BEAM AUTO HEADLIGHTS, FOR DRIVING AT NIGHT ... AND EVEN CHRISTMAS TREE BULBS, FOR HAPPY HOLIDAYS!"





"QUARTZLINE LAMPS HAVE AN EXCITING APPLICATION. SCIENTISTS ARE USING THEM TO GROW ALGAE FOR FOOD AND OXYGEN IN THE SPACE SHIPS OF THE FUTURE...

"AND THERE'S THE WORLD'S BIGGEST INCANDESCENT BULB... **75,000 WATTS!**

"AT THE OTHER EXTREME THIS TINY 'GRAIN O' WHEAT' BULB FITS RIGHT **INSIDE** SPECIAL INSTRUMENTS FOR DELICATE SURGERY.' AND THAT REMINDS ME --"

I KNOW OF ONE HOSPITAL WHICH USES **70 DIFFERENT TYPES** OF LAMPS!

I GET THE MESSAGE. THERE ARE INCANDESCENT LAMPS FOR **EVERY** PURPOSE.

NOT SO FAST, JOHNNY. REMEMBER I SAID THAT THERE ARE **THREE** MAIN TYPES OF LIGHT SOURCES? ANOTHER IS THE 'MERCURY' LAMP.

'MERCURY?' I'VE HEARD ABOUT MERCURY LAMPS BUT DON'T KNOW HOW THEY OPERATE.

THESE LAMPS OPERATE ON AN ENTIRELY **DIFFERENT** PRINCIPLE. THE ELECTRIC CURRENT, INSTEAD OF CROWDING THROUGH A FILAMENT ACTUALLY **FLOWS THROUGH SPACE!** IT WORKS LIKE THIS...

"THE ENDS OF THE CURRENT-CARRYING WIRE ARE ATTACHED TO 'ELECTRODES AT EITHER END OF A GAS-FILLED TUBE.

ELECTRODES

"THE CURRENT 'BOILS OFF' ELECTRONS FROM ONE END, THE **CATHODE**, AND THEY ARE ATTRACTED TO THE OTHER, THE **ANODE**.

"AS THEY CROSS OVER, THE ELECTRONS SMASH INTO THE MOLECULES OF GAS IN THE BULB. EACH COLLISION CAUSES A BURST OF LIGHT. THERE ARE SO MANY OF THESE FLASHES IN QUICK SUCCESSION THAT THE LIGHT APPEARS TO BE A STEADY GLOW.

"BECAUSE THE ELECTRONS PASS THROUGH A MERCURY VAPOR, THE LAMPS ARE CALLED **'MERCURY LAMPS.'**


IT'S PRETTY HARD TO IMAGINE HOW ALL THOSE SEPARATE FLASHES CAN SEEM LIKE A STEADY GLOW, ED.
THINK OF THE MOVIES, JOHNNY. --AND HOW ALL THOSE SEPARATE PICTURES SEEM TO MERGE INTO SMOOTH ACTION.
UH -- THAT'S RIGHT.-- BUT WHAT ARE THE ADVANTAGES OF MERCURY LAMPS?
WELL, THEY'RE COMPACT, VERSATILE, HIGHLY EFFICIENT, LAST MUCH LONGER THAN MOST INCANDESCENT LAMPS.
SURE, I CAN SEE THAT WOULD BE IMPORTANT IN HARD-TO-GET-TO PLACES.
"RIGHT, JOHNNY. ALTHOUGH THEIR LIGHT IS UNFLATTERING (SORT OF BLUE-GREEN), THEY ENABLE US TO GET HIGH LEVELS OF LIGHT AT LOW COST FOR...
"STREET LIGHTING
...HIGHWAY
LIGHTING
...INDUSTRIAL LIGHTING
..., SHOPPING CENTERS
PARKING
LOTS
...STADIUM LIGHTING
...AIRPORT LIGHTING
...AND THE LIKE.
MERCURY LAMPS WERE INVENTED WAY BACK IN 1901... BUT, SINCE THEN, WE'VE IMPROVED EFFICIENCY FIVE TIMES AND INCREASED THEIR LIFE SIX TIMES!
EFFICIENC
1901 NOW
1901 NOW
JUST THE WAY YOU IMPROVED QUALITY IN INCANDESCENTS! I SEE WHAT YOU MEAN BY "PROGRESS" IS OUR MOST IMPORTANT PRODUCT.
AND HERE'S A POWERFUL NEW ARC LAMP WHICH OPERATES IN A SIMILAR MANNER. FILLED WITH A VERY RARE GAS, XENON, ITS ARC MAKES A TREMENDOUSLY BRIGHT LIGHT.
12

A SEARCHLIGHT COULD THROW A BEAM OF ITS LIGHT FROM THE XENON LAMP SO FAR YOU COULD READ A NEWSPAPER 15 MILES AWAY.

WHEWIE! WHERE CAN YOU USE SO MUCH LIGHT?

"LOTS OF PLACES, BUT HERE'S ONE OF THE MOST EXCITING... IN G.E.'S 'SPACE SIMULATOR' AT VALLEY FORGE, PA., SCIENTISTS ARE CLOSELY DUPLICATING CONDITIONS IN OUTER SPACE. LIGHT FROM THE XENON BEAM IS USED TO SIMULATE LIGHT FROM THE SUN."

"ANOTHER USE COULD BE IN ROCKETRY. THE BRILLIANT BEAM OF A SEARCHLIGHT USING THE LAMP COULD HELP SCIENTISTS "TRACK" MISSILES VISUALLY FOR THE FIRST FEW MILES AFTER THEY ARE LAUNCHED."

GOSH! AND ITS GLASS PART IS JUST ABOUT THE SIZE OF A 150-WATT HOUSEHOLD BULB.

NOT GLASS, JOHNNY; QUARTZ HAD TO BE USED TO WITHSTAND THE INTENSE HEAT AND GAS PRESSURE. BUT IT EMITS 275,000 LUMENS, MORE THAN HUNDREDS OF HOUSEHOLD BULBS.

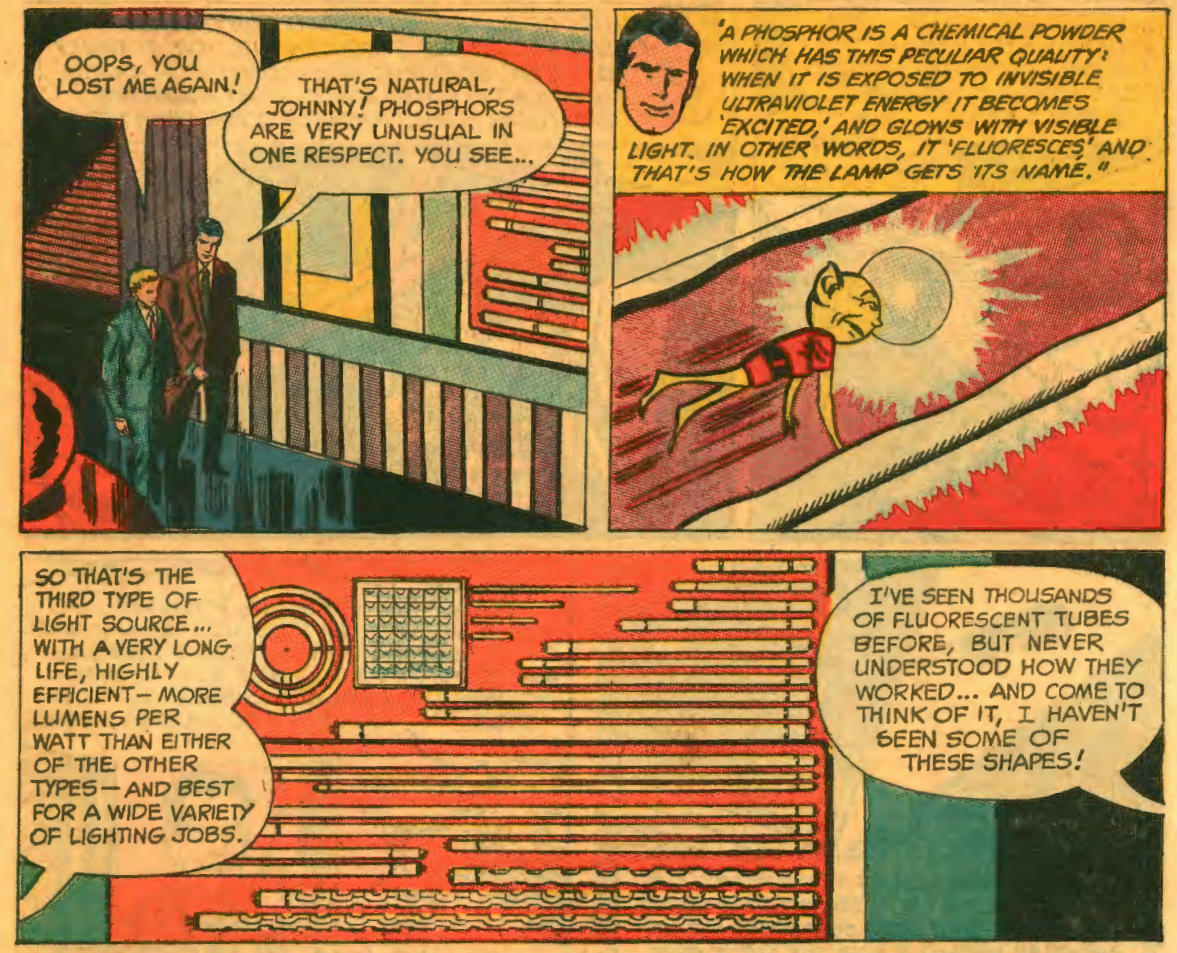
AND, LOOK, ED-- I THINK I'VE GOT THE THIRD TYPE OF LIGHTING ... 'FLUORESCENT'! RIGHT?

GOOD FOR YOU! ALTHOUGH IT WORKS ON THE SAME GENERAL PRINCIPLES AS THE MERCURY TYPE, IT HAS SOME VERY IMPORTANT DIFFERENCES.

"IN FLUORESCENT TUBES THE ELECTRODES BETWEEN WHICH THE CURRENT FLOWS ARE SEPARATED FROM EACH OTHER AT OPPOSITE ENDS OF A GLASS TUBE WHICH MAY BE AS LONG AS EIGHT FEET. ELECTRONS PASS THROUGH ARGON GAS AND MERCURY VAPOR, AND INVISIBLE ULTRAVIOLET ENERY IS PRODUCED.

PHOSPHORS

"BUT THE LAMP WOULD BE OF NO USE AS A LIGHT SOURCE IF PHOSPHORS HADN'T BEEN ADDED TO LINE THE INSIDE OF THE TUBE."



"REMEMBER, YOU'RE AT THE 'UNIVERSITY OF LIGHT'! SOME OF THESE TYPES ARE AS NEW AS TODAY!

"OF COURSE YOU'RE FAMILIAR WITH G.E.'S **STANDARD FLUORESCENT LAMPS**, USED FOR SCHOOL, OFFICE, STORE, FACTORY, AND HOME LIGHTING. AND YOU HAVE SEEN THE **CIRCLINE LAMPS**, SUITABLE FOR CEILING AND WALL FIXTURES. BUT MAYBE YOU HAVEN'T SEEN THE **POWER GROOVE**, THE WORLD'S MOST POWERFUL FLUORESCENT LAMP. IT IS DESIGNED WITH 'DIMPLES' IN THE TUBE TO FORCE ELECTRONS TO FOLLOW A WAVY PATH, SO THAT THEY TRAVEL A DISTANCE OF NINE FEET IN A EIGHT-FOOT-LONG TUBE. THE **POWER GROOVE LAMP** MAKES POSSIBLE HIGHER LEVELS FOR OFFICES, STORES, FACTORIES, STREETS AND HIGHWAYS, SERVICE STATIONS, AND ELSEWHERE. AND YOU PROBABLY HAVEN'T SEEN THE LATEST DEVELOPMENT— **FLUORESCENT PANELS**, A WHOLE SURFACE OF DIFFUSED LIGHT FOR LIGHTING IN COMMERCIAL ESTABLISHMENTS AND HOMES.

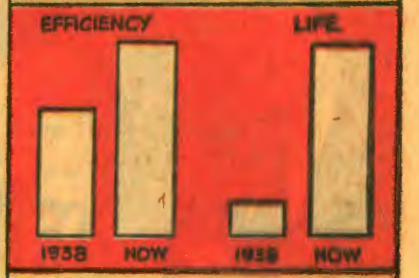
"AND, HERE AGAIN, GENERAL ELECTRIC WENT INTO THE SPACE! THE FIRST U.S. MANNED CAPSULE TO ORBIT THE EARTH WAS ILLUMINATED INSIDE WITH SMALL FLUORESCENT TUBES.

SAY, YOU HAVEN'T SEEN THIS 'ONE OF A KIND' EXPERIMENTAL FLUORESCENT-MERCURY TUBE... THE GIANT OF THEM ALL... A LABORATORY MODEL THAT GIVES OUT 330,000 LUMENS!"

WHEE... NEXT THING YOU KNOW, WE'LL BE LIGHTING UP THE MOON!

PROBABLY NOT THE 'NEXT THING' JOHNNY--BUT IT MAY NOT BE FAR OFF.

"HERE AGAIN IS A RECORD OF PROGRESS. SINCE FLUORESCENT LAMPS WERE DEVELOPED IN THE LATE 1930'S, THEIR EFFICIENCY HAS BEEN INCREASED 65%... AND THEIR LIFE MADE SIX TIMES LONGER!



"AND, IN THE FUTURE, YOU CAN BET WE'LL DO EVEN BETTER!"

IT SEEMS TO ME WE HAVE ALL THE LIGHT WE CAN USE RIGHT NOW!

NO, JOHNNY. THE USE OF LIGHT ABOUT DOUBLES EVERY TEN YEARS, AND THE USE OF MORE AND BETTER LIGHTING WILL CONTINUE.

"IMPARTIAL RESEARCH BY EXPERTS* SHOWS THAT, EVEN TODAY, AVERAGE OFFICE AND FACTORY LIGHTING IS FAR TOO LOW FOR EITHER TOP PERFORMANCE OR SAFETY. COMPARED TO THE PRESENT AVERAGE...

MACHINE SHOP WORKERS SHOULD HAVE THREE TIMES MORE

DRAFTSMEN SHOULD HAVE SIX TIMES MORE LIGHT..."

*ILLUMINATING ENGINEERING RESEARCH INSTITUTE.

GENERAL OFFICE WORKERS SHOULD HAVE THREE TIMES MORE LIGHT...

AND MOST FAMILIES DON'T HAVE NEARLY ENOUGH LIGHT TO DO HOME TASKS BEST.

APG-17-7A EDUCATIONAL RELATIONS, DEPT. MWH, GENERAL ELECTRIC COMPANY, SCHENECTADY 5.

APPENDIX B (continued)

INTRODUCTION OF EXPERIMENT

Overview:

The purpose of this study is to determine whether educational comics influence subject matter learning. The first activity in which you will participate, will be the Experimental Period. This will be followed by a Delayed Post-test Period, in a few weeks.

Preparation:

On the day before the Experimental Period, instruct your students to bring library books, or similar materials, for the Experimental Period. Do not inform them, however, of the Experimental Period.

Before the Experimental Period, you may want to arrange your seating so that students with like materials are together. For the Text-Comic students, it may help you to slip the comic into the textbook. Be sure the front of the comic can not be read. Use your "Material Assignment List" to determine how many of each material is needed and to whom the material is assigned. If you wish, you may also put the reading assignments on the chalkboard, before the Experimental Period, and then refer to them at the proper time.

In the Delayed Post-test Period no preparation is necessary, except to get the question sheets.

Experimental Period:

Before starting the Experimental Period, make sure the students are settled. It is preferred that directions not be repeated except in answering questions at the directed time. Check students for pencils and other work material (see #1). Do not deviate from the instructions under "Experimental Period Directions" unless absolutely necessary. Start the administration as soon as possible.

Delayed Post-test:

Again, there must be no forewarning of the students. Procedures will be the same as during the experimental period. The reading of materials is not included. There is no time limit, however, it should take no more than approximately fifteen minutes.

Confidence:

Confidence of the experiment relies on several factors. There must be no discussion by the teachers with the students regarding purpose, materials, content, or answers until after the Delayed Post-test. The students should see the materials only during the Experimental Period and after the Delayed Post-test Period. Since the statistical analyses are comparative forms, conduct of the experiment must be rigidly structured and followed.

Inventory:

You should have the following in the kit:

-- "Introduction of Experiment"

-- "Experimental Period Directions"

-- "Material Assignment List" for each group involved under your direction.

-- Educational comics necessary to supply largest assigned number of your groups.

-- Textbooks necessary to supply largest assigned number of your groups.

-- Question Sheets necessary to supply all students under your direction.

DO NOT ALLOW STUDENTS TO SEE ANY MATERIAL EXCEPT UNDER CONTROL CONDITIONS!:

APPENDIX B (continued)

EXPERIMENT PERIOD DIRECTIONS, I

1. Make sure all students have:
   (1) Pencil,
   (2) Something with which to work, silently, when they have finished.

2. Say the following:

Today you are going to participate in an experiment. At this time, we can not explain the experiment, except to tell you it may help us to find ways to make learning easier. Because this is an experiment, you must pay strict attention to the directions and follow them closely.

(Pause)

I am going to pass out some materials. Some of you will get a book, some of you will get a comic, and some will get both.

(Pause)

Do not open the book nor the comic until I tell you to do so. Leave the comic face down.

3. Distribute the materials to the students according to the "Materials Assignment List". Make sure you place the comic "Face-down".

4. Say the following:

I am now going to put reading assignments on the chalkboard. Do not open the materials, yet.

5. Write on the board:

Text: Pages 95 to 99.
Comic: Read all of it.
Both: Read the same, read the comic first.

6. Say the following:

Those with the textbooks will read from the top of page 95 to the bottom of page 99. Those with the Comics will read all of the Comic. Those with both, will read the same and will read the Comic first.

(Pause)

When you are through reading, close your material and raise your hand. I will then give you a sheet of questions to answer. Once you have the question sheet, you can not go back to the material and find the answers. The answers may be one or more words. Several answers may be correct for one question. One answer is enough. There will be no

grades made from these questions and I will not be the one who corrects the sheets. This is an experiment.

(Pause)

When you have finished answering the questions, raise your hand and I will collect your question sheet.

(Pause)

Are there any questions?

7. Answer questions from the students. Remind them of the assignments. Make sure they understand the procedure, thoroughly.

8. Say the following:

If you need help, raise your hand. I can help you individually, only by pronouncing words and defining some of the words in the questions. Never leave your desks. You have until _____ to finish.

(Pause)

You may begin.

9. Observe the class for raised hands. Be prepared to replace pencils, pronounce words, or give questions sheets.

10. When distributing the question sheets, make sure students can not refer to the materials. Carry the "Question Master Sheet" with you to assist in defining words.

11. When collecting question sheets, make sure student's name is legible. Have student circle 'T' if he had the text only; the 'C' if he had the comic only; and, 'TC' if he had both. Instruct students to work silently with something, so as not to bother the others.

12. At the end of the period, or when all of the students have finished, collect all of the materials. If a student did not finish, write "NF" on the question sheet.

13. Say the following:

If you wish, you may tell others that you have participated in an experiment. But, don't tell them what you did or give them the answers. If you do, this experiment, which may help make learning easier, is ruined.

EXPERIMENT PERIOD DIRECTIONS, II

1. MAKE SURE ALL STUDENTS HAVE:
   (1) PENCIL.
   (2) SOMETHING WITH WHICH TO WORK, SILENTLY, WHEN THE STUDENT HAS FINISHED THE QUESTION SHEET.

2. SAY THE FOLLOWING:

   Today you are going to do the last activity of the experiment you started several weeks ago. Again, you must pay strict attention to the directions and follow them closely.

   (PAUSE)

   I am going to pass out some question sheets. Leave them face down on your desks.

3. PASS OUT THE "QUESTION SHEET" FACE DOWN ON THE DESKS.

4. SAY THE FOLLOWING:

   Turn the sheets over. Print your name on the line as directed.

   (PAUSE)

   If you had the textbook before, then circle the 'T'; if you had the comic book, then circle the 'C'; and, if you had both, then circle the 'TC'. If you were absent, then circle the 'A'.

   (PAUSE)

   Any questions?

   ANSWER STUDENT QUESTIONS.

5. SAY THE FOLLOWING:

   Read the directions silently, as I read them aloud:

   1. Your answers may be one word or more.
   2. Some questions have several possible answers, one is enough.

3. Do not guess when you do not know the answer.

6. SAY THE FOLLOWING:

If you need help, raise your hand. I can help you, individually, only by pronouncing words and defining some of the words.

(PAUSE)

When you are finished, raise your hand and I will take your "Question Sheet".

(PAUSE)

Do not leave your desks.

(PAUSE)

You have 15 minutes to finish. You may begin.

OBSERVE THE CLASS FOR RAISED HANDS. BE PREPARED TO REPLACE PENCILS. CARRY THE "MASTER QUESTION SHEET" WITH YOU TO ASSIST IN DEFINING WORDS.

7. WHEN COLLECTING SHEETS, MAKE SURE THE STUDENT'S NAME IS LEGIBLE AND THE PROPER "CODE LETTER" IS CIRCLED.

8. AT THE END OF THE TIME, COLLECT REMAINING "QUESTION SHEETS".

9. SAY THE FOLLOWING;

There are no grades from this test and I will not be the one who corrects the sheets. This is an experiment. Please do not tell the others that you have had this test. If you do, it will ruin the experiment.

APPENDIX B (continued)

MATERIALS ASSIGNMENT LIST

TEACHER _____ ROOM _____ AM PM

PRINT LAST NAMES AND THE FIRST INITIAL OF STUDENTS IN ALPHABETICAL ORDER. INDICATE MALE OR FEMALE BY PRINTING 'M' OR 'F' IN THE FIRST COLUMN. MAKE A DIFFERENT "MATERIALS ASSIGNMENT LIST" FOR EACH OF YOUR GROUPS.

M/F	NAME	T	C	TC

BY EACH NAME THERE IS AN 'X'. THE COLUMN THE 'X' IS IN, SIGNIFIES WHETHER THE STUDENT IS TO RECEIVE THE TEXT (T), THE COMIC (C), OR, BOTH (TC).

QUESTION SHEET

Print Name _____ T C TC A
(First) (Last)

DIRECTIONS:
1. Your answers may be one word or more.
2. Some questions have several possible answers, one is enough.
3. Do not guess when you do not the answer.

1. _____ developed the electric light.

2. Man first used _____ to make light.

3. Electricity passes through a _____ in flourescent lights.

4. The _____ of an incandescent light glows.

5. _____ means there is no air.

6. Man learned to put a _____ in oil, fat, or hard tallow for better light.

7. A filament of _____ was used in the first successful light bulb.

8. The electricity passes through a _____ in an incandescent light.

9. The first successful light burned for _____ hours.

10. Before he could make any kind of light, man got his light from the _____.

11. A gas called _____ is now put in light bulbs.

12. The metal called _____ is now used to make the filament.

13. The _____ of a flourescent light glow(s).

QUESTION SHEET

Print Name MASTER (First) (Last) T C TC A

DIRECTIONS:
1. Your answers may be one word or more.
2. Some questions have several possible answers, one is enough.
3. Do not guess when you do not the answer.

1. _____ developed the electric light.

2. Man first used _____ to make light.

3. Electricity passes through a _____ in (flourescent) lights.

4. The _____ of an (incandescent) light glows.

5. _____ means there is no air.

6. Man learned to put a _____ in oil, fat, or hard tallow for better light.

7. A (filament) of _____ was used in the first successful light bulb.

8. The electricity passes through a _____ in an (incandescent) light.

9. The first successful light burned for _____ hours.

10. Before he could make any kind of light, man got his light from the _____.

11. A gas called _____ is now put in light bulbs.

12. The metal called _____ is now used to make the (filament).

13. The _____ of a (flourescent) light glow(s).

Circled words may be explained only as follows:
Flourescent) "a type of light"
Incandescent)

APPENDIX B (continued)

Answer Sheet 'T'

Question	Possible Answers
1.	Edison; Thomas Edison
2.	torches; fire; flame
3.	tube; gas; mercury gas
4.	wire; filament
5.	vacuum
6.	wick; string
7.	carbon; thread; carbonized thread
8.	filament; wire
9.	40; forty
10.	sun; moon; stars; sun, moon, and stars
11.	argon; nitrogen; argon and nitrogen
12.	tungsten
13.	particles; coating; tube; gas; gas particles

APPENDIX B (continued)

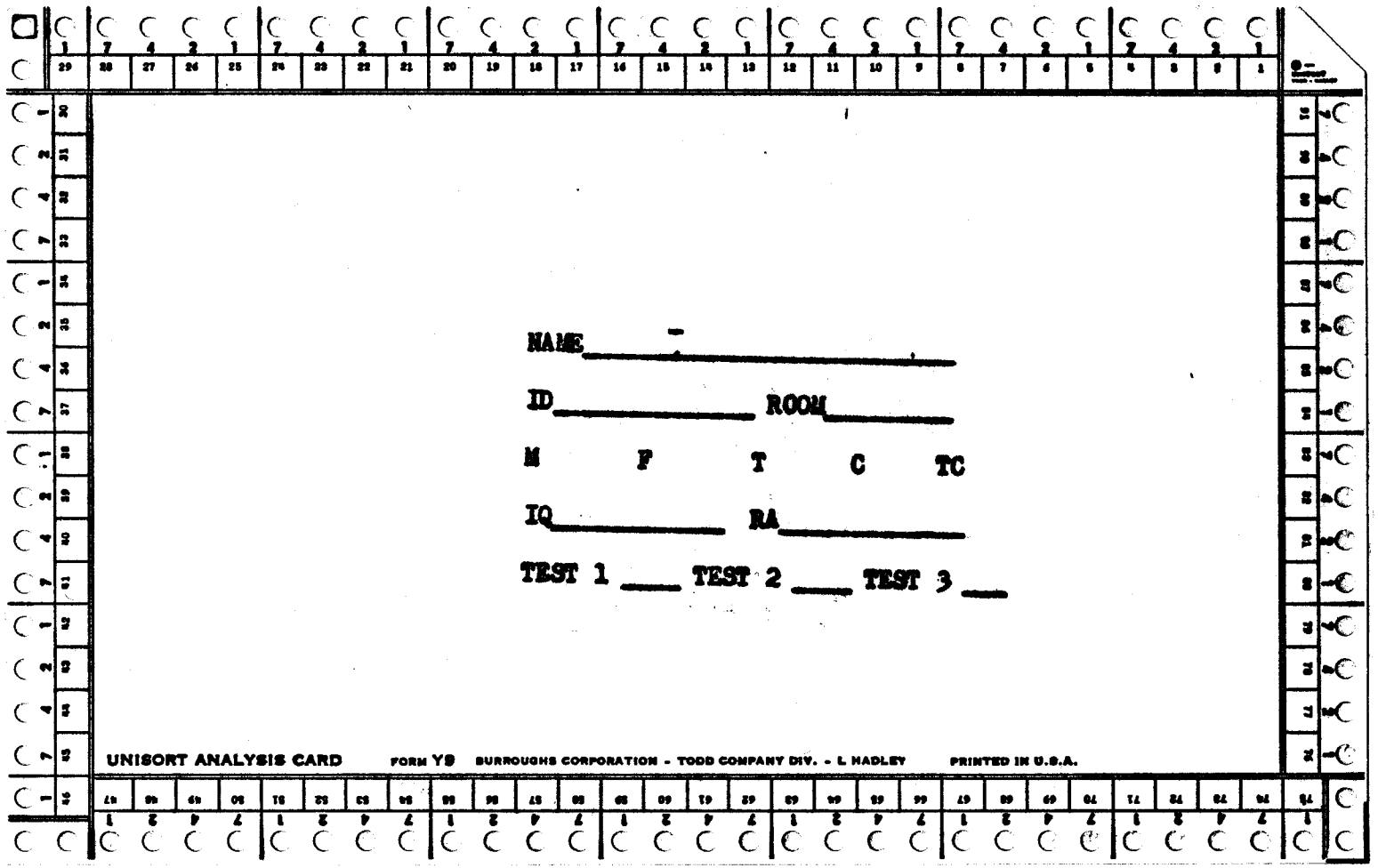
Answer Sheet 'C'

Question	Possible Answers
1.	Edison
2.	fire; flame; torches
3.	argon gas; mercury vapor; gas; vapor; space; tube
4.	wire; filament; coil
5.	vacuum
6.	wick; string
7.	carbon; thread; carbonized thread
8.	wire; filament; coil
9.	40; forty
10.	sun; daylight
11.	argon
12.	tungsten
13.	phosphors; lining; sides; coating

APPENDIX B (continued)

Answer Sheet 'TC'

Question	Possible Answers
1.	Edison
2.	fire; flame; torches
3.	argon gas; mercury vapor; space; tube; vapor; gas
4.	wire; filament; coil
5.	vacuum
6.	wick; string
7.	carbonized thread; carbon; thread
8.	filament; wire; coil
9.	40; forty
10.	sun; daylight; moon; stars; sun, moon, and stars
11.	argon; nitrogen; argon and nitrogen
12.	tungsten
13.	particles; coating; tube; gas; gas particles; phosphors; lining; sides



UNISORT DATA CARD

APPENDIX B (continued)

DATA PROCESSING CODE

Hole(s)	Selection
1-8	Reading Achievement score
10-17	Intelligence score
20-29	Student's Experiment Identification Number
30	Male
31	Female
32	Experiment Group 'T'
33	Experiment Group 'C'
34	Experiment Group 'TC'
35	Experiment Control Group
36	Top 27% Reading Achievement Group
37	Bottom 27% Reading Achievement Group
38-46	No selection
47-54	Achievement Post-test score
55-62	Retention Post-test score
63-75	Questions missed on Achievement Post-test
76-80	First letter of student's last name
82-89	Common-learnings class number
90	Afternoon class
91	Morning class

APPENDIX C

DATA FOR FUTURE STUDY

The following tables were included to present data for consideration of future study. The format and data follow the form used in Chapter V.

TABLE I

EXPERIMENT GROUP MALE DIFFERENCES OF ACHIEVEMENT WITHIN THE TOP READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	9.86	11.00	10.29	9.86
Differences:	1.14		.71	.43
Levels of Significance:	.25		.50	.75

(df=12)

TABLE II

EXPERIMENT GROUP FEMALE DIFFERENCES OF ACHIEVEMENT WITHIN THE TOP READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	9.25	8.58	9.75	9.25
Differences:	.67		1.17	.50
Levels of Significance:	.40		.90	.60

(df=22)

TABLE III

EXPERIMENT GROUP MALE DIFFERENCES OF ACHIEVEMENT WITHIN THE MIDDLE READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	8.71	7.90	8.05	8.71
Differences:		.81	.15	.66
Levels of Significance:		.25	.90	.40

(df=40)

TABLE IV

EXPERIMENT GROUP FEMALE DIFFERENCES OF ACHIEVEMENT WITHIN THE MIDDLE READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	7.20	6.33	7.07	7.20
Differences:		.87	.74	.13
Levels of Significance:		.40	.40	.90

(df=28)

TABLE V

EXPERIMENT GROUP MALE DIFFERENCES OF ACHIEVEMENT WITHIN THE BOTTOM READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	5.63	6.88	7.88	5.63
Differences:		1.25	1.00	2.25
Levels of Significances:		.20	.30	.05

(df=14)

TABLE VI

EXPERIMENT GROUP FEMALE DIFFERENCES OF ACHIEVEMENT WITHIN THE BOTTOM READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	5.44	5.11	5.11	5.44
Differences:	.33	0	.33	
Levels of Significance:	.80		.80	

(df=16)

TABLE VII

EXPERIMENT GROUP MALE DIFFERENCES OF RETENTION WITHIN THE TOP READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	9.00	9.29	6.57	9.00
Differences:	.29	2.72	2.43	
Levels of Significance:	.80	.05	.10	

(df=17)

TABLE VIII

EXPERIMENT GROUP FEMALE DIFFERENCES OF RETENTION WITHIN THE TOP READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	7.00	5.00	7.40	7.00
Differences:	2.00	2.40	.40	
Levels of Significance:	.10	.05	.75	

(df=18)

TABLE IX

EXPERIMENT GROUP MALE DIFFERENCES OF RETENTION WITHIN THE MIDDLE READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	6.79	5.93	5.50	6.79
Differences:		.86	.43	1.29
Levels of Significance:		.40	.75	.20

(df=26)

TABLE X

EXPERIMENT GROUP FEMALE DIFFERENCES OF RETENTION WITHIN THE MIDDLE READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	4.64	4.91	3.91	4.64
Differences:		.27	1.00	.73
Levels of Significance:		.75	.20	.40

(df=20)

TABLE XI

EXPERIMENT GROUP MALE DIFFERENCES OF RETENTION WITHIN THE BOTTOM READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	6.00	4.67	4.67	6.00
Differences:	1.33		0	1.33
Levels of Significance:	.40			.40

(df=4)

TABLE XII

EXPERIMENT GROUP FEMALE DIFFERENCES OF RETENTION WITHIN THE BOTTOM READING ACHIEVEMENT LEVEL

Experiment Groups:	T	C	TC	T
Means:	3.00	3.33	4.00	3.00
Differences:	.33		.67	1.00
Levels of Significance:	.80		.75	.75

(df=10)

GENERAL ELECTRIC COMPANY

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MARKETING and PUBLIC RELATIONS SERVICES

APPENDIX D

February 19, 1963

Mr. H. Donald Jacobs
Central Washington State College
Ellensburg, Washington

Dear Mr. Jacobs:

I'll try to answer as many of your questions about our educational comic books as I can.

A 1. We do not release figures on advertising expenditures

2 In 1962, a total of 1,738,000 copies of booklets in comics format were distributed to teachers, all at their request

3 During the past few years, the proportion of comic to total booklets distributed in this program has decreased considerably. In 1962, comics represented about 40%, in 1961 it was 66%, and in 1960 it was 80% This is in part explained by the greater emphasis we've given to guidance messages, presented in non-comics booklets I'm not sure there's any real evidence of a significant change in acceptance, pro or con, of comics-type booklets.

4. It's impossible to tell how many people at General Electric are involved. Two of our Educational Relations staff have responsibility for the program, but it is only a small part of our work. Both production and distribution staff, as well as warehouse people, have a part in this program, but also handle many other publications.

B. 1. Decision as to the choice of subjects of the booklets is made by two individuals, a colleague and I, responsible for Educational Relations Materials. Editorial and art work is done by the producing agency, Pictorial Media, Inc., of New York City. We, however, participate in all stages, have final editorial responsibility, and handle all approvals by the scientific and other personnel of the Company components responsible for the subjects being treated.

2. Pictorial Media, Inc., as vendors

3. As to readability, we just exercise common sense. We assume that secondary-school students can read; if that is not so, then the picture technique may help them. (My colleague in this work has taught English at both college and high school levels and is something of an authority on teen-age reading habits).

C. The booklets are printed by letterpress, from 4-color plates, on a good grade of newsprint. (We leave all these details to the vending organization, which has had extensive experience with the medium.)

I am enclosing, for your information, a set of the booklets we offer to teachers.

Sincerely,

Neil B. Reynolds
Consultant-Educational Communications.

NBR:mb
encl.

Please note:
The signature has been redacted due to security reasons