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By-Craytor, Josephine K.

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The four goals of this project are outlined in some detail. First, a unit programed for self-instruction in nursing, entitled "An Introduction to Radiation Therapy" was revised and rewritten on the basis of knowledge gained from controlled use. The revised unit took less time, showed a decreased error rate and indicated greater learning. A second goal was to use the unit in two alternate ways within the basic nursing curriculum. It was tested successfully with one group as a preparation for a brief clinical experience in the radiation therapy department and with another group as an out-of-class assignment during formal classes in the nursing care of the individual with cancer. A third goal was to validate the material in other nursing programs, and the two trials are described. The processing details are also given for the development and testing of a second unit "An Introduction to Cancer Nursing," which was the fourth project goal. (JK)

THE DEVELOPMENT OF PROGRAMMED UNITS IN NURSING

FINAL REPORT
On the Research Project

June 1, 1964 to May 31, 1967

Josephine K. Craytor

Department of Nursing
School of Medicine and Dentistry
University of Rochester
Rochester, New York

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DEVELOPMENT OF PROGRAMMED UNITS IN NURSING

I. Purpose of the Study

This project was designed to revise a unit programmed for self-instruction in nursing, "An Introduction to Radiation Therapy"; to use the unit in two alternate ways within the basic nursing curriculum; to validate the material in other nursing programs; and to develop a second unit, "An Introduction to Cancer Nursing".

II. Background

Pressure on nurse educators to teach more content, to teach it more effectively, and to turn out practitioners more quickly continues to grow. The knowledge explosion, changing patterns of medical practice which have shifted responsibilities to nurses, and demands by the public for more and better health care have all contributed to the pressures (1). Coincident with the mounting demands for nurses has been the increased determination within nursing to improve professional education and to establish uniform requirements for the preparation of the professional nurse (2). Different approaches can be made to different parts of this large and baffling problem. One approach which seems appropriate in many problem situations is to increase the use of self-instructional methods, especially programmed instruction. Programs can be designed to use student time more effectively and to spread instructor efforts farther without sacrificing quality of instruction.

We have found programs of particular value in helping students master factual material before class discussions or before special clinical experiences where the information can be used. Our first use of programming grew out of our particular needs.

We wished to provide students with an opportunity to review some of their college sciences related to ionizing radiation and to acquire new information, and to do these things individually with a reasonable expenditure of time, at a point where they could apply knowledge in a clinical area, and in a way in which they could be responsible for their own learning. A program seem to be the answer.

The programming process is based on reinforcement theory, which, in turn, grew out of Thorndike's work on stimulus-response learning (3). Practices in education have been slow to reflect the growing body of knowledge about learning as a rational process. Programming changes behavior in a planned and orderly way by reinforcing that which is desirable and extinguishing that which is undesirable or ineffectual. A program is a unit of material prepared to allow the student to learn by himself. It is a carefully designed sequence of steps through which the learner moves, making some kind of an active response at each step and receiving immediate feedback informing him that his response was or was not correct. The student advances at the rate of speed at which he learns best and is constantly interacting with the program. In using a well-constructed program the learner makes relatively few errors. Both success and the immediate knowledge of achievement reinforce learning. Learning and retention are further enhanced by review which can be built into the program.

III. Related Research

College courses have been taught by programs or by programs combined with other teaching methods since the late 1950's (4,5,6). Student achievement has been as good or better in the programmed

courses as it has in traditional lecture courses (7, 8). In spite of the fact that programmed materials have been shown to teach effectively, we found it appropriate to measure our first program against the traditional presentation of the material by a radiologist and a nurse to establish its comparative effectiveness (9). In 1964, only one other report of the use of programmed materials in nursing was available (10). Since that time other reports have appeared in the nursing literature (9, 11, 12, 13). Many programs have been written and used in nursing education, the use of which has not been reported. A number of articles on programming, applicable to nursing, have appeared (14, 15, 16, 17, 18).

Other indications of the growing interest in programming in the health fields are that the number of published programs in para-medical fields (including nursing) has grown from 5 in 1963 to 67 in 1967 (19). In 1964 a new subject heading, "Programmed Teaching" appeared in The Cumulative Index to Nursing Literature. Under this heading there were 14 entries in 1964, 10 in 1965, 12 in 1966 and 10 in the first four months of 1967.

In spite of the changes which have taken place, the need exists in 1967, as it did in 1964, to develop more programs suitable for use in nursing education and to determine how and where such programs can best be used.

IV. Procedure

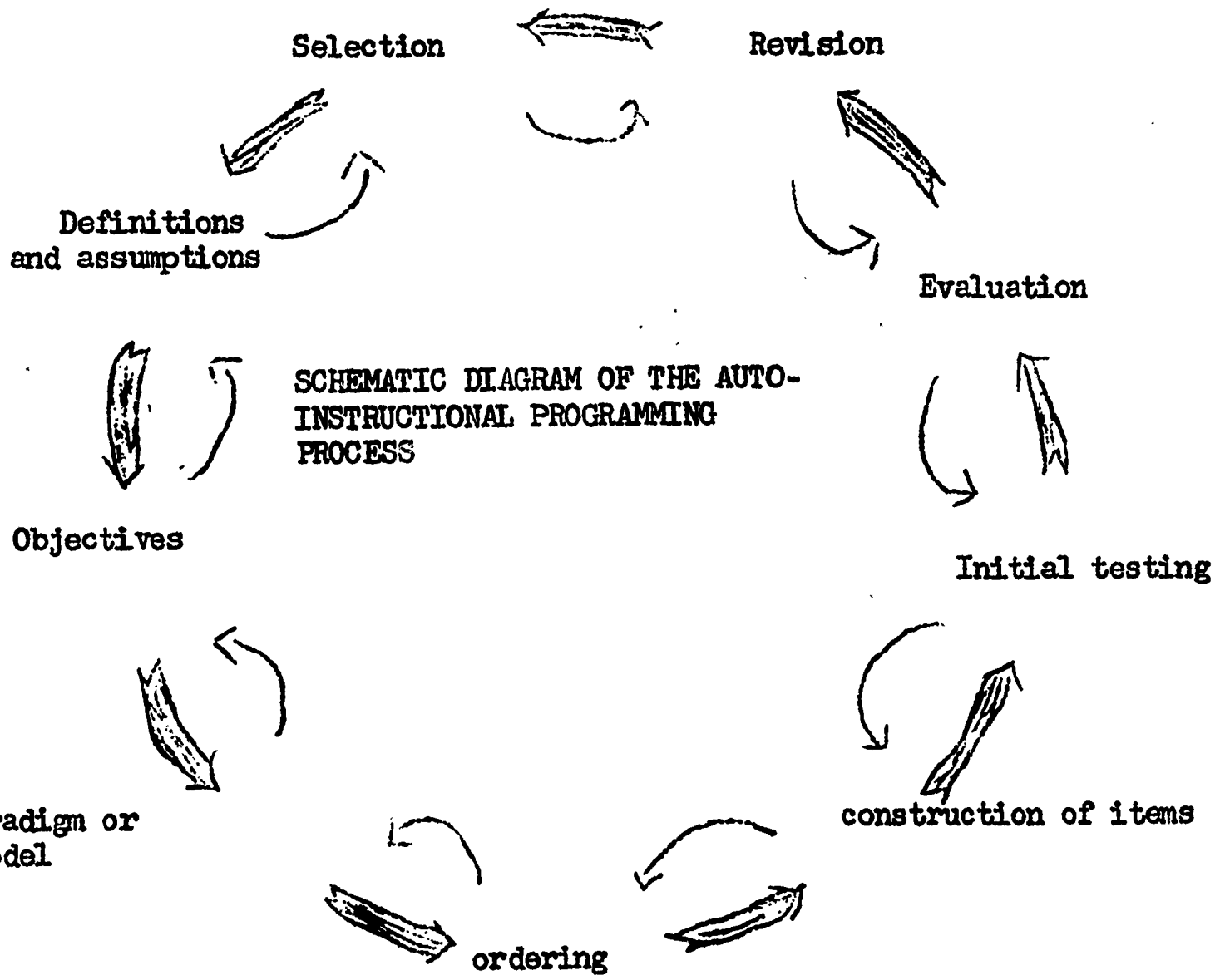
A. Revision of the unit, "An Introduction to Radiation Therapy".

In developing the first program we followed the theoretical model developed by educators teaching programming at the University

of Rochester (20, 21). This model includes a series of steps which are taken sequentially. Each new step may require some modification of previous steps. Changes are and can be made at any stage in the development of a program. (See figure #1). If, for example, an initial field test reveals the fact that students are confused rather than enlightened by a sequence of items, items can be rearranged or re-written.

We again used some steps in this model to guide our revision of the program - reviewing our assumptions about the learners; re-writing our objectives; looking critically at the choice of a paradigm; re-ordering the sequence of information; and re-writing frames and writing new frames. The developmental testing was repeated before the study of the use of the program began.

Figure #1



SCHEMATIC DIAGRAM OF THE AUTO-INSTRUCTIONAL PROGRAMMING PROCESS

Based on: Lysaught, J.P. and C.M.Williams
A Guide to Programmed Instruction
New York: John Wiley & Sons, 1963

During the controlled use of the unit we had found that it taught effectively, that, in general, the material selected was appropriate to the students for whom the program was developed, and that the paradigm was appropriate to meet the instructional objectives. Initially, however, the objectives had been stated in such abstract, non-behavioral terms that achievement of the objectives was difficult to measure. These objectives were rewritten to make them more concrete and descriptive of the desired student behavior. (See Appendix I)

A new ordering of the material and extensive re-writing of the items was based on:

1. An analysis of errors made on the program by the first two classes of students who used it (N=81.)
2. An item abalysis of the pre-tests, (N=81.)
3. An item analysis of the post-tests, (N=81.)
4. Student comments included on the response sheets.
5. Suggestions of the programming consultant.
6. Suggestions of the subject matter experts in Radiation Biology, Radiation Physics, Therapeutic Radiology, and Medical-Surgical Nursing.

The analysis of the response sheets showed that the errors made in responding clustered around 16 items. In most instances it was possible to determine that an error was due to an ambiguous item or to a lack of adequate instruction preceding the required response.

Students had been asked to comment on problem spots and many were very explicit in detailing their difficulties. This helped to identify and correct problems.

Analysis of the pretest showed that nearly 50% of all items were answered correctly, confirming the impression that many

students did not need the review which had been included in the program. Since some students obviously did need the review it was not eliminated, but criterion frames were developed which allowed a student to demonstrate his knowledge and "skip" parts of the program, resulting in a modified linear paradigm.

Item analysis of the post-tests identified certain areas where the program did not teach effectively and these were then amplified. To make these changes, frames were re-written and new frames added.

Both the students and the programming consultant pointed out the monotony of the style and the faulty construction of many frames in the program. In re-writing the program an effort was made to vary the style, to correct the faulty frames, and to eliminate unnecessary technical vocabulary.

The subject matter experts checked the accuracy of factual information, pointed out places where simplification of ideas had created erroneous impressions, checked vocabulary, and suggested some illustrations.

The revised unit was used with 5 junior students who had not yet had cancer nursing or any experience in the Radiation Therapy Department. This trial was designed to identify ambiguities, eliminate anncying items, and test vocabulary level. After the preliminary trial the material was again revised and prepared in booklet form for use with students.

B. Alternate uses of the program.

After revision of the unit, the second objective of the project was to use the program in the nursing curriculum in at least two

different ways, both of which seemed logical and possible within Medical-Surgical Nursing, or similar course. We hypothesized that both groups of students would make significant gains in learning but that there would be no significant difference in the size of the gains achieved by the two groups, as measured by a paper-and-pencil test. One group of students used the program as preparation for a brief clinical experience in the Radiation Therapy Department, and the other group used the program as an out-of-class assignment during formal classes in the nursing care of the individual with cancer.

A class of 44 college juniors in the nursing major was divided randomly into two sections. One section had Medical-Surgical Nursing I in the second semester of their junior year, the other during the summer session before, and part of the first semester of their senior year. Each section was pre-tested on the material covered by the program at the beginning of the Medi Surgical Nursing I course. Each section of the class was again divided randomly into Group A and Group B. Group A from each section used the program at the time they started a week's clinical experience in Radiation Therapy and Tumor Clinics. Group B from each section used the program at the time of formal class work in cancer nursing. The same procedure was repeated with the next incoming junior class. All of the students were allowed to use the program as they wished during a period of 3½ days, and all had the same directions for use. (See Appendix II) Each section was post-tested after all students had completed the program, at least 3 months after the pre-test.

Figure 2

DESIGN OF THE STUDY OF THE USE OF THE RADIATION THERAPY PROGRAM

GROUP A (1966)	Group B (1966)
1. Pre-Test	1. Pre-Test
2. Used Program with clinical experience in Radiation Therapy	2. Used Program with classes in Cancer Nursing (before clinical experience in Radiation Therapy)
3. Post-Test	3. Post-Test
4. One year retention test	4. One year retention test

Group A (1967)	Group B (1967)
1. Pre-Test	1. Pre-Test
2. Used Program with clinical experience in Radiation Therapy	2. Used Program with classes in Cancer Nursing (before clinial experience in Radiation Therapy)
3. Post-Test	3. Post-Test

A pre-test - post-test was developed using the objectives of the program as a basis for writing the questions. Internal reliability of the test was evaluated by a split-half correlation. This correlation was .78. When corrected by the Spearman-Brown Prophecy Formula, the correlation was .82.

The first three sections of students, one class and half of the next, were asked to comment on their reactions to the program on their response sheets. These comments were helpful in understanding students and their particular difficulties, but so diverse as to make analysis difficult. The last section was asked to complete a questionnaire which was later used with groups of students from other schools, who used the program.

The first class to use the revised program completed a retention test one year after use of the program, to give some idea of what part of their gain in knowledge they retained a year later.

C. Development of an Instrument for the Evaluation of Clinical Performance

One way in which we hope to demonstrate the usefulness of the programmed unit is to measure change in student performance in the clinical area. A checklist of behaviors was developed from the objectives of the program and was reviewed by experts in cancer nursing. The development and validation of this tool was reviewed in a paper presented at the annual meeting of the Society for Programmed Instruction in Boston, April 20, 1967. (See Appendix III for the paper reporting this, and Appendix IV for the checklist, the directions for its use, and the list of incidents of effective and ineffective behaviors used as examples.)

D. Use of the program, "An Introduction to Radiation Therapy" in other college programs in nursing

Trial 1 was carried out in a college program where students have a three-week affiliation at a specialized cancer hospital in their senior year. Observation in the Radiation Therapy Department and care of patients being treated by radiation theraoy are part of this experience. Six groups of students each had a three-week affiliation during the study year. Although the program had been shown to teach effectively in the setting where it was developed it had not been used in a controlled way in other schools. Faculty of the college involved and teaching staff in the hospital were much interested in trying the program in their setting. Since they spent a great deal of time and effort in teaching the material many times over during the academic year, they hoped to find a time-saving method of teaching. They were somewhat skeptical about the usefulness of the program and wished to try it with their own students. Alternate groups of students

were taught by traditional lecture presentations of the material and by the program. Before starting the study the faculty and the staff who were teaching students, reviewed the program, the tests, and the objectives of the program. Traditional instruction here consisted of two formal two-hour lectures on radiation given by experienced nurse educators, the use of a textbook chapter on radiological nursing and a conference on patient problems related to treatment by radiation. The instructor had the objectives of the program to use as a guide in her teaching. (See Appendix I for list of objectives used.)

Figure 3

DESIGN OF THE TRIAL # 1

Study Group (N-39) Sections 2, 4, 6	Control Group (N-38) Sections, 1, 3, 5
1. pre-test	1. pre-test
2. formal classes omitting radiation therapy	2. formal classes including radiation therapy and care of the patient treated by radiation
3. use of the program	
4. post-test	3. post-test
5. questionnaire	

The questionnaire was used to determine student reactions to the program and its effectiveness. It was very brief and was administered at the time of post-testing.

Trial 2 was carried out in a midwestern state university where there is great interest in self-instructional materials and in finding ways to use these effectively. Here there were two classes of student neither of whom had had formal classroom instruction about radiation therapy. The question was, could a limited trial give help in deciding

where such material might best be used in the curriculum? Seventeen juniors were to have a course in Medical-Surgical Nursing during the year and 13 seniors were to have Advanced Medical-Srugical Nursing during the second semester.

Figure 4

DESIGN OF TRIAL # 2

Group I (N-17) (Juniors)	Group II (N-13) (Seniors)
1. pre-test	1. pre-test
2. program before any cancer nursing	2. program 1 year after formal classes in oncology
3. post-test	3. post-test
4. questionnaire	4. questionnaire
5. group discussions observations in Radiation Therapy	5. group discussions observations in Radiation Therapy

Group I was considered new to the whole subject of cancer nursing at the time of the use of the program. Group II on the average was a year older, and had had a unit on neoplastic disease during Medical-Surgical Nursing the previous year. Obviously, these were not matched groups. The hypothesis to be tested was that they were different and would react differently to the experimental treatment.

E. Questionnaire

Merely asking students to add comments about the program to their response sheets had provided material which was interesting but hard to organize in any satisfactory way. Therefore, a questionnaire was developed. This was completed by four groups of students from four different schools, after they had used the program. All 92 students were asked to identify

their school but to use their own name only if they wished to do so. The questionnaire was designed to give some idea of student attitudes toward programs in general, toward this program and its usefulness for them, and some information on how they actually used the unit. (See Appendix VI) The questionnaire in each case was used immediately after the post-test.

V. Development of a second program, "An Introduction to Cancer Nursing"

A. Determination of Content.

Selection of content for this unit was difficult since the program had to be kept to a manageable size for use in the basic nursing curriculum. A tentative outline of content to be included was based on:

1. Content of introductory classes in cancer nursing which we had developed;
2. A review of the subject in current textbooks of Medical-Surgical Nursing;
3. A review of content covered in the introductory chapters of medical textbooks on cancer;
4. Accummulated notes from journal articles, medical student classes, tumor conferences, continuing educations programs for physicians in the local community.

A list of 34 statements about cancer was drawn up. (See Appendix V for sample from this list) This list was reviewed with four nurses considered experts in cancer nursing and four physicians, particularly knowledgeable in Oncology. Each reviewer was asked to indicate whether:

1. the statement was true
2. it was important in increasing understanding of or acceptance of therapy for cancer
3. it was important information for a nurse who would have responsibility for planning, giving, and directing the care for individuals with cancer.

In general the jurors accepted, rejected, or made comments on each

statement. Some of the comments and questions led to further study of the material and to deletions, additions and changes in emphasis.

B. Programming Process

In developing the second unit we again followed the general steps identified at the University of Rochester as necessary to the effective development of programs (20).

1. Selection of the Unit. The unit, including basic factual material considered important to some understanding of cancer as a disease, and to making reasonable decisions about the nursing care of the person with cancer, had been selected, because it fell within the special interest of the author, it covered information basic to clinical practice, it was considered necessary for all students, and it had required much formal class time to cover in a less comprehensive manner.

2. Assumptions about the learners. The following definitions were utilized:

   a) The student reads at a college level.

   b) The student has a vocabulary at the college level, a beginning medical vocabulary, and ready access to a medical dictionary.

   c) The student has had college courses in general chemistry, human anatomy and physiology, general biology, sociology, psychology, and at least one course in clinical nursing.

   d) The student is motivated to acquire information necessary for the safe practice of nursing.

3. Objectives. The statement of the objectives of instruction in precise behavioral terms is a crucial and difficult part in constructing any program. As first developed, the objectives for this program were:

   I. The student will demonstrate his understanding of cancer as a disease by his attitude toward cancer, by his health teaching, in the physical care he gives to the person with cancer, and in the emotional support he provides patient and family.

   II. He will demonstrate his knowledge about cancer by answering correctly questions of fact regarding:

      a) the magnitude of the health problem
      b) characteristics of malignant tumors
      c) etiology of cancer and preventive measures

d) early case-finding and diagnostic measures;
e) methods used in treatment;
f) course of the disease;
g) general aspects of acute care;
h) rehabilitation

III. He will use his knowledge abo ut cancer in assessing nursing needs of the cancer patient, in planning nursing care, and in the evaluation of the effectiveness of care. Given case histories of cancer patients or potential cancer patients, the student will make appropriate decisions about:

a) signs and symptoms to report and/or record;
b) helping the individual with suspicious symptoms seek medical advice;
c) explaining a test or treatment to a patient;
d) reasonable reassurance which can be given to patient and/or family;
e) nursing measures to prevent or keep to a minimum complications of cancer or side-effects of treatment;
f) teaching of self-care measures;
g) appropriate agencies to call upon for assistance;
h) whether and how to involve family members;
i) preventive measures to be taught.

As we considered these objectives, we decided that sections I and III were beyond the scope of this particular unit. This program included only the first six areas in objective II, but to a considerable extent calls on the student to make responses based on thinking and understanding skills, as well as on purely factual material. Mastery of the program is measurable by paper-and-pencil tests.

4. Development of a Criterion Test. At this point, we introduced another step in the programming process, the development of a criterion test, which had been found to facilitate development of programs for medical students (22). A tentative set of specifications for the test was developed outlining the levels of learning to be tested (see Table 1), and the content areas to be included (23). We then planned distribution of test items on a form found helpful in the development of evaluation instruments by other educators (22). (See Appendix VI for sample planning sheets)

TABLE 1

PLANNED DISTRIBUTION OF TEST ITEMS
FOR THE UNIT
"AN INTRODUCTION TO CANCER NURSING"

		Percent of Items Planned	Percent of Items Actual
I	Objectives of Instruction		
	A. Knowledge of facts, definitions, etc.	40%	36%
	B. Understanding of principles, data, etc.	40%	40.5%
	C. Thinking, analysis, judgement	20%	23.5%
II	Subject Matter		
	A. Magnitude of the health program	10%	11%
	B. Nature of the disease	10%	13%
	C. Etiology and prevention	15%	10%
	D. Early case-finding and diagnostic methods	20%	34%
	E. Methods of treatment	25%	15%
	F. Problems resulting from disease and therapy	20%	16%

Since the program was to cover basic factual material, many of the objectives dealt with "knowing". However, we further wished to test the ability of students to apply the facts and to evaluate alternate possible actions. Table #I shows the planned distribution of test questions against the actual distribution on the criterion test. Questions involving judgment were weighted 2 points against 1 point for all other questions. This weighting accounts for the relatively greater emphasis on early case-finding questions, (D.) as against those on treatment methods, (E.) in the final test.

Once the test items were completed, the instrument was administered to two physicians, and eight nurses, particularly knolwedgable about cancer. Each expert was asked to indicate:

1. the best answer to each question
2. whether the question was ambiguous or misleading
3. whether he thought the information was usually part of the content taught in a college level nursing program.

4. whether the information was important to the nurse making decisions about nursing care (including health teaching).

There was very little agreement on what is now being taught in college courses about cancer nursing, and almost unanimous agreement about the importance of the material included as it related to decision-making. Questions which were ambiguous or misleading were re-worded with the expert who identified them and then submitted to at least two other experts, before use. The "correct" answers were those of the majority, checked against the literature. Material was retained which was considered important, whether it had been taught traditionally or not.

The criterion test was then used with two senior students who had had cancer nursing. Their advice on content was to include most of the material, amplifying some of it. They recommended less emphasis on pathology, feeling already well prepared in that area, and statistics, as aversive to most students. Consequently, we provided a bypass for the pathology section, and used statistics in the program itself, only as they illuminated some of the points necessary to learn.

5. Selection of a paradigm. As in the first unit, we used a linear paradigm. Except for the first section on pathology, we wished all students to use the entire program. The paradigm was varied by requiring different kinds of responses, fill-in, checking, selecting answers, and by using graphs and tables as well as verbal information.

6. Ordering the Material and Item Writing. Ordering the material had been done and determining the relative importance of each objective had been accomplished during development of the criterion test. This test, therefor, served as a guide in developing the first draft of the program. This speeded the actual writing of the program and eliminated some of the duplication and overlapping that we had had to cope with in the first unit.

7. Initial Testing. The first draft was used by three students in succession, making some alterations after after each use if students' suggestions seemed reasonable. The first students selected had high verbal skills, a strong academic background, and little or no hesitation about saying exactly what they thought of the style and the content. A great deal of material was deleted on their suggestions.

8. Evaluation and Revision. Revision of the program was made on the basis of this initial testing and evaluation. Concepts which were challenged had to be further clarified, and review questions were developed for each section.

C. Trial of the Program.

The junior class of 49 students in the nursing major was divided randomly. Early in the spring semester they were all pre-tested on the material to be covered in the program. Internal reliability of the pre-test was measured by a split-half correlation. It was .62, as corrected by the Spearman-Brown Prophecy formula.

Three months after the pre-test, one randomly selected half of the class was again tested to see how much of the information covered in the program they had acquired since the time of the first testing, and before use of the program.

That programs teach has been amply demonstrated in many other studies. Our post-test would show whether this program taught adequately. At this point we wished to determine what part of the increase in knowledge shown by the post-test was due to the use of the program itself, and not the use of a pre-test and to learning from other sources. Half of the class was used so that we could test the hypothesis that the use of a second pre-test

would lead to significant gain in post-test scores for those students who had the additional practice.

Immediately after pre-test #2, the entire class was given the program to use. They were told that the program replaced three hours of class time and the six hours of expected preparation for those classes. They had the program for one week and could use it wherever they wished for as long at a time as they wished, could take notes or not as they chose, and could attend a discussion session on the material at some future time if they wished to do so. They were told that the material was part of the regular curriculum and they would be tested on it as on any other content. Each student was given a response sheet and asked to make the response to each item which the program called for, in the left-hand column. If an error was made the corrected response was to be placed in the right-hand column. Any comments on an item or suggestions for change could also be entered in the right-hand column. Students were asked to record the time they spent on the program. They were told that time spent would in no way affect grades, but that this information was needed to evaluate the material.

One week after the use of the program all students were post-tested on the material and response sheets were collected for analysis. Two weeks after the use of the program an optional discussion period was held, at which about one-third of the group appeared. These students wished to continue a discussion of the material covered and to raise questions of how they were going to use it in the clinical situation.

VI. Findings

A. Revision of the unit, "An Introduction to Radiation Therapy".

The revision of this unit resulted in several changes:

1. The revised unit, though longer (318 frames against 221 frames in the earlier version) took students less time to complete, 1½ to 3½ hours as opposed to 2½ to 4½ hours on the first version.
2. The error rate decreased from 16% to 4%.
3. Learning, insofar as it could be measured by a paper-and-pencil test, was greater with the revised program.

One indication of the effectiveness of a programmed unit as a teaching tool can be shown by calculation of the modified gain score. This score is derived by a method of calculating achievement, which allows for individual differences in the level at which students start, and computing gain score in terms of the amount of growth possible for each student (24).

$$\text{MODIFIED GAIN SCORE (\%)} = \frac{\text{POST-TEST} - \text{PRE-TEST}}{\text{MAXIMUM} - \text{PRE-TEST}}$$

A mean modified gain score for a group represents that percent of gain possible to the group which was actually achieved. The M.G.S. for the students who used the earlier version of the unit (N=41) was 51.6%, while that of the first class to use the revised version (N=44) was 60.53%. A modified gain score of 50% is considered reasonable achievement for any form of instruction, and is generally accepted as the benchmark for programmed material.

B. Alternate uses of the program in the nursing curriculum.

Table #2 shows the pre-study variables on the 81 students who used the radiation therapy program in different ways in the course in Medical-Surgical Nursing I. The group represents two college classes, each of which was randomly divided into four sections. In spite of the random division, Group A in the class of 1966, had significantly higher verbal scores on CEEB than did Group B, of 1966. In the second class the situation was reversed, Group B, of

of 1967 students had significantly higher verbal scores. When all the Group A students (1966 and 1967) were combined and all the Group B students (1966 and 1967) were combined, there were no statiscally significant differences in pre-testing variables between the groups.

TABLE #2

COMPARISON OF PRE-TESTING VARIABLES

Classes of 1966 and 1967 using
"An Introduction to Radiation Therapy"

	GROUP A		GROUP B	
	1966	1967	1966	1967
	(N-22)	(N-19)	(N-22)	(N-18)
Mean Age	21.5 yrs	21.3 yrs	21 yrs	21.4 yrs
Mean CEEB scores				
verbal	590.90	550.05	552.30	601.61
math	603.70	574.10	572.60	567.00
Point-hour ratio	2.9	2.7	2.8	2.8
Cancer Quiz	81%	83.9%	80.9%	84.9%
NLN Med-Surg. Achievement Test	93.80	73.35	91.90	81.55

The null hypothesis was applied to state that there would be no significant difference in the learning of the two groups, as reflected in their gain scores from pre-to post-testing. Table 3 describes test scores on these groups. On the basis of scores in the first class of students, the null hyposthesis could not be supported. Pre-test scores of Group A and Group B of this class showed no statistically significant difference. However, Group A, which used the program with clinical experience, scored significantly higher on the post-test. The difference was significant at the .01 level of confidence, when a t-test was applied. The point-gain from pre-to post-test was higher for Group A than for Group B. This difference was significant at the .05 level of confidence when a t-test was used. Since there was a significant difference between the groups on one pre-testing variable, the verbal score, it was necessary to repeat the study with the next class of students.

TABLE #3

DESCRIPTION OF TEST SCORES

Classes of 1966 and 1967 using the Radiation Therapy Program in Alternate Ways

	GROUP A		GROUP B	
	1966 (N-22)	1967 (N-19)	1966(N-22)	1967 (N-18)
Pre-test Mean	55.70	55.10	56.40	53.50
Median	56.00	56.50	56.30	51.50
Range	35	47	38	37
Post-test Mean	86.60	80.90	81.50	83.20
Median	86.50	82.00	82.00	84.00
Range	22	30	24	35
Point gain, Mean	30.40	26.30	25.10	29.70
Modified Gain Score	65.40%	54.90%	53.90%	29.90%
	60.53%		56.60%	
One year Retention Mean	77.60		74.41	

When all Group A students, who used the program with clinical experience were compared with all Group B students, who used the program with their classes in cancer nursing, there were no significant differences between the groups on pre-testing variables. There was no significant differences on pre-test scores, post-test scores or point gains between the two groups. The null hypothesis was upheld. Both groups made significant gains in learning but there was no significant difference in the amount of learning between the two groups.

The Modified gain score for Group A was 60.53% and for Group B 56.60%. This difference suggests that there may be an advantage to the use of the program with clinical experience, over its use as an assignment during cancer nursing classes.

The one year retention test with the first class demonstrated that there was a high level of retention. It did not seem necessary to repeat this measurement, with subsequent classes.

C. Use of the program, "An Introduction to Radiation Therapy" in other college programs.

1. Trial 1 was a test of the program in which alternate groups of senior nursing students in a college program used the program or had a lecture presentation of the material during an affiliation at a cancer hospital. Table #4 shows the pre-testing variables and test scores on these students. There was no significant difference on pre-testing variables or on pre-test scores. Both post-test scores and point gains were significantly higher in the experimental group. These differences were significant at the .01 level of confidence. (t value 4.33 with 73 degrees of freedom on post-test scores; t value 4.99 with 70 d f on point gains.) Insofar as our test instruments could measure the students using the program learned significantly more than those taught by a traditional lecture presentation when the same objectives of instruction were used, and the same clinical experiences and observations made available to the students.

Table 4

Trial 1: Program vs Traditional Presentation

	Experimental Group (N-39)	Control Group (N-38)
PRE-TESTING VARIABLES		
Mean Age	24.1 years	22.9 years
Mean CEEB Scores		
Verbal	512.61	525.39
Math.	477.55	481.22
TEST SCORES		
Pre-test	52.89	55.42
Post-test	75.58	67.83
Point gain	22.05	13.41

2. Trial 2 involved the use of the radiation therapy program with the Junior and Senior classes in a University Nursing Program. There were no pre-test factors available except for age and grade-point averages. The seniors averaged a year older and grade-point averages were not significantly different between the groups.

Table 5

Trial 2: Use of Radiation Therapy Program by a class of college juniors and a class of college seniors

TEST SCORES

	Juniors (N-17)	Seniors (N-13)
Pre-test mean	46.00	54.92
Post-test mean	86.43	84.77
Point Gain	40.43	29.75
Modified Gain Score	70.93%	61.86%

Table #5 shows test scores on the two groups of students. Pre-test scores were significantly different, as were the point gain scores. Pre-test scores were lower in the junior group. Point gains were significantly higher in the junior group, at the .01 level of confidence. However, post-test scores were not significantly different for the two groups, indicating that while the juniors started lower, they caught up to the seniors in this area and the two groups finished at a comparable level of achievement. While the M.G.S. is higher for the juniors, it was not a statistically significant difference between these small groups. For both classes modified gain scores were unusually high and suggest both an enthusiastic acceptance of the program and a highly satisfactory use of the unit.

D. Results of the Questionnaire:

Ninety-four (94) questionnaires were completed by students from four nursing programs who used the Radiation Therapy program. Tables #6, #7, #8 summarize responses to the questionnaire. There was a greater range on time spent on the program within each school group than there was between groups from any two schools.

Responses to the questions about whether the student felt he had acquired information which was useful in patient care and whether he felt more comfortable about that care were consistently positive and confirmed our observations that students appeared more comfortable and more effective in the highly specialized clinical area of the Radiation Therapy Department.

80% of the students replying to the questionnaire indicated that they would like to use the program in association with clinical experience in the care of patients treated by radiation therapy, though only 43% of them had actually used it in this way. (See Appendix VII for questionnaire, and summary of added comments.)

Results of Questionnaire on

Self-Instructional Program, Revised Version

"Introduction to Radiation Therapy"

by Josephine Craytor

Table #6

Summary of Student Attitudes Toward Program and its Effectiveness (N=94)

	Yes	No
Did you like using this particular program?	85%	15%
Would you like additional programs?	95%	5%
Was the material interesting?	95%	5%
Was the material difficult?	34%	66%
Did program improve your knowledge about caring for patients being treated by radiation?	98%	2%
Did program change your feeling about caring for patients being treated by radiation?	89%	11%

Table #7

Summary of Student Use of Program (N=94)

Did you write your responses to items?	All 62%	Some 24%	None 14%
Did you take notes as you went along?	Many 6%	Some 41%	None 53%
Would you like quizzes in the program?	Frequently 42%	Some 33%	None 25%
Would you like references with the program?	Several 1%	Some 90%	None 9%
Did you read the directions?	Thoroughly 7.4%	Generally 91.6%	Not at all 1.0%
Did you read the bibliography?	Thoroughly 9%	Generally 63%	Not at all 28%
Did you "skip" sequences when given an opportunity?	Always 19%	Sometimes 42%	Never 39%

Table #8

Reactions Concerning Time of Use and Placement
(N=94)

	Hours			
How long did it take you to complete program?	0-2 3%	2-3 50%	3-4 37%	4-+ 10%
How much of the program did you complete at first sitting?	Less than half 38%	About half 46%	Three Quarters 6%	All 10%
When would you prefer to use this material?	Senior Nursing 3%	Med-Surg-Nurs. 17%	With Clinical Experience 80%	

E. Trial of the program, "An Introduction to Cancer Nursing"

Table #9 shows the pre-testing variables on the students who used the second program, "An Introduction to Cancer Nursing." The randomly divided halves of the class showed no significant differences on any of the variables.

TABLE #9

PRE-TESTING VARIABLES ON TWO GROUPS
USING "AN INTRODUCTION TO CANCER NURSING"

	GROUP I (N-25)	GROUP II (N-24)
Mean Age	23.16 years	22.13 years
Mean CEEB Scores		
Verbal	612.86	607.79
Math.	603.05	598.37

Table #10 shows test scores and the time spent on the program. The mean time for all students using the program was just over five hours and the range was from three to seven hours. There was no statistically significant relationship between time spent on the program and post-test scores or modified gain scores (r=0.105).

Pre-test scores for Group I were significantly higher than those for Group II. (t value=2.05 with 47 degrees of freedom.) Since the groups had been randomly divided and were equivalent on all observed variables we could not explain the difference on any basis but the special knowledge and/or interest of a few students. In Group I there was a significant change in scores from the first pre-test to a second pre-test two months later. (t value 5.42, with 48 df.) The gain in factual information could result from:1) the learning possible in taking a well-designed test, 2) clinical experience during the intervening two months, 3) classes which touched upon related material, and/or special student interest. The gain was relatively uniform and so did not come

from concentrated study by a few students. 55% of the students in the group had had a brief clinical experience in Radiation Therapy during the intervening time, and hence had some limited exposure to knowledge in this field. The group who had this experience scored an average of 23.7 points higher on the second pre-test, while the group who did not have the experience gained 16.9 points. The difference was not significant at the .05 level. (t value 1.37, 23 d f) From the second pre-test to the post-test, after the use of the program, Group I made a much greater gain, as would be expected.

Group II, without the second pre-test made equally significant gains from pre- to post-testing. Scores of the entire class from pre- to post-testing showed gains which are significant at the .001 level. (t value 17.04 with 48 d f) In spite of the fact that Group I scored significantly higher on the pre-test, the post-test means of the two groups showed only a small difference, barely significant at the .05 level. (t value 1.69 with 47 d f) These findings refuted our hypothesis that the group (I) given the practice of a second pre-test would make a significantly greater gain from pre- to post-testing. In fact Group I gained less than Group II, though the difference was not significant at the 0.05 level.

TABLE #10

DESCRIPTION OF TEST SCORES ON STUDENTS
USING "AN INTRODUCTION TO CANCER NURSING"

	GROUP I (N-25)	GROUP II (N-24)
Pre-test #1 Mean	125.40	115.91
range	61.	66.
Pre-test #2 Mean	146.12	
range	47	
modified gain score	26.36%	
Post-test Mean	183.20	178.79
range	32	43
Gain score mean	58.80	62.87
Modified gain score		
Pre-test #1 to post-test	74.04%	71.12%
Pre-test #2 to post-test	64.06%	
Time in hours	5.15	4.97

That the program teaches effectively was shown by the modified gain scores of 74.04% for Group I and 71.12% for Group II. Generally a M.G.S. of 50% indicates satisfactory gain with programmed materials. Differences in the groups were reduced by the use of the program. The modified gain scores between the two groups showed no significant difference. (t value 0.91 with 47 d f)

Group I had a modified gain score of 26.36% without instruction from pre-test #1 to pre-test #2. From second pre-test to post-test, after instruction, the group had a modified gain score of 64.06%, This part of the gain can be said with assurance to be due to the use of the program.

Group II without the experience of a second pre-test made gains as great as did Group I.

VII. Conclusions and Recommendations.

Our experience with the use of two programmed units in a college nursing program has been very positive. The programs taught effectively, the material was appropriate to the students for whom it was used, and the students found the method acceptable. One unit was used at different times with different students with a related clinical experience, and the other was used at the same time for all students in a course in Medical-Surgical Nursing. Though the difference was not remarkable, we found some evidence that a program designed to help prepare students for clinical practice in a specialized area was more effective when used in conjunction with the clinical practice than when it was used as a class assignment.

We have just begun to explore the flexibility of programs for meeting special instructional needs, such as preparation for special clinical experiences, supplying deficiencies in basic preparation, for review, make-up, or for enrichment of the curriculum.

Students found programs an easy way to learn and there was saving of both instructor and student time. The saving of instructor time resulted from the fact that students could use a program to replace a two-hour class which had to be repeated with a new group of students each week.

Students having saved time from class work and outside preparation could spend more time on patient problems.

We found again that the way in which material was presented to students influenced their use of it. In those study situations where students were told how they could use a program, how long they had to accomplish certain objectives, and how their accomplishments would be evaluated, they performed better and indicated greater satisfaction than when a program was passed out as optional assignment with vague or indifferent directions.

The set of detailed behavioral objectives developed for a self-instructional program was very useful as a basis for developing a check-list to evaluate performance in one clinical area. We believe that combining a critical incident technique with a clear definition of behavioral objectives offers promise in developing more precise tools for measuring clinical performance. (See Appendix III)

In each of the four study situations reported here, the use of programmed materials brought all students to a more nearly uniform level of achievement. While there were wide variations in the time it took students in all groups, there was no significant correlation between time used and student achievement.

To draw conclusions from a group as small as the Trial 2 group (N=30) is somewhat hazardous, but the findings are suggestive. In this limited sample a program designed for use with college juniors was used more efficiently by juniors than by seniors. Further study of such questions is needed.

While it is no longer necessary to demonstrate that programs teach, each new program must be tested and each faculty group must learn to use programs most effectively if they are to be worthwhile. Some small studies of the use of programmed units within various educational programs will continue to be useful to faculty members involved.

Writing programs is a difficult and time-consuming job. We feel that following the method of carefully developing a criterion instrument, before attempting to write the program itself, increased the efficiency of the writing. (22)

The effectiveness of programs in teaching this material confirmed our belief that self-instructional methods can become very important in most nursing education programs, and offer one of the best means to extend the effectiveness of the present supply of nursing educators. Like any other teaching method, programming must be used appropriately and with imagination. Finally, in addition to increasing our knowledge in the use of programs, we need to increase the numbers of programs suited to use with students in all levels of nursing education.

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APPENDICES

APPENDIX I

REVISED OBJECTIVES FOR "AN INTRODUCTION TO RADIATION THERAPY"

OBJECTIVES USED IN DEVELOPING THE UNIT

"AN INTRODUCTION TO RADIATION THERAPY"

1. The student will list the three major treatment modalities used in cancer therapy and indicate which are used for cure and which for palliation.

2. The student will list the sources of ionizing radiation most frequently employed in therapy.

3. The student will use correctly such words as tumor, neoplasm, cancer, malignant, benign, metastasis, palliation, roentgen, curie.

4. The student will label a Bohr-Rutherford model of the atom.

5. The student will explain to her classmates the need for prolonged or extensive treatment for the cure of a malignant tumor.

6. The student will explain, in terms which most patients can understand, the reason for early treatment of malignant tumors and for completing the course of treatment designed and directed by the physician(s).

7. The student will list three symptoms most frequently noted by patients as a result of external radiation treatments.

8. The student will list those observations of the patient most important for the nurse to make and report during a course of therapy.

9. The student will list at least four differences between benign and malignant tumors.

10. The student will instruct patients in correct methods of skin care during radiation therapy.

11. The student will list at least four ways in which skin damage is held to a minimum during external radiation.

12. The student will explain to patients the importance of preserving port markings during the course of therapy.

13. After consultation with the physician the student will help the patient modify his diet or will refer him to someone who can help with diet planning when the patient exhibits anorexia, mucositis of the oral cavity, sore throat, nausea (with or without vomiting), diarrhea, or weight loss.

14. The student will list some of the factors which the physician considers in choosing or rejecting radiation therapy for the treatment of a given individual.

15. The student will explain, in a simplified way, to the patient who is interested, some of the changes which radiation therapy causes in a tumor.

16. The student will explain to co-workers the need for protection from unnecessary exposure to radiation.

17. The student will list the three major factors in protection from radiation exposure and give an example of how each is used.

18. The student will set up a plan of nursing care for a patient with a source of radiation in his body which is safe for the patient, the nursing personnel, and other people in the area.

19. The student will help family members plan with the patient for care at home during a course of radiation therapy.

20. The student will reassure the patient that he presents no danger to other people during a course of external radiation.

21. The student will explain to the patient what is expected of him during a course of external radiation.

22. The student will work with patients in a radiation therapy department with reasonable care and without obvious anxiety over exposure to ionizing radiation.

APPENDIX II

DIRECTIONS FOR STUDENTS: INTRODUCTION TO RADIATION THERAPY

Introduction to the Unit, and ~~to the Teacher~~
Notes to the Teacher

SUGGESTIONS FOR THE USER

This is a self-instructional program, otherwise known as a programmed instructional unit. Material is presented in such a way that you may progress at your own pace. Information is arranged in short logical steps, called frames or items. Each item requires some response from you in which you use the information you have just learned. This may be in the form of a written word, a phrase, a number, or a check mark. Immediate knowledge of whether or not you are right reinforces learning. It will help you if you will remember that this is a method of learning, not a test, and not a traditional textbook. You will need to read each item and to make a written response at each step.

If you use a notebook size sheet of paper on which to write your responses, you can use the same paper as a mask, placing it below the item as you read it, writing your response, then moving it down to reveal the confirming response. Since the purpose of the program is to teach, not just to give information, you will find ideas presented in several different ways in different items. By reading frames carefully, and writing your responses before looking at the printed answer, you can learn efficiently and effectively. Move at a pace which is comfortable for you. There is no prize for rapid work and no penalty for moving slowly.

If you use the unit carefully you will find that you have:

1. reviewed a number of concepts about malignant disease which are necessary to an understanding of the unit;

2. reviewed concepts from the physical sciences which are basic for some understanding of ionizing radiation;

3. learned methods of using ionizing radiation in therapy;

4. developed some understanding of why the treatment method is selected and how it is effective;

5. learned something about the body's response to radiation and how this can be handled; and

6. learned methods by which you can assure protection for your patients and safe practice for yourself when dealing with radiation therapy.

If you use this second half of the program carefully, you will:

1. review some of the concepts presented in the first part of the unit;

2. learn some of the biologic effects of radiation;

3. learn some of the factors considered by the physician in selection or rejecting radiation as treatment for a particular patient;

4. learn the therapeutic results of treatment;

5. learn the side effects which may accompany radiation therapy;

6. learn some ways in which therapeutic effects are enhanced and side effects reduced in treatment;

7. learn measure to practice and to teach patients, to prevent or reduce unpleasant sequellae to treatment;

8. learn what observation of the patients need to be made, reported, and acted upon during treatment;

9. learn methods to assure protection for your patients and safe practice for you when dealing with ionizing radiation.

An Introduction to RADIATION THERAPY

This unit on radiation therapy is designed for students of nursing and is the first of several projected units that will deal with various areas of knowledge important to planning and providing effective nursing care for the individual with cancer.

Since:

a. about one fourth of the total population of this country will have cancer at some time in their lives,

b. a fourth of those who have cancer are referred to radiologists during their illness,

c. and most or all of these people require nursing care at different stages of therapy, it follows that nurses need to be informed about radiation therapy and comfortable in working with patients being treated with radiation.

This unit has been used to supplement a medical-surgical nursing textbook, and is most helpful when combined with clinical experiences with cancer patients.

To the Teacher:

This unit on radiation therapy grew out of a need to prepare nursing students to care for patients treated with radiation and to do this with a reasonable expenditure of time - for instructors as well as students. Both collegiate and diploma students used the material during its development. Areas which are elementary for collegiate students can be skipped as directed in the text or be used for quick review. These areas were retained at the request of graduate nurses who used the material and who felt they needed this extra information.

This unit was planned as one of several dealing with different areas of knowledge basic to informed nursing care of the individual with cancer. Since about one-fourth of the people in our population have cancer during their lives and since about a fourth of the people known to have cancer are referred to a radiologist during their illness, nurses need to be informed and comfortable about radiation therapy in order to work effectively with many of their patients.

Several studies have been done using this material at different stages in its development. The first study showed that students using the program, in a preliminary form, learned more than their peers who attended lecture presentations. [1]

Because of turnover of staff in Radiation Therapy it was not possible to have a controlled study of student performance in the area. However, those observations which were made pointed to a marked change in the degree of participation by students in the care of patients in the department when they had used the program. Before we used the programs students seemed uneasy and expressed concern about possible hazards in the area and about their feelings of inadequacy in answering patients' questions. They tended to be observers more often than participants. Since we have assigned the program for use the day before a clinical experience in the area, students appear comfortable, ask pertinent questions about the treatments and make simple explanations to patients, give supportive care, and teach self-care measures. Conferences have been lively and students make reasonable plans for patient care.

We have used the program as a supplement to the text used in Medical-Surgical Nursing and have found it most effective when used in conjunction with clinical experience with patients being treated by radiation. This program covers one small area of cancer nursing. Students have spent one and a half to three and a half hours on the program as an outside assignment. Graduate nurses (15) who have used the material have been four to twelve years from their last formal education and have spent longer on the program, ranging from four to six hours.

Currently an analytic study is being made of the program over a larger population of students. This will provide more data on its effectiveness and will give specific information on the value of changes and revisions made on the basis of the earlier controlled use of the material.

A preliminary examination of the data indicates that gain scores are higher among students using the revised edition. We anticipate that it will be even more effective than the earlier versions.

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[1]Craytor, Josephine K., Lysaught, Jerome P. "Programmed Instruction in Nursing Education: A Trial Use," Nursing Research, Fall 1964, Vol. 13, No. 4, pp. 323-326.

APPENDIX III

PAPER PRESENTED AT NATIONAL CONVENTION NSPI,
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CRITICAL INCIDENT TECHNIQUE, PROGRAMMED INSTRUCTION AND NURSING EDUCATION

Josephine K. Craytor*
Associate Professor of Nursing
School of Medicine and Dentistry
The University of Rochester

This paper is a report on work in progress on the development of a tool to measure student performance. We have used some aspects of the critical incident techinque to determine effective and ineffective student behavior in giving nursing care to individuals being treated by radiation therapy.

The Problem

The care of the patient treated by radiation therapy is a highly specialized area of practice, in which few nurses are engaged, and about which little has been reported. We wished to include clinical experience in therapeutic radiology as part of an educational unit in cancer nursing. To facilitate this we developed a self-instructional program to give students a background of factual information about ionizing radiation and its use.

Over a period of three years students demonstrated, on paper and pencil tests, that they did learn from the program (Craytor and Lysaught 1964). Partially as a result of the program, students seemed to be more comfortable in the radiology department, asked intelligent questions, avoided obvious errors in teaching patients self-care measures.

Related Research

On searching the literature we found some references to the dangers inherent in working with ionizing radiation, limited discussions on what radiation medicine is and does, but little about what nurses can do to assist patients undergoing

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this treatment. We began to observe specific clinical incidents to attempt to determine which nursing behaviors were most helpful.

During World War II several studies were done by the Aviation Psychology Program of the United States Army Air Force to determine criteria on which aircrews could be selected and classified. The critical incident technique evolved from these studies. A critical incident is defined by John Flanagan (1963) as "a sample of behavior which occurs in a situation where the intention of the person is clear to the observer and there is little doubt about the behavior being effective or ineffective for completing the task at hand." Flanagan (1954) reviews some of the studies carried out at the University of Pittsburgh in which the technique was used to determine qualifications for successful job performance in industry.

As it is usually employed the steps in the critical incident procedure are:

1. Determine the general aim of the activity to be studies.
2. Develop plans and specifications for collecting factual incidents regarding the activity.
3. Collect data--the incidents of behavior.
4. Analyze the data, describe it in a manner which can be put to practical use.
5. Interpret and report the requirements of the activity, including a statement of the biases and limitations in the data collection.

Flanagan (1954) emphasizes the basic principles of the critical incident technique as: (a) that reporting of facts regarding behavior is preferable to the collection of interpretations, ratings, and opinions based on general impressions; and (b) that reporting should be limited to those behaviors which, according to competent observers, make a significant contribution to the activity.

In a two-year study of staff nurses in Washington, D.C. in 1956-58 William Gorham and Stanley Lichtenstein (1957) applied these principles to identifying those behaviors which contribute to patient care and improvement and, with Angeline Marchese (1959), used the list of identified behaviors to develop a tool for selecting applicants suited to the functional role of the general staff nurse. In the first of these studies some 2,000 incidents were collected from general staff nurses, supervising personnel (including physicians), and patients in 10 general hospitals. The incidents were classified under 15 categories of behaviors, grouped into five major areas:

I. Improving patient adjustment to hospitalization and illness

II. Promoting patient comfort and hygiene

III. Contributing to medical treatment of patient

IV. Arranging administrative details

V. Personal characteristics

Three hundred and twenty general statements of behavior were developed from the original incidents. The affect values (the degree to which such statements described effective nursing performance) and the discrimination values of the statements were established by sorting procedures with groups of head nurses. These showed high correlations; .97 for affect values; .98 correlation coefficient for "good", and .90 for "poor" sort. All of these, of course, are reliable discrimination value. (Gorham, 1962)

The basic principles of the critical incident technique were later applied to evaluating the performance of student nurses in a study by Flanagan, Marchese, Tuska, and Fevars (1960) at Western Pennsylvania Hospital School of Nursing. Two thousand and thirty-seven incidents of student behavior were collected and classified into 12 behavioral areas. From this classification a record form was developed on which

sufficient categories are listed so that it is possible to record incidents of all types of behavior found in their study to be significant in patient care and improvement. Use of the record form showed that it was acceptable to students and instructors and could be used with reasonable expenditure of time. (Flanagan, Gosnell, Fevars, 1963)

The critical incident technique is based upon observing, recording, and weighing actual behaviors which make a difference between success and failure in carrying out a job assignment. The method has been used to study the behavior of both general staff nurses and student nurses and has been effective in identifying those behaviors which contribute to success on the job. There seems to be a logical relationship between this technique, based as it is on the identification of behaviors, and programming which is primarily developed around the specification of behavioral objectives, or outcomes, of learning.

Procedure

Both of the applications of the critical incident technique to nursing practice cited above covered a wide range of nursing functions and applied to nursing care in an acute hospital setting. Our need, on the other hand, was to focus on behaviors important in a highly specialized area where the care of the ambulatory patient overshadowed that of the hospitalized individual.

When they first come to the radiation therapy department, many students are anxious about their own safety and are reluctant to participate in patient care. Those who are most effective generally have more knowledge about radiation and ask more questions. The self-instructional program which was developed at Rochester began as an effort to answer the common student questions thought to be basic to effective practice in any setting where ionizing radiation is used therapeutically.

The objectives for the paper and pencil program were based on five years' observation of student nurse behaviors in a radiation therapy department. While we did not systematically follow the steps outlined in the critical incident procedure for defining our objectives, we did note effective and ineffective behaviors. Nevertheless the pencil and paper test which we used as our criterion examination measured only growth in factual verbal knowledge. To develop a tool to measure other behaviors we revised our program objectives to include, as comprehensively as possible, a statement of the desired behavioral outcomes of an educational experience in radiation therapy. Examples were selected from actual incidents that illustrate effective and ineffective student behaviors in each of the 14 categories covered in the objectives.

Examples of objectives and their illustrative incidents include:

Category 3. The student will check the skin areas included in the treatment field, daily, without being reminded to do this.

Incident A. (effective) Student goes into the treatment room with her patient as he is set up for a treatment given through a port on the anterior chest wall. She looks at the skin in the field and then checks the posterior chest where an exit dose is received.

Incident B. (ineffective) Student accepts patient's answer that everything is fine at the beginning of the third week of post-operative irradiation after a radical mastectomy, without inspecting the skin or asking any more specific questions.

Category 4. The student will care for the patient's skin avoiding mechanical irritation, heat or cold, and using only water, vegetable ointment or medication prescribed by the physician.

Incident A. (effective) Student gently washed sacral area of elderly woman being treated through anterior and posterior pelvic ports, using clear tepid water and patting dry. She urged patient to be up and about and avoid lying on back during the day.

Incident B. (ineffective) Student applied brand name ointment, the contents of which she did not know when questioned, to the axilla of a woman who had redness and itching in this area during intensive radiation from inoperable breast carcinoma.

Then we arranged the behaviors in a checklist to be used in observing student performance. That most of our selected behaviors, or comparable behaviors, discriminate between "good" and "poor" nursing has already been demonstrated by Gorham (1962). A portion of our checklist is shown in Figure 1.

FIGURE 1

		Always	Frequently	Seldom	Never does	Not Observed
APPLY	3. Student checks skin included in treatment field daily.					
Can the student use knowledge?	4. Student cares properly for patient's skin using water, vegetable ointment or prescribed medication only.					
	5. Student helps patient adjust diet when he exhibits anorexia, nausea, etc.					
	6. Student deals appropriately with patient problems such as sore throat, malaise, etc.					

The checklist, directions for its use, the behavioral objectives, and the incidents illustrating effective and ineffective behaviors in each of the categories, were submitted to six nurse experts. They were asked to decide which behaviors were typical of "good" nursing in the field, which could be expected of students, and which could be observed in the clinical setting with which the instructors were familiar. A Summary of their responses is shown in figure 2.

FIGURE 2

	Proportion of 14 Behaviors		
	All 14	Most, 8-12	Few > 8
I. Effective Behavior			
a. Desirable	6		
b. Fostered in home situation	4	2	
II. Student Behavior			
a. Expect of all good students	2	4	
b. Expect with assistance	6		
III. Can observe in Clinical Setting			
a. For each student	0	1	5
b. For some student in each group over a 3 week period	5	1	

All of the judges were experienced nurses closely associated in teaching the care of and/or caring for cancer patients. All said that they felt the statement of behaviors was extremely valuable in establishing criteria for effective performance in the speciality, that these had not been clearly stated before, that the incidents helped to illustrate the behaviors, and that the checklist with the incidents could be given students and staff nurses as a statement of goals to be achieved. They felt that if instructors studied and tried to use the checklist it would sharpen their own awareness of desirable behaviors.

Only one of the nurses felt that she would have an opportunity to try the checklist experimentally in the immediate future. She and one co-worker plan to use the checklist with at least five students during a 3-week experience in a cancer hospital, to determine first, how many of the behaviors they can observe, and second, whether the form is easy to use or needs further revision. We will try it out in our own center with an equal number of students.

Applications and Conclusions

We hope to use this checklist to evaluate how our pencil and paper self-instructional program changes nursing behavior, to determine, for instance, whether knowing the fundamentals of skin care during radiation therapy means that a student will give good skin care or will teach a patient to care for his skin. We hope to use the checklist as the basis for counseling students about such things as: recognizing the need for patient teaching; for using more precise measures for protecting their own and other peoples' health; and for reporting observations more completely and more accurately. Finally, we would like to determine whether the relationships between the results on the paper and pencil test of the program and resultant behavioral performance, as recorded on the checklist, are closely enough correlated so that we can use the test as a predictor of performance in the clinical area.

If it is not possible to observe the listed behaviors in a typical hospital stiuation well enough to judge students' performance in the clinical area, it may be necessary to set up special situational testing exercises under simulated conditions.

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APPENDIX IV

CHECKLIST, DIRECTIONS, LIST OF BEHAVIORS WITH ILLUSTRATIONS

University of Rochester
DEPARTMENT OF NURSING

CLINICAL PERFORMANCE IN THE NURSING CARE OF THE PATIENT BEING TREATED BY RADIATION THERAPY

Checksheet for the Nursing Instructor

Name of Student _____

Name of Observer _____

Date of Observation _____

Date form completed _____

		Always	Frequently	Seldom	Never does	Not Observed
KNOW Is the student knowledgeable?	1. Student uses correctly such terms as tumor, cancer, etc.					
	2. Student refers to treatment equipment by correct name: Cobalt unit super-voltage x-ray machine, etc.					
APPLY Can the student use knowledge?	3. Student checks skin included in treatment field daily.					
	4. Student cares properly for patient's skin using water, vegetable ointment or prescribed medication only.					
	5. Student helps patient adjust diet when he exhibits anorexia, nausea, etc.					
	6. Student deals appropriately with patient problems such as sore throat, malaise, etc.					
	7. Student works around sources of radiation with reasonable precautions but without apparent anxiety.					
	8. Student sets up a plan for nursing care of patient with a source of radiation in body.					
	9. Student answers patient questions accurately and in appropriate terms.					
COMMUNICATE Can the student communicate with patients, colleagues effectively?	10. Student records in chart and reports to charge nurse evidence of adverse reactions.					
	11. Student explains to the patient what is expected of him during treatment.					
	12. Student instructs patients in skin care and other measures of self care during treatment.					
	13. Student reassures patient who complains of side effects expected during Rx.					
	14. Student instructs patient in home care during and after Rx.					

Comments: Please use back of sheet for further comments

Rate this student's performance as: Outstanding ___ Good___ Average___ Poor___ Not Acceptable___

University of Rochester
DEPARTMENT OF NURSING

TO: Instructors in Nursing

RE: Observation Checksheets on Student Performance in Nursing Care of Patients Being Treated with Radiation Therapy

The evaluation of clinical performance of students has been one of the most variable aspects of nursing education. It is possible to ascertain whether a student has acquired factual information. It is more difficult to determine whether she uses this information. It is still more difficult to arrive at an objective evaluation of her performance in a clinical area.

The care of the patient being treated by radiation therapy requires many basic nursing skills. However, in addition to these skills, effective care utilizes specific knowledge identifiable as different from that used in other areas of nursing. It is the use of this specific knowledge which the attached checklist is designed to evaluate.

The checklist is made up of a list of 14 behaviors which we feel characterize desirable nursing behavior in the care of the patient being treated by radiation therapy. On the right side of the checklist are five columns to be checked as the behaviors are observed. There is a final summary question where you are asked to rate this student's behavior against your own picture of behavior characteristic of good nursing in this clinical situation. The back of the sheet may be used for additional comments.

While there are brief examples for each category on the checklist, you may wish amplification of these. With these instructions you will find included:

a. a checklist for each student to be observed
b. a more detailed statement of the behaviors, and
c. some examples of behavior drawn from observations of student performance.
   Examples marked, Incident A represent desirable behavior.
   Examples marked, Incident B show less acceptable behavior.

If there are questions about the categories or marking the checklist please consult us before you begin making your observations.

STATEMENT OF BEHAVIORS WITH EXAMPLES

Category 1. The student will correctly use such words as tumor, cancer, malignant, benign, metastases, palliation, etc., in written and oral reports on patients for whom he/she is caring.

Incident A. Student, in reply to question from the attending physician correctly distinguishes between palliation and cure, and indicates that she understands that her patient is receiving palliative treatment.

Incident B. Student refers to a patient with a keloid as having a cancer, without being able to distinguish between benign and malignant tumor.

Category 2. The student will refer to treatment equipment by its correct name, not by nicknames or approximations. For example, the student will use correctly such terms as cobalt unit, Vandergraaf unit, super-voltage x-ray machine, etc.

Incident A. When asked where a patient was to go in the department the student replied that she was being treated on the Cobalt Unit and she would show her the way.

Incident B. When asked if she had seen a patient treated for basal cell carcinoma by radiation, the student said, yes, on that little tiny machine in the first room.

Category 3. The student will check the skin areas included in the treatment field, daily, without being reminded to do this.

Incident A. Student goes into the treatment room with her patient as he is set up for treatment through a port on the anterior chest. She looks at the skin and checks the skin area on his back which receives an exit dose or radiation.

Incident B. Student accepts patient's comment that everything is fine at the beginning of the third week of post-operative radiation after a radical mastectomy, without inspecting the skin or asking any more specific questions.

Category 4. The student will care for the patients' skin avoiding mechanical irritation, heat or cold, and using only water, vegetable ointment, or medications prescribed.

Incident A. Student gently washed sacral area of elderly woman being treated through anterior and posterior pelvic ports, using clear water and patting dry. Patient was encouraged to be up and about and avoid lying on back for long.

Incident B. Student applied brand name ointment, the contents of which she did not know, to the axilla of a woman who had redness and itching in this area during intensive radiation for inoperable breast cancer.

Category 5. The student will help the patient modify his diet or refer him to someone who can help with diet planning (with the physician's permission), when he exhibits marked anorexia, mucositis of the oral cavity, sore throat, nausea, vomiting, diarrhea, or significant weight loss.

Incident A. When a patient being treated rotationally to the esophagus found orange juice too irritating to swallow, the student suggested that he have a large glass of diluted lemonade twice a day and that he have it cool, not iced.

Incident B. When a patient being treated on the Cobalt Unit through an anterior pelvic port complained of mild diarrhea the student replied that this was to be expected and suggested no modification in diet.

Category 6. The student will deal appropriately with patient problems during external radiation therapy. These problems may relate to those already cited, skin care, nutrition, and to such things as mucositis, difficulty in swallowing, sore throat, cough, fatigue and malaise, etc.

Desirable behavior in relation to any of the possible problems: making pertinent observations, reporting and recording these observations, and using nursing measures to protect the patient and to insure comfort if this is possible.

Incident A. A student notes that a man being treated for cancer of the esophagus has lost three pounds in a week. In reviewing his eating habits with him she discovers that he is having increasing difficulty in swallowing. She reports this to the physician, records it in the patient's chart, and plans with the patient those modifications in his diet which will give him an adequate diet on very soft or full liquid feedings.

Incident B. Student is present when a patient having post-operative radiation after a mastectomy complains of a sore throat. Student offers no assistance and fails to report the symptom.

Category 7. The student will work with patients being treated by radiation with reasonable precautions and with no apparent anxiety.

Incident A. Student closes door carefully as she comes out of the treatment room and when asked if she is not afraid to work here says, no, that the floor, walls, doors and windows are all adequately shielded and that the patients treated by external radiation do not emit harmful radiation.

Incident B. Student was noticeably uneasy in the treatment area and did not approach or work with the patients.

Category 8. The student will set up a plan of nursing care for a patient with a source of radiation in his body. The plan will confirm with the regulations of the agency and will provide for:

a. all possible care measures carried out before source material placed in patient,
b. patient placed at safe distance from all other patients, in private room if possible,
c. radioactive hazard warning sign in place on bed and on door, if private room,
d. daily care given quickly and effectively within time allowed on orders,
e. patient encouraged to do all reasonable for himself,
f. frequent explanations to patient and encouragement to tolerate the inactivity,
g. explanations of precautions made to other personnel and to visitors,
h. laundry, excreta, other waste, trays, etc. handled in safe and simple way,
i. suitable diversion for patient,
j. removal of source by physician at designated time,
k. teaching of patient any measures of after care.

Category 9. Student will answer patients' questions accurately and in language appropriate to the patients' understanding concerning such things as,

a. the use of radiation in treatment,
b. length of treatment course and the importance of completing the course,
c. precautions and protective measures,
d. reactions of tumor and of the patient's body to radiation,
e. use of oxygen with radiation when this is done,
f. importance of early treatment of malignant tumors, and
g. the need for continuing follow-up after treatment.

Incident A. When asked why a patient had to be left in the treatment room alone with the door closed during the radiation treatment, the student replied that the treatment the patient received was carefully calculated to control that particular patient's tumor, and that the same radiation over and over during the day to personnel who are treating and working with patients would be harmful to them.

Incident B. When asked by a patient why the patient had to have treatment in the prescribed way the student said that it was because the doctor wanted it that way.

Category 10. The student will report to the nurse in charge and record in the patient's chart any signs or symptoms noted which relate to or affect the course of the patient's illness or treatment, such as erythema, anorexia, malaise, nausea, vomiting, diarrhea, weight loss, etc.

Category 11. The student will explain to the patient what is expected of him during external radiation therapy, if this has not been spelled out by the physician or some other responsible person in the therapy area. Explanations should include:

a. being alone in the treatment room,
b. provisions for communication with the technician during the treatment,
c. absence of any sensation of heat, pain, any other discomfort during treatment,
d. skin care and preservation of port marks,
e. any expected noise or movement of the machinery,
f. person to deal with questions and to be told of any change in the patient's situation,
g. time of appointment and where to come.

Category 12. The student will instruct the patient in skin care during and following external radiation therapy, according to methods preferred in the agency.

Incident A. Student reports slight area of erythema over area being treated on side of jaw, to physician, records observation and instructs patient to avoid mechanical irritation to area, to use only water on skin, to protect side of face from sun and long exposure to cold, and to use no ice bags or applications of heat, to use no ointments or medications except what is supplied here, and to expose the area to air when indoors.

Incident B. Patient being treated for a cancer of the tongue is smoking and says to the student nurse that if his mouth gets any sorer he's going to stop this treatment. She says that it'll be sorer before it gets any better

Category 13. The student will assure the patient who complains of fatigue or of feeling dragged out that this is an expected accompaniment of treatment and will help him plan for more rest, some assistance at home, better food intake, etc., as indicated.

Category 14. The student will help the patient and family plan for care at home if this is necessary.

Incident A. Student discusses home situation with woman who has weeping erythema on chest wall following intensive radiation therapy for inoperable breast cancer and, after consultation with the physician, makes a public health nursing referral for daily dressings, suggests a room deodorizer and encourages the patient to use the oral cholrophyl which the physician had ordered.

Incident B. When told that a patient would need some protection over a small unhealed area of a mastectomy incision between treatments, student gave the patient a handful of 4x4 sponges, some tape, and no further instruction.

APPENDIX V

SAMPLE STATEMENTS FROM THE LIST ON SUBJECT MATTER FOR "AN INTRODUCTION TO CANCER NURSING"

SAMPLE STATEMENTS FROM THE LIST ON SUBJECT MATTER FOR "AN INTRODUCTION TO CANCER NURSING"

Sample statements from the list of 34 submitted to the jury of experts to be evaluated for development in the programmed unit, "An Introduction to Cancer Nursing":

1. Cancer is a generic term which refers to a large group of diseases.
2. Cancer is second only to diseases of the heart and blood vessels as a cause of death in the United States.
3. Cancer may affect any age group.
4. Malignant tumors differ in significant ways from benign tumors.
5. "Cancer" is characterized by disorderly growth of cells.
6. Cancer may originate in any tissue in the body.
7. Cancer leads to changes within a cell which persists and can be reproduced.
8. The great danger from cancer derives from the fact that cell growth does not stop.
9. Some types of cancer are being cured.
10. Cancer may be an acute or chronic disease.
11. Since cancer usually kills if allowed to run its course, treatment for the person with cancer is mandatory.
12. There is probably no single cause for most types of cancer.

APPENDIX VI

PLANNING SHEETS - CRITERION TEXT

Distribution of Questions - Criterion Test

INTRODUCTION TO CANCER NURSING

	Planned		Actual
OBJECTIVES OF INSTRUCTION			
KNOWLEDGE	40%	83	36%
UNDERSTANDING	40%	93	40.5%
THINKING	20%	54	23.5%
SUBJECT MATTER AREAS			
MAGNITUDE OF THE HEALTH PROBLEM	10%	26	11%
THE NATURE OF CANCER	10%	31	13%
PREVENTION	15%	23	10%
EARLY CASE FINDING	20%	77	34%
TREATMENT	25%	35	15%
COURSE OF THE DISEASE	20%	38	16%

EVALUATION INSTRUMENT Page_____

Unit On Introduction to Cancer Nursing Total No.of Items _____

Planned___ Actual ____

Subject Matter	Knowledge	Understanding	Thinking
1. Magnitude of the health problem	3 (#8,9,10)		
incidence	4 (#6,7 17,18)		
gen. cause of death	1 (#1)		
in children	2(#2,3)		
in men, in women	6 (#83-88)		
Survival-lung	2 (#12,13)		
colon,	6 (#65)		
breast	2 (#11,14)		

Number of Items for this Heading				
	Total	26		

EVALUATION INSTRUMENT Page_____

Unit on Introduction to Cancer Nursing Total No.of Items _____

Planned _____ Actual_____

Subject Matter	Knowledge	Understanding	Thinking
2. Nature of Cancer			
Characteristics of tumors of malignant t.		4 (#22) 1 #21	
Definition of tumor, cancer	2 (#19,20)		
Differentiate between benign & mal.tumors		10(#82,124)	
tissue of origin (nomen clature	4 (#91,92, 93,94		
Methods of spread		5 (#66)	
parasitic nature	(in characteristics of tumors)		
destructive invasion			
latent period		1(#130)	
anaplasia	1 (#123)		
host resistance		1 (#125)	
metastasis	2 (#134)		

Number of Items for this Heading	Total			
	31	9	22	

EVALUATION INSTRUMENT Page _____

Unit on Introduction to Cancer Nursing Total No.of Items _____

Planned____Actual_____

Subject Matter	Knowledge	Understanding	Thinking
3. Prevention			
Etiology, general	2 (#26)		
carcinogens	5.(23,24)	1 (#127)	
viruses	1 (#25)	1 (#126)	
heredity	1 (#25)		
pre-cancerous conditions			
skin and/or causes			2 (#89)
lung		2 (#28)	1 (#90)
cervix		2 (#28)	

Number of Items for this Heading	Total 23	8	9	3X2=6

EVALUATION INSTRUMENT Page _____

Unit on Introduction to Cancer Nursing Total No.of Items _____

Planned_____Actual_____

Subject Matter	Knowledge	Understanding	Thinking
4. Early case-finding		11 (#99-106,34 35)	4(15,36,37,38)
danger signs	7 (#75-81)		
control measures		3(#72,73,74)	
diagnostic measures		21 (#67)	
biopsy	3(#33,133)	1 (#31)	
cytology	4.(#29,30)	1 (#32)	
Screening Methods		2 (#39,40)	8 (#95,96,97, 98)

Number of Items for this Heading	Total 77	14	39	12x2=24

EVALUATION INSTRUMENT Page _____

Unit on Introduction to Cancer Nursing Total No.of Items _____

Planned_____ Actual_____

Subject Matter	Knowledge	Understanding	Thinking
5. Treatment			
general considerations	3.(#69,70,71)	1 (#41)	
surgery	9 (#63,64		
pre-op. prep.		3 (#42)	
radiation therapy	1 (#47)		
Chemotherapy	3.(#44,46,47)	3 (#43,127,45)	
adjuvant therapy		1 (#41)	
Aims of treatment		7 (#107-113)	
cure		1 (#4)	
palliation	2.(#135)	1 (#16)	
radical treatment		1 (#5)	
Quacks		1 (#128)	

Number of Items for this Heading	Total 36	18	18	

EVALUATION INSTRUMENT Page _____

Unit on Introduction to Cancer Nursing Total No.of Items _____

Planned____Actual____

Subject Matter	Knowledge	Understanding	Thinking
6. Course of the disease			
carcinoma in situ	3(#49,50,61)		
spontaneous regression	1 (#62)	1 (#129)	
chronic disease	1 (#54)		
metastasis	2 (#56,57)		1 (#53)
incurable disease			
follow-up			1 (#60)
General dangers of neoplasms			
general		2 (#51,52)	9 (114-122)
infection	1 (#132)		
fever		1 (#58)	
malnutrition		1 (#55)	1 (#59)
pain	1 (131)		

Number of Items for this Heading	Total 38	9	5	12X2=24

APPENDIX VII

QUESTIONNAIRE ON RADIATION PROGRAM
SUMMARY OF ADDED COMMENTS

University of Rochester
DEPARTMENT OF NURSING

QUESTIONNAIRE ON THE PROGRAM

Name _____

School _____

Date _____

In order to complete our evaluations of the program for self-instruction, "An Introduction to Radiation Therapy" we would like frank answers to the following questions. Answers will not affect course grades in any way. We are trying to determine how people use such teaching materials and what ways of using them lead to greater learning. Put the letter of your answer in the right hand column.

1. Did you write your responses to the items?

a.	All of them	No. 57
b.	Some of them	" 22
c.	None of them	" 22

1. _____

2. How much of the program did you do at the first setting?

a.	All	No. 9
b.	About a quarter	" 35
c.	Half	" 42
d.	More than a half	" 6

2. _____

3. Did you take any notes while you used the programmed materials?

a.	None	No. 48
b.	A few	" 33
c.	Summary of each half	" 5
d.	Lengthy notes	" 5

3. _____

4. Would you like short quizzes in the program?

a.	No	No. 13
b.	Middle and end	" 27
c.	Several in each half for teacher correction. No answer given	" 3
d.	Several each half with answers to check own achievement	" 39

4. _____

5. Would you use references if you were asked to use them in the program?

a.	No	No. 8
b.	Only if I were puzzled	" 54
c.	Yes, 2 or 3 of them	" 29
d.	Yes, would like 4 or more	" 1

5. _____

6. Did you read the pages "To the Student?"

a.	No	No. 1
b.	At the beginning	" 39
c.	At beginning of each half of the program	" 47
d.	Yes, and went back and read them again (when I finished the program or at some other point).	" 7

6. _____

7. Did you read the bibliography?

a.	No	No. 26
b.	Glanced at it	" 59
c.	Read it carefully	" 0
d.	Read one or more of the articles listed	" 8

7. _____

8. How long did the total program take you?

a.	Less than 2 hours	No. 3
b.	2-3 hours	" 47
c.	3-4 hours	" 34
d.	More than 4 hours	" 9

8. _____

9. Do you feel that using the program changed your ability to explain radiation treatments to patients?

a.	It's the same	No. 2
b.	Have few more facts	" 56
c.	Feel I am much better able to give a clear explanation	" 34

9. _____

10. Do you feel different about caring for a patient being treated with radiation?

a.	No	No. 10
b.	A little more comfortable	" 34
c.	More comfortable and able to give better care	" 48

10. _____

11. When would you prefer to use such material?

a. As a special assignment in senior nursing or public health nursing	No. 3
b. With the course in Medical-Surgical nursing	" 16
c. In combination with a clinical experience with patients treated by radiation	" 74

11. _____

12. How did you like using programmed materials as a learning method for this subject?

a. Did not like it	No. 14
b. About the same as a textbook	" 17
c. About the same as a lecture	" 6
d. Seemed I learned more easily from the program than I would have from a lecture or textbook. Liked it.	"56

12. _____

13. Did you find the program easy or hard?

a. Easy	No. 61
b. Moderately difficult	" 31
c. Very difficult	" 1

13. _____

14. Was the material interesting or not?

a. Dull	No. 5
b. Moderately interesting	" 68
c. Very interesting	" 20

14. _____

15. Where a choice of skipping or working through all items was given, what did you do?

a. Skipped whenever possible	No. 18
b. Skipped some, worked through others	" 39
c. Did not skip at all	" 36

15. _____

16. Would you like to use additional programs in your nursing education?

a. No	No. 5
b. Occasionally	" 61
c. Yes, would like programmed material frequently	" 27

16. _____

17. We would appreciate any comments you may have about this program and its usefulness to you.

Summary of Comments Written on Questionnaire

Number of Equivalent Comments		
12	1.	I learned
10	2.	Interesting. Preferred to a textbook
9	3.	Godd
9	4.	Made learning easier
8	5.	Like the repetition and/or review
7	6.	Too long
6	7.	Wanted discussion of the material afterward
4	8.	Too much repetition
3	9.	Too easy to cheat
3	10.	Dull
3	11.	Uneven
2	12.	Excellent
2	13.	Like controlling my time
2	14.	Makes learning more fun
2	15.	Have to concentrate too hard
2	16.	Want more quizzes
1	17.	Prefer lectures
1	18.	Well organized