

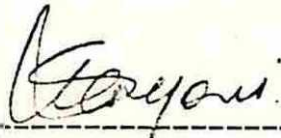
EFFECT OF GUIDED DISCOVERY LEARNING
ON
FIRST YEAR NURSING STUDENTS

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A Thesis submitted in part fulfilment for the Degree of
Master of Arts in Education in the University of Nairobi
1978.

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I declare that to the best of my knowledge this thesis is my original work and has not been presented for a degree in any other University.



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This Thesis has been submitted for examination with my approval as University Supervisor.



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ABSTRACT

The objective of this study was to demonstrate whether or not learning by discovery would motivate Kenyan student nurses to learn more on their own than learning by lecture method, and also whether or not the group that learnt by discovery would recall more and transfer more effectively than the group that learnt by lecture method.

The subjects were 130 first year students who were divided into two groups. The material to be learnt was the principle of ecological balance and how it works in two different situations. Except for the method of presentation of the principle, everything else, including pretest questions and post learning evaluation, was equated for the two groups.

The learning phase included 3 formal learning sessions spread over 2 weeks followed by a retention phase during which evaluation of retention and transfer was done 3 days, 3 weeks and 6 weeks after the last formal learning session.

The recall and transfer results showed that 3 days after the last learning session there was no significant difference between the two groups, but 3 weeks and 6 weeks after the last learning session there was a significant difference between the two groups in favour of greater recall and transfer for the discovery group. A separate measure of levels of motivation revealed generally high motivation for the discovery group.

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These findings are consistent with previous findings and imply that the discovery method could be employed to improve classroom instructions in Kenyan nursing schools. The results also open the way for further studies of long term effects of each method of instruction and whether these effects are generalisable to the clinical setting.

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CHAPTER I

INTRODUCTION

In a recent book Morris (1973) has brought out clearly what appears to be a fundamental aim of education for professional persons. He asserts that "a professional person should have the capacity to understand what he is doing and the education of such a person should facilitate this capacity" (p.150). He also maintains that formal education "cannot provide him in advance with all the knowledge and skills and experience that he will require to solve the problems that he will come across in the future" (p.150). Fenninger (1968) seems to agree with this when she says that education should not be just for the immediate present, because those who enter professional schools today will be practising in the twenty first century. Thus, they will be practising in a totally different world from the one in which they are prepared. The aim of education should, therefore, be to develop a capacity to continue learning so that one can adapt to changes (Fenninger, 1968; p.32).

Because of technical and social changes that are always taking place, the knowledge and skills that the professional person learns while at school soon become out of date. What was adequate preparation for practice a few years ago is not sufficient for today's needs. If the school teaches the students

how to use a number of basic tools, principles and concepts, and if it teaches the student how to think and how to continue learning then the school has made valuable contribution (Schumaker, 1974).

The teacher's aim then should be to give students a firm grasp of a subject and make him an autonomous and self-propelled thinker who will go along learning on his own after the formal school has ended (Brunner, 1961). According to Cooper (1968) the students need to be taught the excitement of learning and of living in a world where change is an ever present constant. They must learn how to learn, how to plan for their own continued learning, where to find resource material and how to be selective in their approach to learning.

In the field of nursing, the importance of providing opportunities for students to engage in self-directed learning cannot be over emphasized. Technical advancement and new knowledge in medical science is accumulating daily and new drugs are also increasing in number. Therefore, as practitioners of nursing in a changing society, the students will have to continue the study of nursing and related areas long after the formal period of preparation is ended and for as long as they continue practising nursing (Heidgerken, 1965). A diploma or a degree in nursing therefore simply means that certain pre-requisite requirements have been fulfilled but the graduate should be given an opportunity to pursue her chosen career.

Besides the general need to produce a nurse who will continue learning on her own, the nurse is increasingly being required to have greater skills in independent decision-making and independent action. The student nurses themselves are increasingly demanding that they be helped to develop skills that will continue to be useful to them when facts learned in schools are replaced by new knowledge (Finch, 1971). Thus, if a nurse has to continue practising effectively she must learn a way of equipping herself with new knowledge independently.

The modern teacher in a nursing school is, therefore, called upon to use methods of teaching that will create interest on the part of the student to explore resource material for the relevant facts independently. Cooper (1968) says that:

"the challenge to the instructor is to teach in a liberalizing way, to instil in adult students a desire for knowledge in many areas, to motivate them to seek it for themselves and to equip them with ways of adding to their knowledge and understanding of the world in which they work and live" (p.289).

The teacher who devices methods that will allow the students to explore primary sources material, organize and interpret the information thus obtained demonstrates her willingness to let the students free of her personal dominance (Heidgerken, 1965). Such a teacher is likely to make her assignments in terms of propositions or hypothesis to be proven or a subject to be covered.

While independent learning is essential for all the nurses, it is even more important for nurses who work in developing countries such as Kenya. The population whom the nurse in a developing country serves, is often situated in an isolated and unsophisticated setting. The nurse who provides care for such communities must have skills, knowledge and attitudes that will assist her to cope with emergencies often without the immediate aid of a doctor. The type of preparation that such a nurse needs should include critical thinking and decision-making and not just the execution of orders and memorizing of facts. It should include identification of the disease peculiarities and what treatment is to be given and how it should be given, watching for possible side effects and other problems that might occur as a result of the illness (Tulloch, 1973). Such a nurse must learn how to look for new information when she needs it. Therefore, the teachers who are responsible for her preparation must devise methods of teaching that aid the student in self-instruction and motivate her to continue learning beyond the formal period of preparation.

One of the methods of learning that is receiving increasing recognition by educationists for promoting student motivation to continue learning on their own beyond the formal period of learning is Learning by Discovery (Marsh 1958; 1962).

Learning by Discovery has been defined by Dececco (1968) "as the searching situations in which the student achieves the

instructional objectives with limited or no guidance from the teacher" (p.464). Kersh and Wittrock (1962) seems to agree with this definition when they say that discovery learning refers to "learner's goal-directed behaviour when the learner is forced to complete a learning task without the help of the teacher. If the learner completes the task with little or no help he is said to have learned by discovery" (p.461).

According to Shulman and Keislar (1966),

"the crux of the discovery process is recognition and understanding of the relationship among concrete experiences and the operation of putting these experiences into the compact form of language. Thus, discovery could also refer to a cognitive aspect of learning which is concerned with the organization and development of concepts and insights".

However, the definition of discovery learning used in this thesis is that advanced by Kersh and Wittrock, (1972). Therefore, as cited above, "If a learner completes the learning task with little or no help he is said to have learned by discovery" (p.461).

By contrast, Reception Method involves learning situations in which "the entire content of what is to be learnt is given in it's final form e.g. in reading a book" (Klausmeir and Ripple, 1971; p.58).

In the same way, Expository Teaching may also be defined as a method of teaching in which the learner is presented "with the

entire content of what is to be learned in the final form" (Ausebel, 1963; cited by Dececco, 1968; p.468). Here the student is not required to make any independent discovery; an example of this is a lecture method in which the student is given all the information (Dececco 1968). When Klausmeir and Ripple's (1971) definition of reception method and Ausebel's (1963) definition of Expository Teaching are compared, it becomes obvious that they are talking of the same thing except that Klausmeir and Ripple (1971) are focusing on the teacher. They say that sometimes (Expository Teaching) is "called deductive teaching, because the teacher often begins with a definition of the concepts to be learned or the principle to be learned, illustrates them, and unfolds their implication" (Dececco 1968; p.468). Ausebel, on the other hand, is focusing on the learner.

Thus, in reception learning the entire content of what is to be learned is given to the student, but in discovery learning

- (i) The teacher may give the principle which applies but not give the problem solution;
- (ii) the teacher may not give the principle but give the problem solution;
- (iii) the teacher may neither give the principle nor the solution (Dececco 1968).

In practice, however, considerable assistance may be given by the teacher and still the learner would be said to have learned by discovery. This is called Guided Discovery Learning (Kersh 1962).

According to Kersh and Wittrock (1962) the process of discovery involves several stages: (i) The starting point at

which the learner is not yet able to make the correct response, (ii) the discovery phase which consist of trial and error, (iii) the point at which the learner makes the first desired response, (iv) the practice phase in which the learner increases skill and memorizing (v) the phase in which the learner can transfer the knowledge and skills to other situations. If a test is done at this point it measures immediate recall (Kersh and Wittrock, 1962).

Advantages of Learning by Discovery:

The main advantage of learning by discovery seems to be the motivating effect on the learner to pursue the learning task independently. If the learner is sufficiently motivated, he then pursues the learning process autonomously beyond the formal period of learning (Kersh, 1962). Kersh (1962) also says that as a result of his added experience the learner may raise his level of achievement, remember what he learns longer and transfer it more effectively. The motivation, according to Kersh (1962), could be explained in terms of operant conditioning in which the searching behaviour is reinforced by the student's successful progress and the experimenters' comments. It could also be explained in terms of "Zeigarnik effect", of superior memory for unfinished tasks and "Ousiankima effect" of resumption of incomplete tasks. Zeigarnik (1927) demonstrated that subjects who were inter-

rupted before they completed a task tended to recall the incomplete task more easily than the same subjects recalled the tasks which they were permitted to complete. Ousiankima (1928) demonstrated that when subjects were allowed to resume an incomplete task they did so overwhelmingly (Cofer and Appley 1964; p.362). According to this explanation the motivation of those who learn by discovery seems to be independent of the extrinsic factors such as the experimental or instructional situation. It seems as if the motivation power lies in the acquired interest or ego involved in a task and develops to the point at which the individual relies on his own cognitive capacity in learning.

The concept of "functional autonomy" (Allport 1937) also seems to describe the motivation that is found in individuals who learn by discovery. The term functional autonomy denotes the kind of behaviour that seems to develop its own motive powers through practice. Allport (1938) argues that some activities such as climbing mountains and making money seem to persist in some individuals in the absence of underlying primary motives. Their continued existence despite lack of underlying motives seems to indicate that these activities have developed drive value of their own. That is, they are functionally autonomous of the original motive and any other existing motivating factors (Cofer and Appley, 1964).

The above explanation seems to agree with Bruner's (1964) suggestion that, learning by discovery increases intrinsic motivation. In other words, the learner who is allowed to learn by discovery is likely to carry out his learning activities with autonomy of self-reward that comes from discovering.

The other important advantage of learning by discovery that Bruner (1964) has suggested is that when a child is allowed to learn through discovery there is increase in "intellectual potency". That is, learning by discovery teaches one how to go about learning, and practice in discovery teaches one how to acquire information in a way that makes the information more readily available for future use; for example, in problem solving.

The third advantage of learning by discovery which was also suggested by Bruner is that by engaging in discovery learning one acquires the "heuristics of discovery". That is in the process of discovering one learns a style of problem solving and inquiry. Bruner (1966) asserts that he has "never seen anybody improve in the art or technique of inquiry by any other means other than engaging in inquiry" (p.269). Massails and Zevin (1964) in support of Bruner (1966) say that the highest state of human autonomy and perfection is achieved when a child is allowed to discover for himself the regularities and irregularities in his total environment.

However, Gagne (1966) suggests that learning by discovery has advantage over reception learning, only in some types of learning situations. In simple association, for example, when the dog raises the paw when the master says a word, and in concept learning (e.g. when an individual learns to respond in the same way to stimuli which may have very different physical characteristics) for example, the concept of "tree" or "cat", learning by discovery would be very slow. But in the learning of principles where there seems to be searching and selection, learning by discovery seems to have the advantage of superior retention and transfer. In problem solving, learning by discovery does take place because the learner is expected to generate novel combinations of previously learned principles. Guidance helps to decrease the time for searching.

One of the most outspoken opponents of Bruner's views on learning by discovery is Ausubel (see Dececco 1968) who defends Expository Teaching by saying that (i) Expository teaching presents ideas and information more meaningfully and effectively and according to Ausubel the information is then retained longer, as an organised body of knowledge- and that (ii) Expository learning is superior to discovery learning because the learner can proceed directly to a level of abstract understanding that is superior to discovery learning in terms of generality, clarity, precision and explicitness. A third advantage claimed

by Carrol (1964) is that expository teaching is more popular in schools because it is more efficient and it takes less time than discovery learning, and "when combined with practice it is very successful in teaching concepts and principles" (Carrol 1964 cited by Dececco, 1968; p.468). Carrol also argues that expository teaching gives a student the material to be learned in an organized view of the discipline he is studying whereas in discovery learning the concern to teach the techniques of discovery overrides the concern for learning the unifying principle of a discipline.

While both the supporters of discovery learning and the supporters of expository learning may be right in terms of the advantages that they claim for each method of learning, both groups seem to have some common agreement; that is, discovery learning is more effective in teaching the learner how to learn autonomously and it also motivates the learner to go on learning beyond the formal period of learning. However, if the objective for a learning situation is to teach some concepts as quickly and as efficiently as possible then expository method is the more effective method.

The purpose of this thesis is not so much to discover the merits and demerits of each method of instruction per se as it is to find an empirical base for the positive claims made for the discovery method. Given that some or all the claims are

empirically founded, the thesis will seek to discover through an experimental investigation the extent to which the positive findings can be generalized to improve instruction in nursing schools in Kenya.

Statement of the problem

All the studies on Discovery Learning have been done in an American setting. Since students in Kenya have had a different educational background from that of the American students, and the students nurses in Kenya have also had a different family background from that of the American student, the question arises whether the student nurses in this country would benefit in the same way by using the discovery method of learning. That is:

(1) Would the student nurses who learn by discovery retain more than students who learn by reception method? (2) Would student nurses who learn by discovery transfer more effectively than students who learn by reception? (3) Would the student nurses who learn by discovery method be motivated to learn more on their own than students who learn by lecture method?

CHAPTER II

REVIEW OF THE LITERATURE

The review of the literature presented below includes studies that have made comparisons between Discovery Learning and Reception Learning and have attempted to determine their relative effectiveness in promoting classroom learning.

Generally studies that have compared the two methods of instructions using post tests to measure terminal performance of the learners have yielded contradictory results (e.g. Kersh, 1962; 1963; and Craig, 1956).

Kersh (1962) did a study to determine whether or not learning by discovery affected motivation. The subjects were 90 high school students who were equated on their ability to learn arithmetical and geometrical concepts related to the material they had to learn. In Kersh's (1962) study, the students were divided into three equal groups. The group that learnt by programmed technique was given a booklet in which the learning task was broken into small steps and answers to questions were revealed to the subjects whether they responded correctly or not. This was called Rote Learning group. The second group was required to discover the explanation to the rules with guidance from the instructor. These subjects were taught tutorially using guiding questions which required the students to do

algebraic manipulation and to make inferences independently. This was called Guided Learning group. The third group was called Directed Learning group because the explanation for the rules was left out. The material to be learnt was odd number rule, which states that, the sum of any series of consecutive odd numbers beginning with one is equal to the square of the number of figures in the series (e.g. $1+3+5+7 = 4^2 = 16$) and the constant number rule which states that, the sum of any series of numbers, in which the difference between the numbers is constant is equal to one half the product of the first and last numbers (for example the sum of a series of 5, 6, 7, 8 = 26) which is equal to $4 \times (5 + 8) = \frac{4 \times 13}{2} = 26$.

Following the initial learning period three separate delayed tests for recall and transfer were given after 3 days, 2 weeks and 6 weeks. Each test consisted of three problems which involved the rules as well as a short questionnaire. The questionnaire asked each student whether or not he used the rules learned and whether he had used the rules after the formal learning period. The results were that the rote learning group was superior to other treatment groups in their performance on post tests. However, with respect to frequency of using the rules after the formal learning period the guided discovery group was superior to the directed group and the difference was found to be statistically significant. With respect to retention and effective transfer the results also supported the hypothesis

that the guided discovery group would be superior to the directed learning three days after the learning period and the difference still stood after six weeks.

The results were interpreted to mean that learning by discovery is superior to learning with external direction only in so far as it increases student's motivation to pursue the learning task autonomously beyond the formal period of learning. Presumably as a result of this added experience the learner rehearses and remembers what he learns longer and therefore transfers it to other situations more effectively (Kersh 1962).

According to Kersh (1962) "the motivation power does not seem to appear in strength unless the student is required to learn almost completely without help and expends intensive effort over a period of 15 minutes or more" p.286. In this study Kersh (1962) also demonstrated that apart from the advantage the student has in terms of increased motivation, the learner did not seem to benefit from knowing the explanations for rules and procedures. That is what is meaningful or understood by the student may or may not be retained long and transferred more effectively than what has been learnt by rote. Kersh (1962) also suggests that superficial efforts to gain understanding after a rule or a principle has been memorized may have inhibiting effect when the student attempts to recall or transfer the original learning (Kersh, 1962).

Therefore, he argues, the main advantage of learning by discovery is increase in motivation (Kersh 1962).

Kersh's (1962) study was a follow-up of an earlier study (Kersh 1958) whose purpose was to determine whether or not the superiority of learning by discovery was explainable in terms of "meaningful learning" and if not to discover a more adequate explanation. The material to be learnt were mathematical rules. That is the odd number rule and the constant difference rule, stated above. The rule could be learnt by memorizing but on the other hand the learner could become cognizant of certain relationships to arithmetical concepts which the two rules involved. In the latter case the learning would be more meaningful. The subjects, numbering 60, were college-students volunteers from an educational psychology class. They were divided into three groups of about 10 subjects per group and the groups were balanced in terms of age, sex, grade level and scholastic aptitude. One group was called "no help group", because the subjects were required to learn the principle involved in the mathematical problem without any help. The second group was called "reference group" because it was given assistance in the form of perceptual aids accompanied by verbal instructions which directed their attention to the perceptual aid. The third group, called "the rule given group" were told the rule directly and were given practice in applying the rules. In addition there were two treatments called the "number treatments" which consisted of 8 subjects in each group. The procedure was to

have each subject learn the rule to the point where he could verbalize the rules and apply them to the solution of three different problems. However, the learning period allowed was 60-90 minutes. It ended as soon as the subjects successfully applied an acceptable rule to the solution of three problems. Immediately after the learning period a test was given followed by other tests four and six weeks later. Each test was accompanied by a questionnaire on the thinking process of the subjects.

The results showed that some of the subjects especially in "no help" group failed to learn the rule during the allowed time. But when all the subjects were retested after four weeks the number of subjects in "no help" group who applied the rule correctly increased while the number of subjects who used the rule correctly decreased markedly in the rule given group. Kersh (1958) concluded that "as a result of their experience during the learning period the subjects in the no help group were motivated to continue learning afterwards and those treated otherwise were not" (p.290). Thus the superiority of learning by discovery is explained in terms of motivation rather than in terms of understanding. Therefore, in both of Kersh's (1958 and 1962) studies learning by discovery was found to be superior to learning with external direction only in so far as it increased student's motivation to pursue the learning task. The difference in motivation was illustrated

the experimenter.

Allport's concept of functional autonomy seems to account for the motivation that was found in "no help group" (Kersh, 1958). That is, the motivation of those in no help group seem to be independent of the extrinsic factors such as the approval of the experimenter or instructional situation. According to Kersh (1958), "presumably the motivating power is of the type that lies in the acquired interests or ego involved in a task and develops to the extent that the individual relies on his cognitive capabilities in learning" (p.291). Kersh (1958) also suggests that teachers should continue to guide the learning of their students but they should refrain from giving answers directly because the results of these experiments demonstrated that when the learner is required to rely on his own cognitive capacities it is likely that he will become motivated to continue the learning process or to continue practising the task after the learning period. Therefore, he will remember what he learnt longer and it will be transferred more effectively than when the learner is not motivated.

Further support for the superiority of the guided discovery method comes from a study by Craig (1956). The purpose of the study was to determine the effect of giving direction to learners upon retention and ability to discover new principles. The subjects were second year college students who were divided into two groups of fifty students each. The material to be

learnt involved identification of the relationship of four out of five words. The items were related by the sound of words, the spelling of words, the meaning of the words or combination of sound, spelling and meaning of the words. Four items illustrating each relation were grouped together and separated from each other by spacing. If a subject solved any of the items organized on a given basis correctly he was given credit for knowing that relation. The directed group was provided with a statement of the relationships common to items in each group to direct him to discover the item that did not belong and why. The independent discovery group was not given any information that would tell them the reasons for the correct choice. However, all the subjects had been informed that there was a relationship between the words that belong. Thus the learner had to search for the underlying similarity to help him discover the item that did not belong and why.

The results showed that there was a statistically significant difference between the groups in terms of the number of the relations that were learnt. The group that received information was superior to the independent discovery group (Craig 1956). The guided discovery group was also found to be superior to Independent Discovery Group in retention thirty one days, after the last learning session. These results seemed to indicate that teachers should be liberal with suggestions that aid discovery of relationships and principles. The kind of direction given should include general statement of the

relationships and principles to be learned. According to Craig (1956) "large amounts of external direction given now may help to ensure that the learner will have adequate background of knowledge to direct his future discovery" p.234. These findings seem to be supported by those of Kittel's (1957) study.

Kittel (1957) did a study to determine whether or not an intermediate amount of direction given during learning of principles increases greater learning, transfer and retention, after a period of two and four weeks. His argument was that it is not valid to say that, the more freedom of learner's activity and the less amount of external direction the learner has the better. On the other hand the learning situations in which the learner is presented with all the specific principles and facts are inferior to learning by discovery (Kittel 1957). Therefore, some degree of direction in discovery is superior to independent discovery in promoting discovery in promoting transfer.

The subjects were 132 sixth grade pupils from public elementary schools. The subjects were randomly divided into three different treatment groups. The groups were named "maximum group", "minimum group" and "intermediate group" in accordance with the amount of direction given. The groups

were equated in terms of I.Q., age, and pretraining knowledge of principles to be learned. Although the material used on pretest training and post test did not involve identical items the underlying principles were the same. The items consisted of five words with four words that belonged because of the underlying principle and one word that did not belong. The "minimum group" were told that each group of items belong because of an underlying principle but they were not told the underlying principle. They were then asked to choose the words that did not belong. The "intermediate group" were told that each group of items had an underlying principle just like the "minimum group" but they were also supplied with a verbal statement of the underlying principle. The principle was printed immediately preceding the group of items. The "maximum group" were given all the information supplied to the "intermediate group" as well as oral statements of the correct answer for one group of items, before the subjects made their responses. The learners were then expected to identify the word that did not belong. In doing so the learner had to discover the principle that related the other four words. The training period was five weeks in length. Nine items based on three principles were presented twice each week making for a total of 45 items based on fifteen principles. The words in each item were varied so as to avoid the subject's reliance on memory.

The results showed that both intermediate and maximum group were superior to minimum group in the learning and transferring of principles to previously encountered situations. There was no significant difference between the intermediate and the maximum group. However, the intermediate group was superior to both minimum and maximum group in their ability to transfer principles to new situations. The intermediate group was also able to discover a significantly greater number of new principles than either of the other groups. But the maximum group was superior to minimum group in discovering new principles.

In relation to retention, the intermediate group was found to be superior to both maximum and minimum groups after two weeks and after four weeks. Therefore, this study seems to demonstrate that subjects benefit from direction given in their search for the principle that apply, but specification of responses and the correct answer tend to encourage reliance on memory rather than discovering the underlying principle. Thus informing the learner of the underlying principle promotes transfer, retention and ability to discover new principles in the future (Kittel 1957).

Another study that offers support to the method of learning by discovery was done by Kernreich (1969). The purpose of the study was to find out what was the optimal amount and type of information that the learners needed to acquire a focusing strategy on concept-identification problem. By strategy he

meant "a way to describe the different approaches of subjects in problem solving experiments"(p.384). The subjects, who were 90 college students, were divided into three different treatment groups which differed in the amount and type of information given during training. One group, called the "Programmed group", received extra information after every four problems. The extra information consisted of informing the student that he had made an incorrect response and informing him of the appropriate response. This continued until a subject acquired an appropriate strategy for solving the problem. The second group, called the "Guided Discovery group", were told to rethink what they were doing before they started each problem. The third group, called the Discovery group, were not given any more information after the initial instructions. The material to be learnt were concept identification problems. The concepts were presented on cards with symbols which served as stimuli. The stimuli varied in four ways: colour (black or white) size (big or small) letter and position (left or right). The subjects were then required to identify the correct characteristic from the symbols as soon as possible.

The results showed that the 'guided group' had the greatest number of subjects who acquired the focusing strategy while the 'discovery group' was second and the programmed group last. Statistically the "guided discovery" was significantly superior to the other two in acquiring the focusing strategy.

The explanation of these findings seems to be that when the guided discovery group were told to 'rethink' they read the

instructions over again and they used their cognitive efforts and actively searched for the correct response. On the other hand, the programmed group that was the last effective seemed to rely on the experimenter's instructions passively. Therefore according to Kernreich (1969) the study seems to suggest that instructors should be concerned about the optimal prompting techniques to facilitate the most effective learning for the desired outcome. For example one technique might be optimal for effective transfer while another technique may be more effective for retention.

Klausmeir (1968) did a study to see the effect of giving varying amounts and types of information on students' ability to attain a focusing strategy. The subjects were educational psychology students from the University of Wisconsin.

Klausmeir (1968) says that instructions that the teacher gives to the student may differ in terms of the method of instruction, amount of information given or the amount of guidance provided by the teacher. The objective of giving the information also varies. The objective may be to make the subject familiar with the specific stimuli material or the objective may be to acquaint the subject with the desirable response or to get the subject informed about the procedure or the method to be followed. The objective may also be to let the subject know the principle to be employed in performing the required task. The teacher may also give information so as to raise the level of motivation of the subject.

The results showed that the group that was given information on the focusing strategy had best performance, while the group that received the least information had the poorest performance and the group that was given information about the structure of the stimulus fell somewhere in between. Performance also improved with practice. Therefore, Klausmeir (1968) concluded that teachers should spend more time on teaching students how to learn concepts, how the subject matter to be learnt is organized and the principle for utilizing information.

Massails and Zevin (1964) did a study to find out how much a group of students with slightly above average ability were capable of participating in discovery and inquiry. They also wished to find the extent to which discovery method of teaching operates as a motivating device. They were also interested in finding out how historical material could be used to prompt students to study independently and acquire skills in learning. The subjects were 35 Chicago public High School students whose average age was fifteen years. Massail and Zevin (1964) supplied partial material in the form of Art, Music, Literature, poems and architecture in the classroom and challenged the students to gather the missing information. The instructor's role then was to moderate the discussions and to challenge the students but he did not give any direct answers to questions.

The results of this study showed that the students were able to participate in the process of inquiry and discovery. The students became increasingly independent and they began to question the authority of secondary material with intelligent doubt, as well as

proposing new ideas which were carefully defended. Massails and Zevin (1964) also found that teaching by discovery had a highly motivating effect on students. This was demonstrated by students' involvement with the material to be learned. While the study was going on, there was an intensive utilization of library resources (Massails and Zevin, 1964). However, this study is limited in that there was no control group and the sample of 35 students is also rather limited.

In the field of nursing there have been some attempts to utilize ideas from educational psychology research in order to improve the quality of nursing. Tornay (1968) did a study whose purpose was to determine whether or not learning by discovery was superior to learning by lecture method in increasing problem solving skills. The subjects were 65 second year students at San Francisco State College and the material to be learnt included the concepts of homeostasis and how the body maintains the balancing mechanism. The test, which consisted of simulated patient care problems, was introduced by a brief description of a patient and his health problem. The subjects were randomly divided into six groups three of which were experimental and the other three controls.

The students were asked not to discuss the classroom procedures so as to minimize the contamination. The groups were not told whether or not they were in the experimental group so as to minimize the Hawthorne effect. The experiment

took place over a two week period of 90 minutes daily sessions.

The results showed that the students who learnt by discovery solved the unfamiliar problems better than students who learnt by lecture method. However, there was no statistically significant difference between students with different academic aptitude who learnt by discovery (Tornyay, 1968).

Another study done by Brown (1968), attempted to see how students who were required to look for their own information would compare with students who were taught by conventional lecture method at State Board Examination. The subjects were 50 students who had indicated a sincere interest in nursing. The material to be learnt was theory on child psychology, and growth and development from birth to sixteen years. The teachers told the students that they would not be graded for material learnt in this unit. Therefore, the only motivating factor would be their desire to learn more about the child's care. The subject were divided into four groups of 11 to 14 students. Two of the groups were experimental groups and the other two were control groups. The experimental groups were given problems and they were required to find solutions to these problems on their own. For each problem a bibliography was provided and students were encouraged to share information in the seminars, group discussions and pannel discussions. The instructor was always available as a resource person and served as a discussion leader. The source of material included text books,

governmental pamphlets, reference books, as well as any other relevant article that the student could find in any of professional magazines and daily papers. The control groups were taught by lecture method. A post test was done at the completion of the course.

The results showed that there was no significant difference in the level of achievement between the experimental and control groups. However, the experimental group indicated that they spent more time studying than they had done in the previous courses. Many of the subjects in the experimental group also indicated that they had found the study more interesting and challenging. 60% stated that they had been willing to use more than one resource material and they had felt free to disagree with their classmates and their instructor because they had prepared prior to attending classes (Brown 1968). This seems to indicate an increased motivation in learning which would agree with Kersh's (1958 and 1962) experimental findings discussed above.

In summary, research findings reviewed above seem to indicate that discovery method of learning is more effective in motivating students to pursue the learning task independently. If the student is sufficiently motivated he then pursues the studies autonomously beyond the formal period of learning. As a result of his added experience the learner remembers what he learns longer and transfers it to other situations more effectively (Kersh 1962).

The literature that has been reviewed also tends to indicate that there is an optimal amount and type of information that the students should receive during the learning process for the most efficient and most effective learning to take place. This is supported by Kersh's (1958 and 1962) Craig's (1956) Kittel's (1957) Kornerich's (1969) and Klaismeir's (1967) findings. Their experiments demonstrated that some direction or intermediate amounts of direction or guidance aids discovery. This is called Guided Discovery (Craig 1956). Informing the learner of the form of the underlying principle promotes transfer, retention and ability to discover. Thus guided discovery seems to offer a happy medium between independent discovery (no information given) and highly directed learning, like programmed learning. Some efficiency of directed learning is maintained along with the effectiveness of discovery process in promoting motivation to learn autonomously and to retain what is learnt longer and transfer it to new situations effectively. Learning by discovery has also been found to be effective in promoting problem solving skills (Kersh and Wittrock, 1962).

However, all of these studies were done in an American setting. Since the students in Kenya have a different educational background from that of the American students, and the students in Kenya also have a different cultural background from that of the American students, the question of whether or not the student nurses in Kenya would benefit in the same way still remains. Thus it is important to do some studies here in Kenya to establish whether

or not the student nurses, who learn by discovery would retain more and transfer better, than student nurses who learn by lecture method. It is also important to do a study here in Kenya, to demonstrate, whether or not the student nurses who learn by discovery, would be motivated to learn more on their own, than students who learn by lecture method.

CHAPTER III

METHOD

The study was done at Kenyatta National Hospital School of Nursing. The subjects were 130 first year students who were divided into two groups. The two groups represented two different intakes - one group that came in January and the other group which came in May. The group that came in May learnt by lecture method. The learning task consisted of the principle of ecological balance. A pretest was given to both groups three days before the learning session and the result showed that, there was no statistically significant difference between the two groups in their knowledge of the principle of ecological balance. One group of students was required to discover how the principle of ecological balance works in the development of Immunity and how the principle works in the process of satisfaction and frustration of basic needs. The other group was taught by lecture method how the principle of ecological balance works in development of immunity and in the process of satisfaction and frustration of basic needs. The study took place over a period of two weeks but post tests were done 3 days, 3 weeks and 6 weeks after the last learning session. Each learning session lasted for a period of 90 minutes each, while the post tests were allowed a period of 60 minutes each. The students were asked to keep a time schedule from the day when the pretest was done to the end of the study. From the time scheduled the instructor worked out the amount of time each student spent studying on his own prior to exposure to the treatment and after exposure to the treatment. The amount of time each student spent on his own was used as a indication of his motivation to learn independently.

Independent variable in this study is the method of study (i.e. discovery method of learning and lecture method of learning). Dependent variable is the effect of method of study on the retention, transfer and the motivation to learn independently.

- Hypotheses:
1. Kenyan student nurses who learn by discovery will be superior in transfer than students who learn by lecture method.
 2. The student nurses who learn by discovery will be superior in retention than those who learn by lecture method.
 3. The student nurses who learn by discovery will spend more time studying on their own than students who learn by lecture

(See Appendix X for definition of recall, transfer and motivation)

Materials The material to be learnt included the principle of ecological balance (see appendix IV for details of the content) and how the principle of ecological balance works in the process of immunity and in the process of satisfaction and frustration of basic needs. The classroom was at the School of Nursing Kenyatta National Hospital where students normally have classes. The students in both groups used the same classroom and both groups sat in rows facing the instructor. The classroom had fitted blackboard, a table and a chair for the instructor. Except for the method of presentation of the material to be learnt everything else including pretest, questions and post learning evaluation was the same for all subjects. Students were to take notes on

individual basis. Noise from extrenous sources was kept at a minimum and equated for both groups.

Subjects The subjects were 130 first year students from the School of Nursing, Kenyatta National Hospital. Most of these student were girls but in each class there were at least six boys of about the same age as the girls. The subjects were divided into two equal groups. Each group represented a separate intake. The group that was admitted in January learnt by discovery whereas the group that came in May learnt by lecture method. Different intakes were used in this study so as to minimize exchange of information between groups receiving different treatments. Such control is necessary because student nurses have a lot of informal interactions after classes and it would be difficult to control informal discussions related to their learning experiences (Tonyay, 1968). The two groups were otherwise equated on such variables as performance in the final school certificate examination in six of the subjects. The scores of those who missed any of the learning session were not included in the analysis, therefore, in the end each group had about 45 subjects.

Procedure The study took place over a two week period with the three post tests done three days, 3 weeks and 6 weeks after the last leaning session. The same experimenter taught both groups (see appendix I for details of the instructions). The same experimenter also did all the evaluations of both groups. All together the students had 3 learning sessions besides one session on pretesting and explanation about their participation in the study. Each of these sessions lasted 90 minutes. Post learning tests were allowed 60 minutes each.

Pretest Session: On the 1st session (90 minutes) a pretest was given so as to determine the level of their existing knowledge on the material that had to be covered (see Appendix II for a sample of pretest questions and answers). On this session the instructor also explained to the students that they were participating in a study so as to determine the advantages and disadvantages of using different methods of learning. The students were also informed of what they would be expected to learn and do (see Appendix I for instructions). They were also asked to keep a time schedule of all their activities for twenty four hours each day for the duration of the study. The objective of keeping a time schedule was to find out how much time each student spent studying during his/her own free time.

Discovery Group:

First Learning Session: (3 days after pretest)

On the second session which lasted 90 minutes the students were assisted by the instructor to discover the principle of ecological balance (see Appendix IV for details of the principle). To help them achieve this the students were encouraged by the instructor to discuss their concept of "environment" and the concept of "organism" and their relationship (see Appendix IV for details). The instructor then gave the students written guiding questions (see Appendix III for details) and the students were encouraged to ask questions although direct answers to their questions were not given. At the end of the session students were asked to hand in the answers to the guiding questions. A student was said to have discovered the principle of ecological balance if she/he gave the expected answer or was otherwise rated in accordance with the scheme of marking (see Appendix VII for details of the expected answers).

Second Learning Session: (5 days after pretest)

This session was introduced by stating that the principle of ecological balance was applicable to different problems and the specific problem of development of immunity was given. The students were then asked to work out individually how the principle of ecological balance works in the development of immunity. Guiding questions were given (see Appendix III for details).

The students were told that they were free to ask any questions but direct answers to their questions were not given. At the end of the learning session the students were asked to hand in their written answers to the guiding questions. A student was said to have discovered how the principle of ecological balance works in the development of immunity if she/he had the expected answer (see Appendix VIII for expected answers).

Third Learning Session: (8 days after pretest)

This session, as in the second learning session, was introduced by stating that, the principle of ecological balance was applicable to different problems and the specific problem of satisfaction and frustration of basic needs was given. The concept of basic needs was explained to the students (see Appendix III for details). A student was said to have discovered how the principle of ecological balance works in satisfaction and frustration of basic needs, when she could state in writing that man depends on the environment for supply of his basic needs.

At the end of this learning session a bibliography for the reference on the material learnt was provided to all the students (see Appendix V for details).

Lecture Group

First Learning Session (3 days after pretest)

On the second session which lasted 90 minutes, the students were given a lecture on principle of ecological balance (see Appendix IV for content of the lecture). Students were allowed to ask questions during the lecture and direct answers were given to the students. (see Appendix I for instructions).

Second Learning Session (5 days after pretest)

This session was introduced to the lecture group in the same way as for Discovery Group (see Appendix I for instructions) After introduction a lecture on development of immunity was given (see Appendix IV for content).

Third Learning Session: (8 days after pretest)

Introduction for lecture group was the same as that for the Discovery Group (see Appendix I for details of instructions). After the introduction, a lecture on the process of satisfaction and frustration of basic needs was given (see Appendix IV for details of content).

At the end of this learning session, the bibliography that was given the Discovery Group was also provided to all the students in the Lecture Group (see Appendix V for details).

Evaluation:

(1) 3 days after the last learning session a post test for immediate recall and transfer was done for both groups (see post test questions for details, Appendix VI). The recall tests consisted of asking the subjects to recall the material that they had learnt in the class. The transfer tests consisted of simulated health problems that required the students to apply the principle of ecological balance in solving the

(2) 3 weeks after the last learning session a post test was done to measure retention and transfer (see Appendix VI)

(3) 6 weeks after the last learning session a post test was done to measure retention and transfer (see Appendix VII for details)

(4) To evaluate motivation (a) students were asked to keep a time schedule for the whole duration of the experiment. The students were only informed that the instructor was interested in all their activities for the whole period. The purpose of keeping a time schedule was to see how much time they spent studying on their own (see Appendix I on instruction) (b) Students were asked to fill questionnaire items to see their attitude towards learning (see Appendix VIII) 6 weeks after last learning session.

Problems Encountered:

The main problem that was encountered in this study was that the students had too many lectures scheduled throughout the day. Therefore, the subjects were very limited in terms of the amount of time they could devote to learning and practicing what they had learnt on their own. In this study this is taken as a limitation which could have influenced the results of the evaluation tests.

CHAPTER IV

RESULTS

Pretest: The pretest results are presented in Table I and Figure 1. The mean for Discovery Group was found to be 2.1 while the Lecture Group's mean was found to be 1.95.

See Table 1 and Figure 1

Generally none of the pre-lecture and pre-discovery method students could express in writing their understanding of the principle of ecological balance, and only very few could express in writing their understanding of the related concepts at pretest. No student gave the expected answer when asked what "health" is or what "disease" is (see Appendix VII for expected answers and the scheme of marking). The highest score at pretest was 5 while the possible maximum was 20. Most of the candidates in both groups scored zero at pretest, because they did not give the expected answers to any of the questions.

A t test was done to compare the mean scores of Discovery group with those of the Lecturer group, but there was no significant difference between the two groups at .05 level of significance.

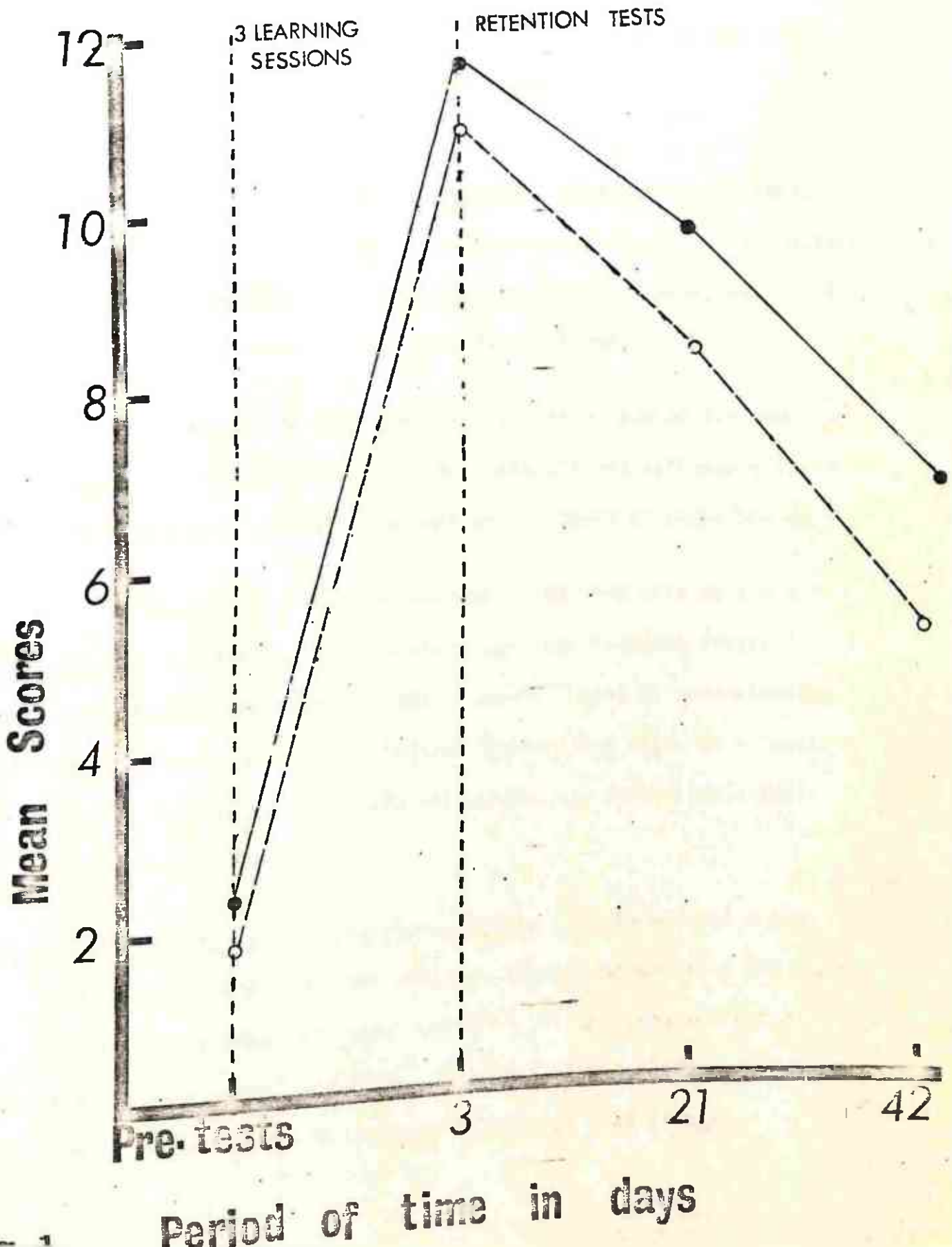
These results are taken to mean that before the student were exposed to the two different methods of learning there was no significant difference between the two groups in the

Table 1: Mean Retention Scores of Pretest and Post tests done 3 days, 3 weeks and 6 weeks after the last learning session.

	Pretest		3 days		3 weeks		6 weeks	
	\bar{x}	t_{95}	\bar{x}	t_{95}	\bar{x}	t_{95}	\bar{x}	t_{95}
Discovery	2.1		11.57		9.48		7.023	
		0.55		0.385		*2.749		*3.197
Lecture	1.95		10.9		8.455		5.705	

Critical t_{95} at df 86 is 1.671

* Statistically Significant.

KEY**Discovery** ●——●
Lecture ○- - -○

level of the existing knowledge of the principle that had to be learnt. The results also indicate that the level of knowledge that existed was very low, in both groups.

Recall

3 days after the last learning session: As Figure 1 and Table 1, shows the results of a test done three days after the last learning session showed that mean score for the Discovery Group was 11.57 while the mean score for the Lecture Group was 10.9.

A t test was done to compare the mean scores of the two groups. There was no statistically significant difference in the mean scores of the two groups at .05 level of significance.

A comparison of the performance of the subjects at pretest and their performance 3 days after the last learning session demonstrated that generally the students' level of understanding of the principle of the ecological balance had risen as a result of the treatment but this difference did not reach statistical significance (see Table 1)

3 weeks after the last learning session: The results of a test done 3 weeks after the last learning session showed that the mean score for the discovery group was 9.48 but the mean score for the "Lecture Group" was 8.455. A t test of the difference between the two means was found to be statistically significant.

Therefore, although there was no significant difference between the mean scores of the two groups in a test done three days after the last learning session, 3 weeks after the last learning session the "Discovery Group" was found to be superior to the "Lecture Group".

However, inspection of Fig. 1 and Table 1 shows that, generally, the level of performance is lower three weeks after the last learning session than the performance of the subjects three days after the last learning session. This is observed to be so for both groups.

6 weeks after the last learning session: The mean score of the Discovery Group was found to be 7.023 while the mean score of the Lecture Group was 5.705. A t test found this difference to be statistically significant.

When the results of the performance at 6 weeks after the last learning session are compared with the results of the test done 3 days and 3 weeks after the last learning session it is observed that although the "Discovery Group" remained superior to Lecture Group, 3 weeks and 6 weeks after the last learning session, the performance at 6 weeks continued to be lower than the performance 3 days and 3 weeks after the last learning session for both groups.

A t test was done to compare the mean difference between the Discovery Group and the Lecture Group. The results showed that

there was a statistically significant difference, at the 0.5 level, between the means of two groups, 6 weeks after the last learning session.

Transfer

3 days after the last learning session: The results of transfer tests are shown in Table 2. 3 days after the last learning session the mean score of the Discovery Group was 5.27 but for the Lecture Group it was 5.63. (See Table 2 and Fig. 2)

Table 2 and Figure 2

A t test was done to compare the mean score of the two groups and the results showed that there was no statistically significant difference between the mean scores of the Discovery Group and the "Lecture Group". three days after the last learning session.

3 weeks after the last learning session: On a transfer test done 3 weeks after the last learning session the mean score for the Discovery Group was found to be 8.00 while the mean score for the Lecture Group was found to be 6.59 (See Table 2).

A t test found statistically significant difference between the mean score of the Discovery Group and that of the Lecture Group at .05 level of significance. Thus although there was no statistically significant difference in transfer, 3 days after the last learning session, 3 weeks after the last learning session, the Discovery Group was found to be superior in transfer.

Table 2 : Mean Transfer Scores obtained, 3 days, 3 weeks and 6 weeks after the last learning session.

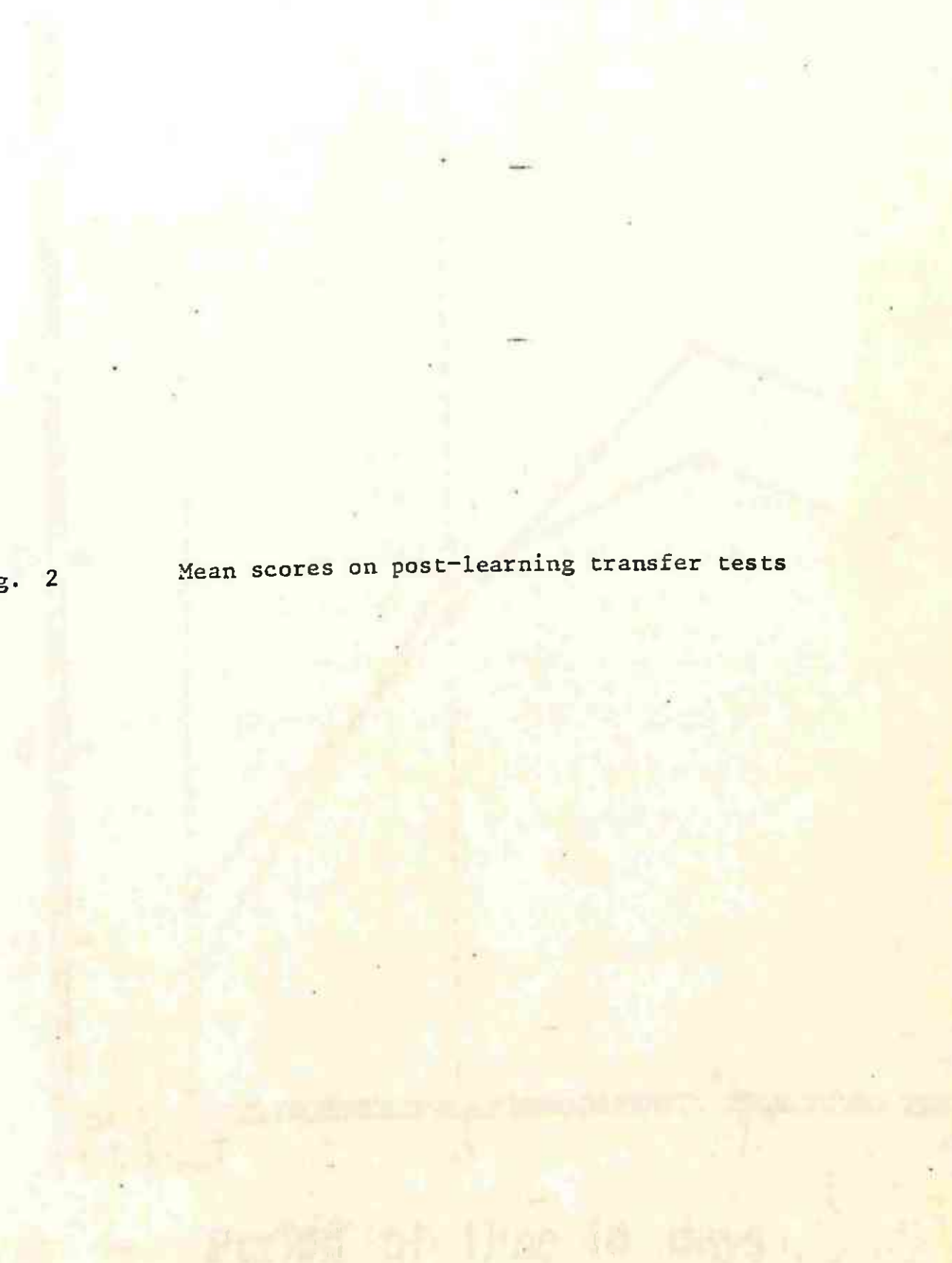
	3 days		3 weeks		6 weeks	
	\bar{x}	t_{95}	\bar{x}	t_{95}	\bar{x}	t_{95}
Discovery	5.273		7.955		6.955	
		.332		*1.989		*1.725
Lecture	5.628		6.591		5.705	

Critical t_{95} at df 85 is 1.671

* Statistically Significant

Fig. 2

Mean scores on post-learning transfer tests



KEY

Discovery ●——●
Lecture ○- - -○

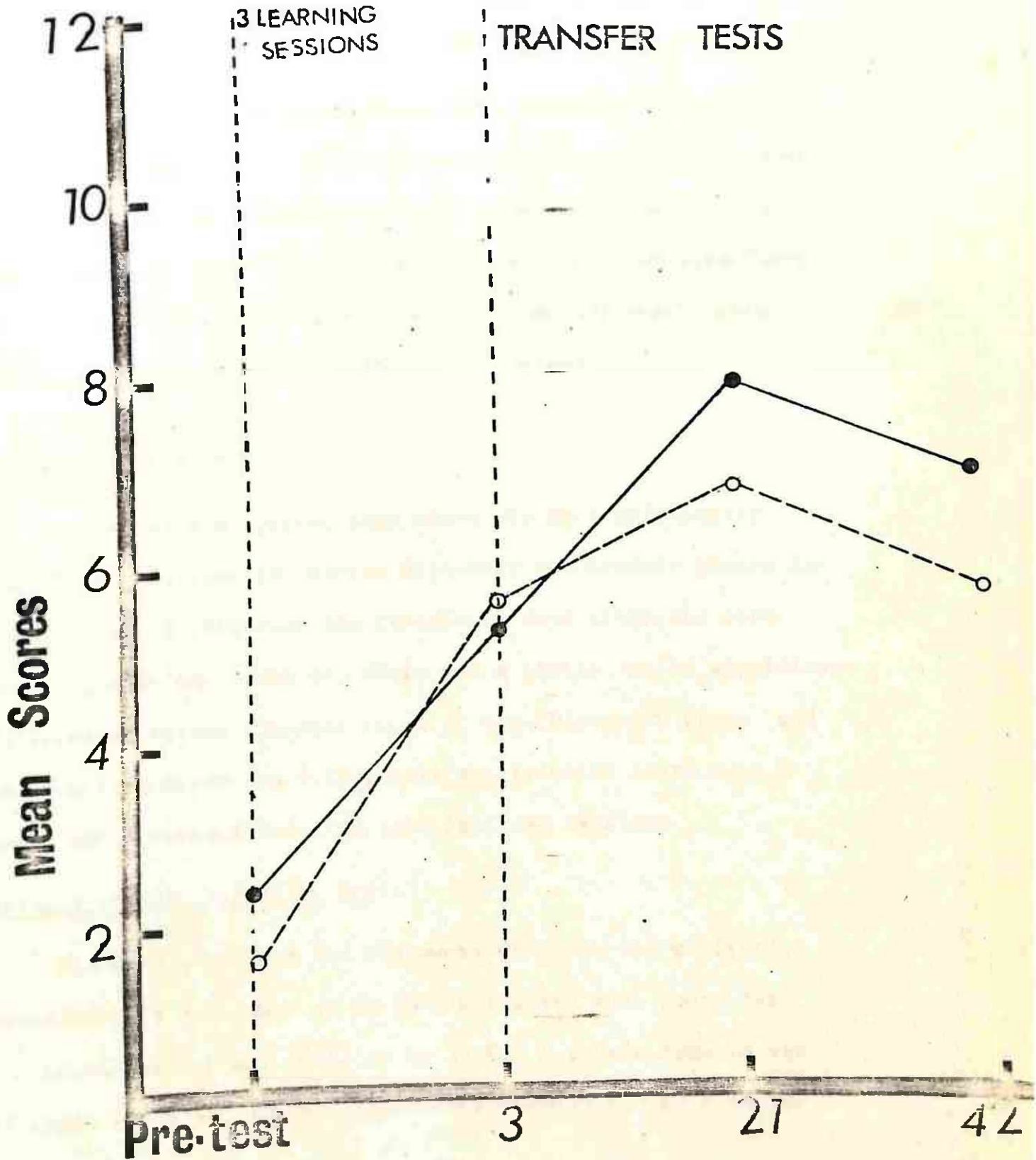


Fig. 2 - Period of time in days

6 weeks after the last learning session: The mean score of the Discovery Group was found to be 6.96 while the mean score of the Lecture Group was found to be 5.705 (see Table 2 and Fig. 2).

A t test done to see if there was a significant difference between the mean scores of the two groups showed that there was a statistically significant difference between the mean score of the Discovery Group and the mean score of the Lecture Group at .05 level of significance. That is, the Discovery Group was superior in transfer to the Lecture Group.

Summary of Results:

The results suggested that there was no statistically significant difference between Discovery and Lecture groups in their level of retention and transfer 3 days after the last learning session. However, there was a statistically significant difference between the mean score of the Discovery Group and the Lecture Group on both recall and transfer tests done 3 weeks and 6 weeks after the last learning session.

Results of the Motivation test:

The mean score for the Discovery Group on the motivation questionnaire was found to be 58.3 while the mean score for the Lecture Group was found to be 37.8. A t test done to see if there was a significant difference between the mean scores

of the two groups showed that there was no significant difference between the mean scores of the two groups at .05 level of significance.

See Table 3 for details

Because of the finding that the discovery group was superior in motivation to lecture group another test was done to test the post-hoc hypothesis that the discovery method did actually contribute to the increased motivation and that the group which was superior in motivation was not already highly motivated before learning started. Therefore, for this purpose, all the subjects that participated in the study were divided into four groups. The students who spent 3 or more hours studying on their own in the first three days after the pretest session were classified as being highly motivated. Those who spent less than three hours a day studying on their own in the first 3 days after the pretest session were regarded as low in motivation. The resulting groups were: (1) Highly motivated discovery group, consisting of subjects who spent 3 hours or more per day learning on their own in the first three days of the study and they learnt by discovery. (2) The low motivation discovery group consisted of subjects who spent less than 3 hours per day studying on their own in the first 3 days of the study and they learnt by discovery. (3) The high motivation lecture group was composed of subjects who spent 3 hours or more per day studying on their own in the first 3 days of the study and they learnt by lecture method. (4) The

Table 3 Results of Motivation

	\bar{x}	s	t
Discovery	58.3	8.3	
			4.328
Lecture	37.8	14	

Critical t_{95} at 96 df = 1.658

low motivation lecture group were those who spent less than three hours per day studying on their own and they learnt by lecture method. Each group consisted of 20 subjects.

Analysis of variance of the scores obtained on the motivation tests was done.

See Table 4 for details of Results

The results of the analysis of variance indicate that, there was no statistically significant difference in the level of motivation, in the four groups (see Appendix IX). Therefore, it would seem that, the difference in the level of motivation that was observed, after the learning experience, between the group that learnt by discovery and the group that learnt by lecture method, was due to the method of learning, rather than the level of motivation, that already existed before the subjects were exposed to different methods of learning.

Table 4 Analysis of Variance on Motivation Scores

Source of Variation	Sum of Squares	df	Mean Square
Between Groups	618.86	4	154.72
Within Groups	13487.53	96	140.50
Total	14106.39	99	142.49

F = 1.11

Critical F at .05 2.53

CHAPTER V

DISCUSSION

It will be recalled that the objective of this study was to demonstrate whether or not learning by discovery would motivate the students to learn more on their own than learning by lecture method. The study also aimed at demonstrating whether or not the group that learnt by discovery would recall more and transfer more effectively than the group that learnt by lecture method.

The pretest data presented in Fig. I suggest that before the two groups were exposed to different learning methods their level of understanding of the principle of ecological balance was equally low. In fact no student in either group gave the expected answers when writing his understanding of the principle of ecological balance. Both groups were therefore equal in terms of the level of their knowledge of the principle of ecological balance at pretest.

Three days after the last learning session a test of recall showed that, the mean score of the discovery group was slightly higher than the mean score of the lecture group, but the difference was not statistically significant. This result does not support Kersh (1962) nor does it conform to the hypothesis that the discovery group would be superior to the lecture group in retention. It will be recalled that Kersh (1962) found significant differences between discovery and directed group on a test given 3 days after the last learning session.

The present results are not entirely surprising because there is evidence that at the end of the last learning session, some of the students had not yet

discovered the principle of ecological balance and this lowered the mean score of the discovery group on retention test.

Another possible explanation for this inconsistency is that unlike students in American institutions of learning such as the one in which Kersh (1962) worked and where lectures are interspersed with many rest periods to allow the students to study in the libraries and practice what they have learnt on their own, the students in this study had lectures scheduled one after the other and as a result they had only short periods of time in the evenings in which they could study independently and practice what they had learnt during the day. Therefore, it is possible that the students in this study probably needed more days in which to study and practice what they had learnt on their own than students with whom Kersh was working. This seems to be the case because 3 weeks and 6 weeks after the last learning session the discovery group demonstrated that they were significantly superior to the lecture group in recall, a finding which supports that of Kersh (1962) and which also conforms to the hypothesis that the discovery group would be superior to the lecture group.

The explanation that Kersh (1962) offered for the superiority of the discovery group was in terms of differences in levels of motivation. According to Kersh (1962), the discovery students were sufficiently motivated hence they continued the learning process and practiced what they had learnt autonomously, beyond the formal period of learning and as a result of this added experience they raised their level of achievement and remembered what they learnt longer, Kersh, (1962).

This explanation seems to agree with the observations made in this study that is, in the motivation questionnaire the answers given by the students

who learnt by discovery indicated that they spent more time studying the material covered in the learning sessions, during their spare time, than the students in the lecture group. Thus it would seem that the student who learnt by discovery in this study were also more highly motivated to learn on their own and therefore, they spent more time practising what they had learnt and looked up for more information from the literature than the group that learnt by lecture method.

The results of the test, done to measure transfer were very similar to the results of the recall tests. As fig. II shows, three days after the last learning session, the mean score of the discovery group was slightly higher than the mean score of the lecture group, but this difference did not reach statistical significance. This finding is not consistent with that of Kersh (1962) nor does it conform to the hypothesis that the discovery group would be superior to the lecture group in transfer.

As in the results for recall the explanation for this finding seems to be that some of the students in the discovery group had not discovered the principle of ecological balance during the learning sessions, and this could account for lack of significant difference, between the two groups. Further, as mentioned in the discussion of recall tests, one of the possible explanations for this inconsistency with the previous findings is that the students in this study had too many lectures scheduled throughout the day for the whole week, and as a result they did not have much spare time during the day in which to practice and study on their own as is usual in many other learning institutions such as in the University that Kersh (1962) was working. As a result the students in this study probably needed more days in which to practice and study more on their own, before the effect of their

The arguments used to support this explanation for recall differences could also be used here because the results of the transfer tests given 3 weeks and 6 weeks after the last learning session showed higher mean scores for the discovery group. This finding is in agreement with Kersh's (1962) findings and with the hypothesis that discovery group would be superior in transfer to the lecture group. As Kersh (1962) suggested, the superiority of the discovery group can be explained in terms of higher motivation. That is, if the students are sufficiently motivated, they will continue practicing and studying on their own, and as a result of their practice they will transfer what they have learnt more effectively. It can be argued that the subjects in the discovery group benefit from the information that giving the learners a statement of the general principles to be learnt ensures "that the learners have adequate background of knowledge to direct his future discovery", p.234. Kittel (1957) also demonstrated that subjects benefit from direction given about the underlying principle. Therefore since the subjects in this study received information about the underlying principle, it can be argued that this information promoted their retention and transfer.

Kersh's (1962) explanation is also applicable to this study because, as indicated earlier, the results of the motivation questionnaire showed that the mean score of the discovery group

was superior to the mean score of the lecture group. This meant that the discovery group spent more time studying material, that was covered in this study, than the lecture group. The discovery group also expressed more positive attitude towards learning the material that was covered in this study than the group that learnt by lecture method. This finding could be interpreted to mean that the group that learnt by discovery was more motivated to learn on their own than the group that learnt by lecture method. This is also supported by Brown's (1968) study which demonstrated that students who were expected to learn independently in one course spent more time studying on their own than they had done in other courses.

The above explanations, however, did not establish whether the motivation of the discovery group was the critical factor underlying superior retention and transfer performance, consequently further post hoc tests were done.

It will be recalled that in attempt to establish this relationship it became necessary to demonstrate whether or not the higher motivation actually was the result of learning by discovery or whether it existed before the treatment.

The result of the post-hoc test designed to compare the pre-treatment motivation as measured by the time each student spent studying on his own before exposure to different learning methods showed that there was no statistically significant difference between the discovery and the lecture group in the amount of time spent in private study before exposure to the two treatments. Therefore, the difference in the level of motivation that was observed could only be attributed to the difference in the learning methods. Consequently, the conclusion is justified that the discovery method is superior to the lecture method in motivating the student nurses to learn more on their own.

The finding that learning by discovery does motivate the student nurses in this country to learn on their own, is very important because as discussed earlier, it is important for nurses especially those who practice in rural areas, to continue learning on their own long after their training is ended because no formal training will give them all the material that they will need so as to continue practising effectively. Further, learning by discovery is also positively correlated with retention and transfer of material learned, and these are assets in effective nursing practice.

Although the findings of this study relate specifically to specific learning and retention conditions, it is interesting to ask whether the effects would still be found if testing conditions were manipulated somewhat to conform to what is typically found in the clinical setting. For example, further

studies could be addressed to the question of whether prolonging the period of learning sessions would be more effective in terms of retention and transfer.

Further it would be interesting to ask whether differences of a greater magnitude would be achieved if students were allowed more free time in which to study on their own.

Regarding the effectiveness of transfer, studies could also be done in which transfer of the material learnt is measured in the clinical setting. This is more appropriate measure because ultimately the criteria for measuring effectiveness of the learning experience for the nurses is in the nurse's ability to apply what is learnt in the clinical area.

However, it seems important that other studies be devised in which the evaluation of student's ability to recall and transfer is measured in the clinical area. It would also be important if studies were done to investigate whether or not the motivating effect of learning by discovery would be sustained over a long period of time.

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APPENDIX I

VERBAL INSTRUCTIONS

Instructions for the first session

Although the exact wording of the instructions for the various groups cannot be reproduced here, generally they conveyed the following information:- "You will be participating in a study whose aim is to find out the advantages and disadvantages of learning using different methods. The material that you are going to cover will be treated like any other material that you learnt from other instructors when the time for assessment comes at the end of the three months. You are required to keep a time schedule of all your activities in twenty four hours for the duration of the study. The actual format of recording your activities is not very important but a suggested sample of a format is drawn on black board".

Table showing suggested format of recording each student's daily Activities

10th May 1977	time	activity	remark
	5a.m.-6a.m.	study in my room	Respiratory system
	6a.m.-7a.m.	shower & dressing up	
	7a.m.-7.30a.m.	Breakfast	General discussion with friends
	7.30a.m.-8a.m.	walked to class	
	8a.m.-12.30p.m.	classes	
	12.30-1.30 p.m.	Lunch	Discussed Immunity with friends
	1.30-1.45 p.m.	Relaxed in my room	Listened to Radio

10th May 1977	time	activity	remark
	1.45-2p.m.	walked to class	
	2-4.30	classes	
	4.30-5p.m.	Tea	General discussion with friends
	7-8p.m.	supper	
	8-10p.m.	study in library	socialization of a child
	10-5p.m.	sleeping	

Instructions for Pre-test: "I have a few questions here, try and answer all of them, even when you are not sure just put the answer that you think is the most appropriate". Questions were then given to the students (See Appendix II for Pre test questions)

Instructions for the First Learning Session: "You are going to learn about the principle of ecological balance today and later you will see how the principle is applicable to different situations that affect health"

"First I would like to hear what you understand by the concept of 'environment', 'organism', 'ecology'." After their verbalization the instructor then clarified what these concepts imply. (See Appendix IV on content)

From here instructions for Discovery Group were different from those of the Lecture Group.

Discovery Group:

Students were given guiding questions on principle of ecological balance (See Appendix. III) and verbal instructions were as follows:-

"Try and answer these questions but since this is not an examination

Instructions for Second Learning Session:

"The principle of ecological balance which you learnt in the previous session is applicable to different situations for example, in the development of immunity. But first I would like to hear what you understand by the concept of 'Immunity'. After clarification of the concept of immunity using measles as an example, the instructor then said, "Therefore, an individual becomes 'immune' or 'unsusceptible' to measles after the first attack of measles." Guiding questions were then given (See Appendix III) as in the previous session the instructions were as follows: "Try and answer these questions but since this is not an examination you should feel free to ask any questions and the instructor will be available to answer your questions."

Instructions for Third Learning Session:

"The principle of ecological balance is applicable to different situations. For example, in the satisfaction and frustration of basic needs. But first I would like to hear what you understand by the concept of basic needs". Students were given time to verbalize their ideas. Instructor then clarified the concept of 'Basic need' by using the example of food, water and air to show that, "an individual must have food, air and water so as to survive. Can you tell me some of the social and psychological factors that are necessary in order to survive". The students were then given time to name some examples like "love" and these were written on the blackboard by the instructor.

At the end of this session students were told "since this is the end of the learning sessions, if there are things that we have not discussed, please feel free to see me about it either

individually or as small groups any time when you are not expected to be attending other classes. Your attention is also drawn to the references in the bibliography as a source of more information on the subjects that have been covered".

Lecture Group

Instructions for the first session which included pre-test was the same as those of the Discovery Group.

Instructions for the first Learning Session:

Instructions for the first learning session were similar to that of the Discovery Group but instead of being given guiding questions and the instructions that followed, the students in the lecture group were told:- "We shall now talk about the principle of ecological balance. I shall give you a lecture about it but you can stop me and ask any questions during the lecture". (See Appendix IV for content of the Lecture)

Instructions for the Second Learning Session:

"The principle of ecological balance is applicable in the development of immunity. I shall give you a lecture on the development of immunity". (See Appendix IV for details of content). "You are allowed to interrupt and ask questions or make any comments during the lecture".

Instructions for Third Learning Session

"The principle of ecological balance is applicable in the process of satisfaction and frustration of basic needs. I shall now give you a lecture on satisfaction and frustration of basic needs" (See Appendix IV for details)

APPENDIX II

PRETEST WITH SCHEME OF MARKING

1. Principle of Ecological Balance:

A. What is Health?

- (a) A state of maintenance of optimal balance between environmental factors and organism.
- (b) Expression of favourable ecological balance.
- (c) Good (Well) (Proper) adjustment to the environment.
- (d) Constant living inspite of changing variables.
- (e) State of equilibrium.
- (f) State of Homoestasis.

2. marks for any of a,b,c,d,e, or f. Anything else no marks

B. What is disease?

- (a) Alteration of living tissues.
- (b) Pathological alteration of living tissues.
- (c) Change in living tissues that jeopardizes their survival in the environment.
- (d) Maladjustment.
- (e) Conflict between environmental factors and body cells.
- (f) Disequilibrium.
- (g) Poor adjustment.

2 marks for any of a,b,c,d,e,f, or g. Anything else no marks.

C. What are the determinants of disease?

- (a) Agents: e.g. virulence environmental stimuli.
- (b) Host factors: e.g. state of health genetic factors e.g. Age, Resistance of man, Susceptibility.

(c) Environmental condition e.g. overcrowding

Each of a,b, and c get 1 mark total 3 marks

Mention of any example gets 1 mark. Total 3 marks

(Total for the question 6 marks).

D. Describe how ecological balance works to determine health status of man.

(a) Man's health status is a function of heredity and effects of his environment.

(b) Man's health status = f. (genetic man + total effects of the environment).

(c) Man's health status is determined by interaction of environmental factors and genetic factors.

(d) It depends on body's response to environmental factors.

(e) It depends on how man utilizes or eliminates or converts what is available in the environment.

2 marks for a,b,c,d, or e. Anything else no marks.

2. Immunity

A. What is Immunity

(a) Unsusceptibility to specific antigen.

(b) Physiological state that prevents or limits effects of invading agent.

(c) Ability to remain free of clinical overt illness.

(d) Ability to resist clinical illness.

B. What is Antigen?

(a) An invading agent that initiates formation of antibodies.

(b) Agent that stimulates immune response.

- (d) Foreign substance that stimulates formation of protective immunity.

2 marks for a, b, c, or d. Anything else no marks

C. What is Antibody?

- (a) A specific protein developed in response to an Antigen
(b) A protein that combines with a specific protein (Antigen)
(c) A protective protein

2 marks for a, b or c. Anything else no marks

D. How does one acquire Immunity to a specific disease?

- (a) When an Antigen is introduced in to the body. The body reacts and produces Antibodies. These Antibodies protect the body.

2 marks for (a)

E. What are (5) host factors that influence immunity?

e.g. Age, Sex, Predecessor, exposure, health status,

Each one of these will get 1 mark. Total 5 marks.

F. What are (5) environmental factors that may influence immunity?

e.g. Weather, Place, Strength of Antigen.

Each one of these will get 1 mark. Total 5 marks.

G. In your own words describe how the principle of ecological balance apply in the concept of immunity.

- (a) (i) Environmental factors (Antigens) enter the body
(ii) body reacts, is stimulated to produce antibodies.
(iii) ∴ the interaction between the environmental factors (Antigen) and the body determine the development of immunity. ∴ immunity develops

Each of (i) and (ii) and (iii) gets 1 mark.

- III (a) What do you understand by basic needs?
- (b) How does the principle of ecological balance work in satisfaction and frustration of basic needs.

(See answers in the marking scheme Appendix VII)

APPENDIX III

GUIDING QUESTIONS

1st Learning Session

I. Principle of Ecological Balance

1. What is a healthy man?
2. What do you understand by disease?
3. When disease occurs, what is happening between man and his environment?
4. How does man keep healthy inspite of so many factors in the environment that could cause illness.

5. There is a principle of ecological balance that works to determine the health status of man. How does this principle work?

2nd Learning Session

II. Principle of Immunity and Body Defences

1. How does a child become unsusceptible to an infectious disease?
2. When a pathological organism enters the body for the first time what happens in the body?
3. What happens if the organism enters for the second time?
4. Why does this happen?
5. When a child is immunized by vaccination how does he become "immune?" What is happening in the body?

6. If a group of people are exposed to the same pathological organisms some may become "sick" while others will remain free of clinical symptoms. How do you explain this?

7. How does the principle of ecological balance apply in the development of immunity?

3rd Learning Session

IIII. Basic Human Needs

1. What do you understand by a Need?

2. What do you understand by Maslow' hierarhy of Needs?

3. In your own words describe how individuals interact with the environment to satisfy or frustrate his needs.

4. How does the principle of ecological balance apply to the satisfaction and frustration of basic Needs?

APPENDIX IV

CONTENT

Principle of Ecological Balance

Principle to be learned is the one on Adaptation and Balance i.e. the principle of Homeostasis i.e. the principle that, all organisms react to changing conditions in such a way as to maintain a relatively constant internal environment. This steady state, is sometimes called equilibrium: Since in the living organisms, the process is very complex the term homeostasis is often preferred. Cannon saw homeostasis as a process of adaptive stabilization in which a physiochemical constant is maintained, such as the automatic regulation of body temperature, or the pH level in the blood, and the maintenance of osmotic pressure, etc. His principle of homeostasis considered the regulations to be largely automatic it emphasized function and direction in describing how forces act and counteract to bring an unbalanced situation back to prior state of equilibrium (Cannon (1939) cited by Menning (1967)). This principle implies that the organism for it's own sake tries to maintain a steady state outside it's own body as well as inside it's own body. In this kind of system i.e. the state of equilibrium when one of the factors which determine the equilibrium varies the system reacts in such a way as to oppose the variation of the factor (Menninger, 1967).

The student will be expected to learn by discovery how this principle applies in maintaining man's health status. The example to be used are:- 1. Immunity, 2. Basic needs.

Ecological Balance

Man's health status = $f(\text{genetic man} + \text{total effect of environment})$ according to Rogers (1960).

At any given time, a person will possess varying components of pathology and also varying components of good health. The total health status will be the net balance of these components (Rogers, 1960).

Unless man can obtain what is required and convert or eliminate what is in excess he cannot maintain homeostasis or health i.e. the necessary equilibrium. Man adapts physically and emotionally to a great variety of physical, biological and social economic stress but most men are likely to break down if exposed to physical, social or emotional stress beyond their tolerance. Rogers (1960) quotes Selge (1956) and says "an individual's state of health depends upon the maintenance of an optimal balance or adaptation between the impacts of stress - producing events and the body's defensive and surrender mechanism" p.164.

Thus the complex interaction that may result in illness or injury involves three major factors. (1) The injury-producing agent which has been defined by Fox, et. al. (1970) as a substance living or inanimate or a force, sometimes rather intangible, the excess presence or relative lack of which is the immediate or proximal cause of a particular disease. (2) The resistance or susceptibility of the host. Host, refers to man more specifically the particular man or group of men of immediate concern.

Host factors therefore include age, sex, race, specific immunity etc. or behaviour factors that relate to habits and customs.

(3) The term environment which embraces all that is external to the agent and the human being, includes the physical, biological and social economic factors. For example, when the system is in balance, homeostasis or the equilibrium state, health is maintained but when any of the interacting factors change the balance is disturbed and the pathology increases (Fox, et. al., 1970.)

The environment seems to have two ways in which it influences man's health status. (a) It may act upon or within his body as a material agent (b) it may act upon his mind and emotions as non-material agent. Thus most of the illness is an expression of a basic imbalance in man's physiologic adaptation to multiple physical and emotional stress that are initiated for the most part in the conditions of his external environment. Thus "man's health status is a function of his heredity and the current and accumulated effects as they act upon his mind and body" (Roger 1960) p.170.

Man's health status = f. (genetic man + total effects of the environment.)

Disease or pathology here refers to "alteration of living tissue that jeopardizes their survival in their environment" (May 1958) p.1. Thus disease assumes the same meaning as maladjustment. This expresses a temporary conflict between living cells and environmental challenge. Disease cannot occur without the convergence of the host, agent and environment at certain point and time (May 1958).

Thus the state of health is more than mere absence of disease. It is the dynamic expression of a favourable ecological balance.

Health, therefore, depends on the presence of positive assets that promote favourable balance e.g. education, adequate medical services. Since ecosystems are always in a state of dynamic rather than static balance, the maintenance of state of health requires challenges or stimuli to develop the ability of man to respond to the continuing forces of the environment (Clark and MacMaban 1967).

Body Defences and Immunity

Before birth the embryo is protected from many forces of the environment by the defences of the mother. The only antibodies the foetus has are those which cross the placenta. But after birth a number of different types of antibodies pass with the milk to add to the existing low level of antibodies in the young baby.

Repeated exposure to antigens (i.e. the invading agent that is capable of eliciting the immune response i.e. it is capable of initiating the development of protective proteins of the body i.e. the antibodies (Gayton 1966) stimulates the lymphoid system to proliferate and to assume the well-organized form. The delay hypersensitivity reactions can be elicited and antibodies can be made by the baby as fresh stimuli are encountered even at a very early age. But active immunity becomes apparent only after weaning.

If the baby remains protected from bacteria infection (e.g. germ free environment) the immunologic system remains poorly developed. If the baby is then returned to a normal bacterial flora he may die because his immunological system has to be rapidly developed.

Thus exposure to antigen is a necessary stimulus to proper development of the lymphoid system. But the maturation and the development requires the presence of thymus glands in the individual (i.e. the baby).

As the baby grows he is exposed to many micro-organisms and many foreign substances in his diet and his environment e.g. dust, pollen and other animal and plant products. Each new stimulus acts as a trigger of a new specific immunity many of which are long lasting. Repeated exposures to the same antigen reinforces and adds to the existing level of antibodies and therefore to immunity.

Thus because of exposure to the bacteria in the environment and other environmental antigens the baby builds up an immunity to a wide spectrum of antigens. Because the usual reaction to a foreign substance whether bacterial or house dust or any other extraneous antigen material, is to develop immunity to the foreign antigen. Antibody has been defined by Gayton (1966) as "the specific protein developed in the body that combines with the antigen the next time it invades the body (p.137), and antigen "an invading agent that is capable of eliciting the development of protective proteins known as the antibodies" (p. 137).

Immunity can be defined as Insusceptibility. Biologically immunity is usually to a specific infection agent and is one result of infection (Fox etc. 1970). Goerke and Stebbins (1965) defines it as the "physiological state that prevents or limits invasion and parasitism by specific etiologic agent or effect of specific enclon and oxotoxins" Thus immunity can be regarded as the capacity of the individual, when exposed to infection, to remain free of clinical

overt illness. Insusceptibility i.e. immunity and susceptibility are hardly ever absolute states. Sufficient increase in the virulence of the agent or the route of inoculation or a long interval since the last antigen stimulus or a lowering of agent resistance through stress may be sufficient to overcome the existing resistance (Maxcy-Rosenau, 1965).

Immune response is defined as the "capacity of the host to develop specific antibodies to an antigen stimulus involving either invasion and multiplication of micro-organisms during an infection or as a result of active immunization" (Georke and Stebbins 1968). The invading agent that is capable of eliciting the immune response (i.e. it is capable of initiating development of protective proteins of the body i.e. the antibodies) stimulates the lymphoid system to proliferate and to assume the well-organized form. The delayed hypersensitivity reactions can be elicited and antibodies can be made by the baby as fresh stimuli are encountered even at a very early age. But active immunity becomes apparent only after weaning (Gayton, 1966).

Basic Needs

Adjustment of a person may be defined as a characteristic way in which he perceives, reacts to, and solves the main problems of life. The main problems of life are related to man's attempts and frustrations that he meets in trying to satisfy his basic needs.

Disturbances and conflicts in the attempt to satisfy these needs may produce acute symptoms as well as abnormal long-range

modes of reaction. Acute symptoms may be interpreted to mean character disturbance while long-range modes of reaction may be referred to the behaviour of an individual who may not breakdown under normal situations of stress, but if he is faced with threat he would have reaction patterns similar to those of people who break down (Maslow and Mittelmaun 1975)

A psychological analysis of the adjustment process show that the process begins when a need is felt and it ends when the need is satisfied. When an individual proceeds in a course of motivated behaviour the activity may be thwarted or blocked (frustrated). The individual may then make many exploratory trials until one of them overcomes the obstacle and the individual then proceeds as before. Thus the main steps of a normal adjustment process include the existance of a motive, the operation or frustration or thwarting that blocks the satisfaction of the need. This gives rise to a variety of responses until one of them succeeds and find a solution and therefore the satisfaction of the need. Individual may be so preoccupied with avoiding the frustration or the obstacle that he never satisfies the need and abnormal behaviour is then observed. (Shaffer and Shoben 1956). Thus "every living organism has to deal with the world out-side it's own skin as well as to maintain it's inner integrity. The environments of organisms contain many material resources that can aid and threats that can hinder the satisfaction of needs. More important for human beings the world is full of other people whose cooperation and competition evoke and direct many forms of behaviour" (Shaffer and Shoben 1956) p.39.

APPENDIX V

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APPENDIX VI

POST TEST QUESTIONS

Post Test for Retention (3 days after)

1. What do you understand by immunity?
2. How do individuals develop immunity to a specific disease?
3. How do environmental factors interact with organism's factor in the development of immunity?
4. What do you understand by basic needs?
5. How do environmental factors interact with organism's factors in satisfaction and frustration of basic needs?
6. What do you understand by a well adjusted man?
7. Transfer

When a child of four years went to a nursery school one of the other children in the group had measles, so after a few days this child developed measles.

(i) How could the principle of ecological balance have worked in in this situation?

(ii) If his sister who was exposed to the same organism did not develop measles, how would you explain this?

Questions to Students (3 weeks after)

Recall

- (a) In your own words explain what you understand by this principle:

Health Status = (Genetic man + total effect of environment).

- (b) How does the above principle apply in the process of development of immunity?
- (c) How does the above principle apply in the process of satisfaction or frustration of basic needs?

Transfer

- (a) How can people in a village improve on the organism's factors so as to keep healthy?
- (b) How can people in a village improve an environmental factors so as to keep healthy?

Questions to Students (6 weeks later)

Recall

1. Immunity is not an absolute state. Explain in term of principle of Ecological balance.
2. Man depends on the environment for satisfaction and frustration of his needs
Explain this in terms of the principle of Ecological balance.

Transer

1. A child had been vaccinated against measles (and thus considered Immune) but he developed a mild form of measles after a severe gastroenteritis illness.
Explain this in terms of principle of Ecological balance.

APPENDIX VII

SCHEME OF MARKING AND EXPECTED ANSWERS

1. What do you understand by Immunity?
 - (a) Unsusceptibility to specific Antigen.
 - (b) Physiological state that prevents effect of invading Agents.
 - (c) Physiological state that limits effect of invading Agents
 - (d) Ability to remain free of clinical illness
 - (e) Ability to resist clinical illness
 - (f) Body cannot develop clinical illness
 - (g) Body cannot develop clinical signs
 - (h) Ability of body to defend itself
 - (i) Ability to withstand disease.

a, b, c, d, e, f, g get two marks each

h, i get one mark each

maximum mark (2)

2. How do individuals develop Immunity to a specific disease?
 - (a) When Antigen enters, (is introduced into) the body.
 - (b) The body reacts and (is stimulated to) produce Antibodies
 - (c) These Antibodies (d) protects the body the (e) next time that Antigen enters the body.

each of a, b, c, d, e gets one mark. Maximum (5 marks)

3. How do environmental factors interact with organisms factors in the development of Immunity?

- (a) Antigen from the environment enters the body stimulates the body (b) The body react by producing Antibodies.

- (c) The interaction between Antigens from the environment and the body determines the development of immunity

Each of a, b, c get 1 mark

Maximum marks (3)

4. What do you understand by basic Needs?

- (a) Something vital for survival.
- (b) Things required for survival.
- (c) Lack of necessity.
- (d) What is necessary for survival.
- (e) Something that the body cannot do without.

Any one of a, b, c, d, e 2 marks

5. How do environmental factors interact with organisms factors in satisfaction and frustration of basic needs?

- (a) The environment supplies for basic needs.
- (b) The environment provides for basic needs.
- (c) Individuals find fulfilment of basic needs in the environment.
- (d) Absence of necessities in the environment causes frustrations.

Any one of a, b, c get 2 marks

d get 2 marks

Total 4 marks

6. What do you understand by a well adjusted man?

- (a) A healthy man.
- (b) A man in a state of equilibrium.
- (c) A man in a state of balance.
- (d) A man in a state of good balance.
- (e) A man who is not in conflict with his environment.
- (f) A man who has adapted himself to his environment .
- (g) A man in a steady state .

Any one of a, b, c, d, e, f, g gets 2 marks

Total 2 marks

7. (i) Individuals react differently because of:

- (a) their genetic make up plus.
- (b) Experiences in the environment.
- (c) Individuals have different ways of adjusting .
- (d) Some people are more torelant .
- (e) Some people are more adjusted.

(ii) a, b & c get one mark each a total of 3 marks
if only d or e one mark for each maximum mark 1

(ii) The interaction of individuals genetic make up plus total effect of his environment determine how he will react to different situations.

Total 3 marks

8. When a child of four years went to a nursery school one of the other children in the group had measles, so after a few days this child developed measles.

(i) How could the principle of ecological balance have worked in this situation?

- (a) The presence of (a child with measles) measles virus in the environment (surroundings) plus,
- (b) The health status of the child (The child had no immunity) (The child who was susceptible to measles)
- (c) The interaction of a and b determined the development of measles in the child.

a, b and c get 1 mark each

Total 3 marks

(ii) If his sister who was exposed to the same organism did not develop measles how would you explain this?

- (a) The sister might have been in better health state
- (b) Less viruses might have attacked her.
- (c) Sister had better resistance

Mention of any of a, b, c get 1 mark Total 3 marks

APPENDIX VIII

MOTIVATION QUESTIONS

How many times in the last 5 weeks have you read about:

- (1) Ecological balance.
- (2) Respiration
- (3) Immunity
- (4) Osmosis
- (5) Basic Needs
- (6) Digestive system

Mark what applies for each question

Never

Once or twice

Three to ten times

More than ten times.

After classes how many hours in a week do you spend studying?

- (7) Osmosis
- (8) Immunity
- (9) Respiration
- (10) Ecological balance
- (11) Basic needs
- (12) Digestive system

None

1-2 hours

2-5 hours

More than five hours.

In the last five weeks how many times have you spent discussing each of the following topics with a friend?

- (13) Digestive system
- (14) Immunity
- (15) Basic needs
- (16) Respiration
- (17) Ecological balance
- (18) Osmosis

Score according to number of times stated.

How do you like hearing about the following:

- (19) Immunity
- (20) Respiration
- (21) Ecological balance
- (22) Digestive system
- (23) Osmosis
- (24) Basic Needs.

Mark the letter against your feelings

- very much (a)
- A little (b)
- indifferent (c)
- dislike (d)
- dislike very much (e)

(25) If you are given a chance to go on hearing about

the following which would you choose ?

- Digestive system 1st
- Respiration 2nd
- Immunity 3rd
- Osmosis 4th

(26) As in 25 Mark in order of preference

Ecological balance.

Digestive system

Respiration

Osmosis

(27) As 25 Mark in order of Preference.

Digestive system

Respiration

Osmosis

Basic Needs.

(28) Would you be interested, In hearing more about
Ecological balance ?

Yes

Very much

Not sure

No

(29) Would you be interested in hearing more about child
development ?

Not sure

No

Yes

(30) Would you be interested in hearing more about digestive
system ?

No

Yes

Not sure

(31) Would you be interested in learning more about immunity?

No

Yes

Not sure

(32) Would you be interested in learning more about Digestive system ?

Yes

No

Not sure

(33) Would you be interested in learning more about Respiration?

Not sure

Yes

No

(34) Would you be interested in learning more about basic Needs ?

Not sure

No

Yes

(35) Would you be interested in learning more about making a bed ?

No

Not sure

Yes

(36) Write the word that tells how you feel about each of the following topics.

Immunity

Digestive system

Ecological balance

Basic needs

Osmosis

Interesting

Dull

Too hard

Boring

Exiting

Very important

Worthless

Useful

Fun

Useless

APPENDIX X

DEFINITIONS

- (1) Discovery Learning "The teaching situation in which the student achieves the instructional objectives with limited or no guidance from the teacher" (Dececco 1968), p.464. "The crux of the discovery is recognition and understanding of the relationship among concrete experiences and the operation of putting these experiences into the complete form of language" (Schulman 1966), p.28. Therefore discovery learning could be said to refer to cognitive aspect of learning that is concerned with the organization and development of insights (McDonald 1965 cited by Tornay 1968). In this study discovery learning refers to the teaching situation in which the student achieves the instructional objectives with limited or no guidance from the teacher. It also implies to learning by discovery of the principle or a concept with little or no guidance from the teacher. If the learner completes the task with little or no help from the teacher he will be said to have learned by discovery (Kersh 1962)
- (2) Principle "A statement of relationships between two or more concepts. Principles are sometimes called rules or generalizations" (Dececco 1968).
- (3) Learning "Relatively permanent change in behaviour tendency which results from reinforced practice. We can also infer a person has learned when he can do something which he could not do before. We can observe performance but we cannot observe

learning. We can only infer that a person has learned when he can do something later which he could not do before" (Dececco 1968).

- (4) Motivation Here refers to some condition or state of affair within the learner, which gives rise to activity directed towards a goal (Garry 1965). Therefore, a motive can be said to be an energizer or activator of behaviour (Teevan 1967). Therefore, motivation can be defined as the process of arousing action, ~~and~~ sustaining the activity in progress, and regulating the pattern of activity (Sosen 1959 cited by Weetjen 1971). Motivation is usually assessed in education by noting the kind and amount of behaviour of the learner. When we say that a student is motivated we mean that student will be active (Keislar 1971).
- (5) Transfer When the situation in which learning is being tested replicates the situation in which it was learned from, retention is being measured. But when the situation differs then transfer training is being measured. However, the distinction is sometimes very difficult to make (Garry 1965) "Transfer of learning is said to occur when a person's learning in one situation influences his learning and performance in other situations (Biggs 1964). Transfer takes three forms, (1) positive transfer when previous performance benefits the performance on the subsequent tasks. (2) Negative transfer when previous performance disrupts the performance on the second task. (3) zero transfer when previous performance has no effect on the performance in the next task (Dececco 1968).

APPENDIX IX

Table IV Analysis of Variance on Motivation Scores

Source of Variation	Sum of Squares	df	Mean Square
Between Groups	618.86	4	154.72
Within Groups	13487.53	96	140.50
Total	14106.39	99	142.49

F = 1.11

Critical F at .05 = 2.53