1988

An investigation into the problem-based learning model for the educational preparation of dental hygienists

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Abstract

Dental Hygiene is a young profession by most standards. The first class for training dental hygienists began in 1913, a mere seventy five years ago. From its inception, the mission of dental hygiene was to serve the public providing preventive oral health care to those in need. That singular focus has not changed to this date nor is it likely to change in the future. However, what is changing is the emergence of a profession in the fullest sense of the word. A profession is defined by Webster as: "a calling requiring specialized knowledge and often long and intensive academic preparation" (p.919). Members of the dental hygiene profession, armed with critical thinking skills that have been learned and internalized during their educational preparation, must be able to serve the needs of the public.

AN INVESTIGATION INTO THE PROBLEM-BASED LEARNING MODEL FOR THE EDUCATIONAL PREPARATION OF DENTAL HYGIENISTS

A Research Paper

Submitted

in Partial Fulfillment

of the Requirements for the Degree

Masters of Arts in Education

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July 1988

This Research Paper by: Sarah Ann Turner

Entitled: AN INVESTIGATION INTO THE PROBLEM-BASED LEARNING MODEL FOR THE EDUCATIONAL PREPARATION OF DENTAL HYGIENISTS

has been approved as meeting the research paper requirement for the Degree of Master of Arts in Education: General Educational Psychology.

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Chapter I

Introduction

Dental Hygiene is a young profession by most standards. The first class for training dental hygienists began in 1913, a mere seventy five years ago. From its inception, the mission of dental hygiene was to serve the public providing preventive oral health care to those in need. That singular focus has not changed to this date nor is it likely to change in the future. However, what is changing is the emergence of a profession in the fullest sense of the word. A profession is defined by Webster as: "a calling requiring specialized knowledge and often long and intensive academic preparation" (p.919). Members of the dental hygiene profession, armed with critical thinking skills that have been learned and internalized during their educational preparation, must be able to serve the needs of the public.

Currently, dental hygiene does not meet the basic requirements of the above abbreviated definition. The minimum preparation for the dental hygienist is the Associate of Arts or Applied Sciences degree. However, the American Dental Hygienists' Association, in its

aspirations to become a recognized profession, has declared its intent to establish the baccalaureate degree as the minimum entry level into the career.

Further, dental hygiene has an enormous task ahead in defining the specialized body of knowledge that is unique to dental hygiene. In that process, movement must be away from a technical orientation to one which is knowledge based (Lindeman, 1984). With the technological advances in the dissemination of knowledge via numerous forms of media and the computer as well, the professional is no longer the sole source of knowledge. However, it remains that knowledge is what makes for "an unambiguous profession" (Lindeman, 1984, p.24). Therefore, a primary challenge to dental hygiene education becomes one of changing the focus to a knowledge-based curriculum.

The professionalization process occurs in an educational environment. It takes time for the student to mature and as socialization takes place, the values or unique characteristics that embody the discipline become accepted. The student not only learns roles and how to perform them, but also attitudes are shaped as the interalization of the new knowledge and skills is acquired.

Dental hygiene graduates must be capable of solving

problems, making decisions, being creative and critical thinkers, and exhibiting behavior guided by an internalized code of ethics of dental hygiene (Lukken, 1986). Dental Hygienists of the future will need the above stated skills to assist the public in obtaining optimal levels of health and social well being. Dental Hygienists influence attitudes and behaviors of the individual and the community. As such, there needs to be an emphasis on the personal and humanistic values in the promotion and provision of health care in a technological society. The professional needs to be capable of visionary, expansive integrated thinking and action.

Dickoff and James (1987) stated that Dental Hygienists must be "thinking doers"--they must "possess as thirst for information and a spirit of inquiry" (1987,p.17,18). In doing so, they will be prepared to adapt and apply their knowledge base to an ever changing environment. The dental hygiene educational community must respond to the future needs of the emerging profession. Curriculum change can be responsive to the knowledge based demand, as well as to the roles and responsibilities established for the future Dental Hygienist.

The scope and depth of the educational preparation

of dental hygienists evolves from a definition of six roles and responsibilities determined by participants of the 1984 ADHA education workshop. The roles were subsequently adopted by the American Dental Hygienists' Association. The six integrated roles are: administrator/manager, change agent, clinician, consumer advocate, educator/health promoter and researcher.

Miller (1986) astutely presented the crux of the problem:

> "How will this be translated into the establishment of an education system? How will that system provide not only skills and credentials but prepare graduates who can be activists, who can speak out on behalf of the patients they serve, who can function in a political arena, who can participate in building a dental hygiene body of knowledge, who can assume leadership positions in the world of health care delivery?" (1986,p.11)

A critical element in curriculum change may be to look to alternative teaching strategies in order to develop an individual who can apply decision making to solve problems within a rapidly changing environment. Conceptually, Abrahamson (1987) described a problem-based strategy as an innovative design for the development of "clinical skills, intellectual curosity, self-directed learning, problem-solving ability, and the ability to identify and locate needed information" (p.B1) Clearly,

proficiencies needed by the Dental Hygienist in order to address the questions posed by Miller.

Statement of the Problem

This study purports to investigate problem-based learning as a teaching strategy to develop critical thinking skills for the future educational preparation of selected Dental Hygienists. This study is an extensive review of the literature and answers to the following researchable questions:

1) What are the historical roots of inquiry learning?

2) What is the application process of inquiry?

3) What are the problems in utilizing the approach of inquiry learning?

4) Can the problem-based learning model be useful in developing critical thinking skills required of Dental Hygienists in an ever changing society?

Anticipated outcomes are that the problem-based learning model can be traced to the more traditional approach of inquiry learning and that the process of inquiry can develop critical thinking skills. Further, that the problem-based learning model can enhance the educational preparation of the future dental hygienist by providing useful strategies in developing critical

thinking skills.

Definition of Terms

The terms listed below will be utilized throughout the study in the following context:

Problem-based Learning:

An approach where "students meet in small tutorials and consider biomedical problems that they cannot solve without acquiring--and thus learning--new information and skills" (Abrahamson, 1987,p.B1).

Inquiry Learning:

Learning experiences that try "to help students examine, investigate, and explore questions and situations and discover their own insights and understanding" (Dewey, 1933; Suchman, 1966; Taba, 1966; Scott,et all, 1985).

Guided Design:

A learning approach where students work together in small groups on open-ended problems with resource materials prepared by the instructor to "actively seek solutions rather than assimilating knowledge" (D'Amour/Wales, 1977; Goldberg/Shuman, 1984)

Thinking:

A lawful process that can be taught involving inquiry and problem-solving based upon past experiences, current observations or by both. (Dewey, 1933; Taba, 1966)

Significance of the Study

There will be dramatic changes in the future in the health care delivery system. The focus will be on community and home-based care rather than institutionized and private practice settings of today. And, more health care will revolve around self-care and/or family administered care, ie: blood tests, tests for cancer accomplished by the individual in the home (Kramer, 1984). The impact of the change in delivery systems and the acceptance of dental hygiene as a profession, involve the realization that the future dental hygienist must be able to accommodate these changes. That accommodation will occur through the six identified roles and responsibilities referred to earlier. They are administrator/manager, change agent, clinician, consumer advocate, educator/health promoter and researcher. Educationally, to prepare this new genre of Dental Hygienists requires innovation in teaching strategies.

Strategies must be sought that will successfully aid students in the acquisition of knowledge to be applied to decision making and problem solving in an environment in which they provide service to the public.

Procedures in Obtaining Literature

Several avenues were utilized to obtain a thorough review of the literature. The initial step was a computer search using key terms such as inquiry, problem-solving, inquiry and higher education, inquiry and curriculum and beyond secondary level and inquiry and learning strategies. Various indexes were perused for further resources such as the Index to Dental Literature, the Education Index and the Current Index to Journals in Education. The card catalog provided further sources, as topics of education, thinking, problem-solving and inquiry were reviewed. This appeared to result in a thorough investigation in the review of the current literature.

Limitations

A limitation to the study is to the scope of its use. The problem-based learning model as a teaching strategy requires the early development of a hypothesis in order to channel the systematic inquiry of a problem. Therefore, it could be argued that only students mature

enough to employ a problem-solving approach will have success in internalizing and transferring the skills to unique problem situations. A further limitation could be to the generalization of the model to all content areas within a curriculum.

Methods of Answering the Questions

As the literature was reviewed, note cards were made of each reference. The note cards were initially divided according to the major headings of: historical perspective, the application of inquiry/problem-based learning, problems in utilization of the model and the problem-based model in developing thinking skills. Within each question area, there were key concepts to sub-categories. Emerging in the historical perspective, were base-line theories of education and of thinking. Then, the initial strategies of inductive thinking and inquiry were explored. The literature was replete with the application of inquiry as a teaching strategy. Note cards were segmented to different applications inclusive of two sub-sets; guided design and the problem-based learning model. While maintaining the constructs of inquiry, examples of the application of inquiry and related designs were categorized and explored. The literature was then reviewed again to evaluate designated

problems in the utilization of the approaches. Finally, note cards and references were selected that responded to the final question of using the problem-based model and similiar inquiry approaches to develop critical thinking skills. Cross-references were made with the concept of the educational preparation of future dental hygienists.

Summary

Currently, Dental Hygiene is not recognized as a profession, in part due to the level and orientation of the educational preparation, in other words, less than a baccalaureate degree as an entry level and a technical orientation over a knowledge-based one. In concert with the change to a recognized profession, the dental hygiene educational community needs to respond to an increasing need to develop future dental hygienists who are capable of employing critical thinking skills necessary for decision-making, clinical judgment, and assessment. This study into the problem-based/inquiry learning approaches proposes that these teaching strategies will assist in meeting the above stated needs for the dental hygiene educational community in the preparation of the future dental hygienist.

Chapter II

Review of the Related Literature

The purpose of this study is to review the related literature and provided data for the four questions posed in regard to problem-based/inquiry learning and its application to dental hygiene education. The questions are: 1) What are the historical roots of inquiry learning? This question will be explored under the heading of Historical Perspective. 2) What is the application process of inquiry? The subheading is: The Process of Inquiry Method as a Teaching Strategy 3) What are the problems in utilizing the approach of inquiry learning? This question is explored under: Problems Involved with the Inquiry Approach. and 4) Can the problem-based learning model be useful in developing critical thinking skills required of dental hygienists in an ever changing society? The subheading is: Problem-based Model in Developing Critical Thinking.

Historical Perspective

A discussion of problem-based learning prior to at least a cursory definition of education would seem presumptuous. However, this is a difficult task at best. From a philosophical viewpoint, education deals not only

with the individual but with society and life in general and is a "value-judgment enterprise" (Morris, Pai.1976,p.19). To have value for anything means that one believes that the thing is good and true. Education, then, could be interpreted as the way for individuals to have a good life and perpetuate society (Charles, 1985). John Dewey (1938) interpreted education "as the scientific method by means of which man studies the world, acquires cumulative knowledge of meanings and values, these outcomes, however, being data for critical study and intelligent living" (p.xi).

The process of inquiry begins with thinking. Dewey (1916) theorized that thinking is not done in isolation, but that "thinking is experience" (p.180). In other words, thinking is not merely thoughts, but indeed involves actions, events, facts as well as the relationship of things (1916). Therefore, any attempt to solve any manner of problems by thinking will include an inquiry regarding other facts from one's memory or by being observant or by a combination of the two (Dewey,1933). Dewey's prescription then is one of reflective thought as "active, persistent, and careful consideration of any belief, or supposed form of knowledge in the light of the grounds that support it and

the further conclusions to which it tends" (p.9). The process of reflection is guided and steadied by a "demand for the solution of a perplexity" (Dewey, 1933,p.14).

Dewey (1938) in Experience and Education, saw that education need not be based on either an autocratic foundation or one of total individual freedom but rather, education based on personal experience. This is not to say that experience and education are directly equated with one another. Education can be "conducted upon the basis of experience" (1938, p.23). According to Dewey, learning by experience is a more humane and democratic process as it arouses curiosity, strengthening initiative and is a moving force to the individual. There must be a connectedness, a purpose which grows and is molded by a process. The individual does things to the environment and then must accept the consequences of his/her actions. This is seen as a powerful way to grow in intelligence (Morris/Pai,1976). The educator sees that occasion and takes advantage of it and guides the student by making suggestions for activities. Further, the educator needs to determine what direction the experience is heading assuring that it will lead to worthwhile growth (Dewey,1938). Part of the philosophy of experience is to also recognize the role of habit. Dewey (1938) stated

that the basic characteristic of habit is where every experience that is enacted and is undergone is modified by the one who acts and that modification affects ultimately the quality of any subsequent experience.

If, as Dewey (1938) suggested, education is a social process, then education becomes the leader or facilitator for group activities rather than single source for action. He stated that "the ideal aim of education is creation of power of self-control" (p. 75). And in Dewey's mind, self-control is equivalent with freedom. Indeed, a purposeful 'stop and think' proposition. The educator must establish the environment and the conditions for activities to help the student develop inductive mental processes.

Hilda Taba (1966) in analyzing thinking formulated three postulates: 1) thinking can be taught, 2) thinking is an interaction with the individual and the data, and 3) processes of thought evolve by a sequence that is "lawful" (p. 35). Her conclusion was that these skills are taught by specific strategies of concept formation, interpretation of data and the application of principles. (1966) These are succinct features of inquiry learning.

Suchman (1966) believed that in terms of time and

effort expended, the demands on the teacher for inquiry development is great. However, the rewards are also sizable and it is in the nature of thinking, that the teacher will find exciting. No longer will the teacher worry if the student is thinking or what thinking is occuring. Nor will the teacher question how to reach the student. In this context, the primary task of the teacher is to monitor how students are processing information. Then, the teacher can sense the students' readiness for new experiences and new cognitive activities. (Joyce/Weil,1980) The educator is responsible for thought and planning, gaining knowledge of the students and of the subject matter that allows activities to be selected. The activity becomes the driver, not the person and allows for all to contribute. (Dewey,1938)

Suchman (1966) believed inquiry training to be a process to explore and reach a level of understanding of discrepant events. He based his theory on four basic axioms: that when puzzled, people will naturally inquire; that people will and can learn to analyze thinking; that people can be taught new strategies puposefully; and that inquiry not only enriches thinking but aids people in their ability to recognize that knowledge is tentative and has an emergent nature and

that people can appreciate explanations divergent from their own. He stated that "inquiry leads not so much to new answers as to new and more productive questions".(Suchman 1966, p.3) Indeed, his belief was that inquiry is "the fundamental means of human learning. All human knowledge comes through perception, analysis, inference, theorizing and verification". (1966,p. 76) Fundamentally, these are characteristics of the scientific method. Suchman (1966) believed that the goal of inquiry programs is to develop an individual who will grow in creativity and have the capacity to add not only new answers but new questions to the constantly changing body of knowledge.

Dewey (1938) would have the inquirer (student) begin with a formation of a purpose by: observation of surrounding conditions. The inquirer will use his/her knowledge of what has happened in similar situations in the past (either by recollection and/or by the information, advice and warning of others) and then make a judgment. This is accomplished by putting together what is observed and recalled to see what is significant.

Suchman (1966) refined the process further into five phases. First, there must be confrontation with a puzzling situation. Secondly, data gathering occurs with

verification of the nature of objects and conditions and of the problem situation. The third phase is regarded as experimentation, either by exploration or direct testing. Phase four requires organizing information and explaining the discrepency. And in phase five, the learner must analyze by reflecting on the strategies developed. Suchman (1966) stated that a primary purpose for inquiry training is that it can make the learner more autonomous. Further, the key to inquiry is the interchange between the data and the theory. In fact, data keep the process moving, while the theory provides direction.

John McCollum (1978) discussed a simplified taxonomy for inquiry learning based on the original work of Bloom's taxonomy.

1. Describing (memory or recall)--make observations
2. Explaining (interpret or convergent thinking)--develop a cause and effect relationship
3. Predicting (applying or divergent thinking)--apply cause and effect relationship to generate probability statements.
4. Choosing (evaluation)--analyzing alternatives

According to Suchman (1966) the student forms concepts through a series of concrete experiences and thus generates knowledge. Conceptual growth matches

Piaget's stages of categorizing and assimilation and then of concrete operations. Conceptual growth builds new models of old. In Taba's concept formation, the student must identify and enumerate data that are relevant to the problem or discrepant event. Then, the items are grouped on the basis of similarity and finally categories and labels for the groups are developed.

Taba (1966) formulated two subsequent inductive thinking tasks to concept formation. The second was the interpretation of the data. This step matches the second and third taxonomies above and interfaces with Suchman's second and third phases. This task involves differentiating the characteristics of the data, determining cause and effect relationships among the data, and then making inferences. The third task is the application of principles. The learner predicts consequences, explains/supports a hypothesis and verifies the prediction. The final task can be cross-referenced with the fourth taxonomy and Suchman's fourth and fifth phases.

Inquiry has great meaning to the learner as an intrinsic motivator because people want to learn more about the world (Suchman,1966). Suchman further pointed out that there are two types of motivation, socio-ego

motivation and motivation for closure. In the former, the student puts all emphasis on learning from the viewpoint of how it affects one's own status. This is evidently inherent in all we do and is a survival response. The second type of motivation, that of motivation for closure, is what pressures individuals to close the gap between one's ideas and what one sees. This pressure, according to Suchman, used frequently will bring about motivation for curosity. In his mind, this is the most creative learning and the most productive and allows the student to be autonomous or experience freedom. (1966)

This portion of the paper has presented a historical perspective for inquiry by beginning with a broad view of education as an intellecutal process to enable individuals to live full and productive lives. Next, thinking was discussed as a necessary precedent to and an integral function of inquiry. Finally, the major constructs of inquiry were presented.

The Process of Inquiry Method as a Teaching strategy

A Review of the literature reveals that a number of disciplines-- engineering, medicine, biological and chemical sciences and agriculture to name a few--are seeking to find teaching methodologies that will provide

students with sufficient scope to become better thinkers. Further, to utilize approaches that will assist students to have the ability to inquire, to be analytical, to solve problems in a humane, intellectual process that will evoke a perpetuation of society, in other words, to be educated. Bowman's (1985) approach viewed schooling as focusing on cataloging and dispensing known information which creates "learning outcomes and rewards that focus on right answers" (p.33). Further, as the typical methodologies to learning are utilized, the critical thinking, problem-solving and inquiry skills of the learner atrophy. Bowman (1985) concluded that "if students are to become truly educated, and not just schooled, they will require classrooms which reject answers in the absence of their underlying questions as an insult to those who wish to grow in the problem finding and problem-solving behaviors of educated persons" (p.35).

The process of inquiry teaching strategies in the purest form is presented through the techniques of Suchman and Taba. While Taba is not known for the specific strategy of inquiry, her methodologies parallel those of inquiry as inductive thinking: the collecting, organizing and manipulating of data. Suchman (1966)

stated that when there is a fair assurance that the structure created from the data, theorizing, testing, and modifying, axioms then form a deductive argument that can undergo further testing.

Taba developed three inductive thinking tasks, referred to earlier, which were intended to manifest inductive mental tasks, particularly skills of categorizing and using categories.

Suchman (1962) felt that perhaps the single most important relevancy to the educational process at all levels is the question, "How do you know?" He perceived that the ultimate purpose of inquiry is:

> "The goal of an inquiry program is not primarily to develop a child who can quote the presently approved answers for the sanction of his elders, but a child who will grow into a creative adult capable of adding new questions and answers to the ever changing structure of scientific knowledge" (p.78)

Suchman has four primary parts to the inquiry session. The following represents a capsulized version of the procedure as detailed in his text: Developing Inquiry. (1966)

Part 1: Presentation of the problem. The problem is typically some event and some question about it. It

may be presented using a variety of media or by demonstration. The student must build a potential theory to respond to the puzzling event. Progression of data gathering occurs as the teacher is questioned. There are some basic rules of questioning that are pertinent to allowing the student to data-gather. Questions must be phrased to elicit only yes or no responses. This technique assures that the student will not depend on the teacher for the facts of the event. Each student has the freedom to ask as many questions as is necessary to plan a sequence, discuss uncomplicated issues and strategize before yielding to another student. It is imperative that the teacher does not pass judgment on theories or questions the student's theories. Students can test any theory at any time and need to be able to work with all available resources. The students may also find a need to call an abbreviated conference without the presence of the teacher. It is imperative that the student uses verification, the process of gathering data that is pertinent to the event, be it objects, conditions and/or properties. Following, the students must use experimentation to attempt to determine the consequences of change. So, experimentation has two functions, one of exploration and one of direct testing of a theory.

Part 2: Conditions for inquiry. There are four conditions that need to be created by the teacher. There is a condition of freedom where the student must be autonomous, self-directing and self-starting, able to try ideas and invent ways to account for what the student sees. There is a condition for a responsive environment. Here the teacher provides information that students seek by making available a wide range of materials and facts. The condition of focus is that "inquiry is a purposeful activity" (1966,p.15). A focus event is one that appears discrepant to the students. This is a paramount feature of an inquiry session. The student tries to eliminate the discrepancy by analyzing it in terms of what the student knows and by becoming acquainted with the event. The teacher needs to focus and refocus the event to provide maximum stimulus. The fourth condition is that of low pressure. The teacher responds positively and neutrally which allows for the skillfull guidance of concepts and facts to supervise the conceptual growth of the students.

Part 3: Physical arrangements. For the initial problem presentation the students should be seated in a semicircle around the teacher to allow for all to participate in the questioning session. Then grouping by

teams of three or four appears to be the best configuration. No other special equipment is necessary beyond what would normally be available in the modern classroom.

Part 4: Role of the teacher. Based on the stated process, the teacher must stimulate and challenge the student to think while providing support for inquiry and ensuring freedom of the operation. It is necessary to diagnose any difficulties and identify and use 'teachable moments'. Possibly one of the arduous tasks confronting the teacher is that of waiting for the first question from the student. This is a vital step, however, in aiding the student to accept the proposition of open-endedness, exploring for the goal of constructing more useful theories. The teacher is but one source of data and is a facilitator. The emphasis is to assist the student in the recognition that an inquiry problem is never totally solved, but that there is a level of understanding when most discrepancies disappear.

McCollum (1978) viewed the teacher's role of structuring the environment to encourage the student to generate and test ideas for meaning. Again, the process is more important than the content emphasizing the explanation and examination of the phenomena.

McCollum (1978) condensed the process into a five step approach. The student (1) confronts the problem posed by the teacher which is focused on the content of the class, (2) acquires information. By doing so a knowledge base of information related to all elements of the problem is generated, (3) analyzes the cause and effect relationships, (4) generates ideas to explain the cause and effect, and (5) tests the ideas. McCollum suggested that an important part of the process is to develop the language or to gain the meaning of words. The teacher asks questions to aid the student to avoid single meanings to words and in fact, the student learns to build discrete meanings for words. Further, the student learns to share meanings of words by reporting words vs inferential or judgmental meanings. An example would be: "You make her very happy." A more appropriate language that exemplifies analysis and cause and effect relationship which generates an idea is: "Her face was smiling and her eyes were bright after you made that statement".(1978)

In the winter quarter of 1980-81 at Moorehead State University, Bowman (1985) presented an undergraduate course in test and measurements utilizing the inquiry methodology. Interestingly, he began the course on the

first day with "Ah, but what are the ten questions?" Students were directed to do two things as they proceeded through the course: make a personal journal noting issues, concerns, practices and questions that interfaced with their discipline and measurement and evaluation, and to identify questions, concerns and issues which seemed to be critical to the individual if they were to become successful in their given field. The students were encouraged to utilize journals, interviewing teachers, other professionals in their discipline, potential employers, whomever could provide new insights and data. Each week those classmates who shared common interest met. These sessions exposed issues within the peer group and Bowman reported results in promoting learner reflection and response. He believed the sessions allowed the student to explore creative processes and enhanced thinking skills. In his opinion, an important outcome of the process is that the students accept the shared responsibility for their learning.

This outgrowth of the inquiry method demands that the teacher be able to spontaneously determine guided reading assignments and structured activities based on the daily class discussions. The students also were involved at the end of each class session of selecting

working partners for particular exercises to be completed as a team. (1985)

Guided Design as an Inquiry Method

In D'Amour and Wales (1977) opinion, it was with the advent of the Land Grant Act of 1862 that higher education changed. Prior to that time a small group of students, four to five, spent years together with the teacher learning their heritage as well as "professional beliefs, attitudes and decision-making". D'Amour and Wales believed that land grant education "compartmentalized" knowledge with increased class size, cost factoring, etc.

D'Amour and Wales developed the concept of 'guided design' that is based on the belief that the teacher has more to give than merely information. The teacher facilitates students' learning how to make decisions. Again, the students work in small groups, attack open-ended problems, "actively seek solutions rather than assimilating knowledge" (p. 383). The roles of the teacher and student are very explicit. The former being a guide, prompter, manager and consultant and the latter "thinks, makes value judgments and is a professional decision maker" (p.384).

Adams(1983) refined D'Amour and Wales guided design

technique for a biochemistry laboratory for college freshmen dental students. His assertion is that not only does this technique improve problem-solving, it also increases the students' ability to "seek, use, interpret information and develop solutions to problems logically".(p.317) This process upholds the constructs of the inquiry method.

The guided design strategy, in Adam's opinion, also appears to improve information retention. Another purpose of the strategy is to teach subject matter. The following represents a general description of the tasks which can easily be correlated to Suchman's procedure.

The session begins with a description of a real life situation in which there is a problem. Small groups of four students each role play to reach a solution or decision. They are guided by a series of instructions involving a series of tasks. The group gets feedback of a potentially appropriate response which aids the students in staying on task. The students begin by identifying the problem. The group sets goals for the solution (project). The feedback process continues with listing facts, assumptions and constraints, brainstorming,developing hypothesis, analysis and synthesis and evaluation. The group must submit a report

of the results. Two laboratory sessions are utilized per project, the first session is devoted to data gathering and planning and the second to lab analysis. (1983) It is important to note that these laboratory sessions were supported with traditional lecture sessions each week.

Goldberg and Shuman (1984) utilized the guided design strategy in a physical science course to about one hundred and fifty non-science majors. In order for the student to learn science content and to be able to process skills, traditional lectures, readings and laboratory experiences are utilized. The guided design projects are interwoven throughout the semester and focus on particular open-ended problems. The authors chose this dual approach for two reasons. Because the projects and the length needed for completion allow for concentrating on a limited amount of subject matter, lectures and labs afford time to cover more information. And, the intensity in which students become involved in the projects would be overtaxing if there were not periodic breaks.

The discussion to this point has focused on the application techniques of inquiry. Descriptions were also delineated for the guided design technique as an comparable method of inquiry.

Problem-based Learning

And now, what of problem-based learning? Where does it fit within the constructs of the previous discussions? In essence, the concept of problem-based learning dovetails nicely with inquiry methods and the guided design strategies previously discussed. Problem-based learning is based entirely on the study of problems both simulated and real. It was developed at the McMaster Medical School in Canada over a decade ago (Thompson/Williams, 1985). The problem situation is presented first, then the student acquires the knowledge to solve the problem. It is therefore helpful in learning content and developing problem-solving skills. In fact at the University of Newcastle, New South Wales, a five year curriculum was developed in the seventies. It has been decribed by Neame (1982) as "totally integrated, problem-based and community orientated. Student knowledge, understanding and skills are developed through the study of a sequence of clinical problems, integrated with appropriated practical and clinical activities."(p 141)

In the Surgeon-General's report of 1979, Healthy People, it was stated that in developed countries causes of illness and death are attributed primarily to

lifestyle, diet, behaviour, environment, socio-economic status and substance abuse. (Neames, 1982) Neames stated that the emphasis in medical and health professional curricula needs to be placed on the behavioral sciences, prevention, primary care, cost containment and continuing education.

It is believed that problem-based learning, as incorporated into a total integrated curriculum, offers a solution to the preparation of professionals who can meet the above stated needs of the public in health care. H.S. Barrows and R.M. Tamblyn (1980) described the PBL system in detail in their book. The authors described a Clinical Reasoning Process as a basis for thinking and subsequent diagnosis of the professional physician which appears applicable to many disciplines. The pattern is that of: the perception of initial clues from the environment and the patient; quick generation of numerous hypotheses; application of inquiry to narrow potential solutions by refining, ranking, verifying or eliminating original hypotheses; builds a case from the data and evidence; comes to a diagnostic and/ or therapeutic closure or decision.

The process of problem-based learning is therefore based on the clinical reasoning skills of the practicing

clinician. There are seven basic stages to PBL:

> identification of the learning objectives of the session, interaction with the problem, identification of self-directed learning questions that are raised by working with the problem, self-directed study,application of the acquired information back to the problem,review and synthesis of what has been learned, and evaluation.(Woods,1985,p.62)

The steps to PBL are not unlike the steps proposed by Polya (1975). His four step approach has been heralded as a methodology for problem solving. They are simply; understanding the problem, divising a plan, carrying out the plan and looking back. Again, the establishment of the problem is the beginning of the strategy.

The key to the PBL system is the development of the problem and ensuing heuristics. These problems act as 'trigger' materials and the students need to determine what topics must be studied in order to understand the materials and to determine what needs exist for the care of the patient. In the process, they are able to construct their own learning (Neames,1982). An underlying premise is that the students will be presented with real life experiences from the very initial phases of their learning (Woods, 1985). In this way, then, once the student has learned how to solve a problem,

encountering a similar situation again, will be become easier and indeed it becomes more of an exercise to be practiced. Therefore, as we gain in the number of situations (problems) we experience, there will be more exercises (practices) and fewer problems.

Another key to PBL is the establishment of learning objectives. This of course is not unique to this strategy. Determining outcome objectives is an attribute of various teaching strategies for the acquisition of knowledge. In the University of Newcastle curriculum, the objectives are at all levels of a course and relate to all three domains of affective, psychomotor and cognitive learning. The course levels refer to three strands of the knowledge base, group medicine and professional skills (Neames, 1982). In a model curriculum for a systems agriculturalist, the objectives take on the form of a "competency matrix". The matrix delineates the three domains as interfaced with the autonomous learner, systems agriculturalist and an effective communicator (Bawden/Valentine,1984). In this way, the objectives are broad based and become the expectations for the competent graduate. Bawden and Valentine (1984) described that it was the discrepancy between the expectations of the competency of the

graduates by the agriculture sector and those of the School that was the driver for change to a PBL, coined a "capability-based approach" (p.274) in their model.

Perhaps the most difficult aspect of utilizing PBL is changing the role of the teacher from the giver of facts and information to a promotor of self-directed learning. This concept is, of course, totally in tune with the inquiry methodology. The teacher becomes the facilitator or a tutor, if you will, to small self-directed groups. Barrows and Tamblyn (1980) recommended that the facilitator be an expert in the subject surrounding the problem presented. As such, the faculty becomes a resource only when the students have exhausted their own logic and cannot proceed further without that assistance (Woods,1985). Beyond that, however, the more important role of the faculty is to focus the student on the identification of the problem and assisting the student to pursue a solution (Polya, 1975). By posing questions, the student must consider data, the unknown, the conditions and by determining whether it is "possible to satisfy the condition". (p.7) The faculty may guide students to different references and redirect the students' inquiry when it is evident

that the process being pursued is not logical (Love/Shumway,1983).

Wood (1985) suggested the use of the following types of questions to facilitate the inquiry:

> 1) Why did you come to that conclusion?; 2) Do you agree with what was just said?; 3) If what you suggest is true, then how could you explain...; 4) For this situation, have you ever considered or thought about...; 5) Please explain what you have just said so that I can understand your conclusion...; 6) Are you sure of what you are saying?; 7) Do you feel you need to look up that point?; 8) You seem unsure. Could this be a learning issue that should be studied before we go further?; 9) Perhaps there are better ways to examine this problem. Is there a resource that might be consulted?; 10) I'm not sure that you are right. Why don't you look that up and review it with us next time? (p.63)

Further, the faculty member must generate the structure of the integrated experiences. For example, in the case of the medical curriculum, the collaboration among the disciplines requires a great deal of educational research for implementation. The study materials relevant to the problems become, in effect, a "problem-based textbook" (Neame,1982,p.146). Or, as described by Bawden/Valentine (1984), there need to be resource packages developed by the staff in structured learning units to support the problem situations.

Finally, the faculty must assist the student with review and synthesis of what has been learned or as in Polya's model, the looking back. The evaluation and reexamination of other paths are perhaps more effective. The understanding that "no problem whatever is completely exhausted" is of paramount importance (Polya,1975). One of the crucial questions that the student must be able to answer is, "Can you use the result, or the method, for some other problem?" (1975,p.16)

Neames'(1982) evaluation of the advantages of the problem-based learning approach offered significant features, many worthy of restatement:

1) The material learned by the student takes on relevance and significance because of the relationship to problems which are practical and therefore the student is enthusiastic and motivated to study.

2) Active involvment in learning promotes the student's desire to define their own learning outcomes, research many resources and then make application of their new knowledge which also fosters the recognition of the need for continuing education.

3) Because the material is immediately applied, it becomes internalized and therefore there is greater potential for retention.

4) The development of clinical reasoning is enhanced due to the early study and practice of the process.

5) The interaction among disciplines creates an assurance that relevant material is selected.

6) There is no limit to the spectrum of problem selection. In the case of health care matters, all settings can be utilized.

7) Learning objectives are essential and allow for the review and evaluation of the program as well as the standards by which the student is appraised.

8) Student assessment is based on skill application to situations rather than recall of factual information (p. 143-144).

The literature revealed a number of variations demonstrative of the problem-based learning system. A Patient-Oriented Problem-Solving (POPS) module was developed to teach a segment of pharmacotherapeutics at the University of Kentucky. This method allows the student to learn via the clinical problem presentation provided in a workbook format (Love/Shumway,1983). An additional benefit of the approach is that students work with one another and thereby increase interpersonal skills as well as develop abilities to evaluate the

opinions of others. The system is seen as supplemental to classroom andclinical instruction. By employing the small group student-led discussion technique, there is an improvement in the problem-solving skills of the students.

This same problem-oriented role was applied to the teaching of analytical chemistry and chemical analysis by Pardue and Woo (1984). Their focus was to utilize the problem-based approach to "demonstrate that problem-related dialogue is an indispensable part of client/analyst interactions" (1984,p.409).
The authors stated that students learning problem solving in this way identify that steps in the process are only effective when done in concert with one another. Further, that students learn that every process, even those that seem very routine, at one time required a great deal of research. Students make the connection with original research by seeing examples relative to the problem.

Noble (1983) provided additional insights for the portion of the process involving steps to the solution of the problem. He asserted that it is an appropriate strategy to permit the students to follow an incorrect path until they discover that there is an error. In this

way, the students realize that mistakes are natural. Fear of making errors can hinder creativity (1983). Noble also viewed the grading procedure in PBL to be an opportunity to allow for student growth. When the major portion of credit received is for the proper solution instead of the right answer, anxiety is appreciably reduced.

The most sophisticated system aside from the McMasters' project was the Systems Agriculturalist Baccalaureate program at the School of Agriculture at Hawkesbury, Australia. Bawden and Valentine (1984) stated that the School was philosophically seeking a program that would "reflect the experiential nature of the learning environment" (p.274). Therefore, the program would replicate reality as much as possible. The seven semester program is composed of self-initiated learning projects and structured experiences. The projects and experiences concentrate on effective actions that will improve situations in systems within agriculture. The environment for learning involves a network of interwoven educational models which focus the learner "as an active, problem-solving innovative and creative person" (1984,p.276). There are five phases to the program which incorporates the seven semesters. The

early phases contain staff initiated sequenced and non-sequenced learning units. Student initiated non-sequenced units predominate the latter phases. The learning units are the discrepant events or situations which are to be "investigated, conceptualized, and acted upon in ways in which the outcomes can be evaluated" (p. 277). Interestingly, evaluations include quizzes, written work, essays, interviews, self-assessment as well as oral quizzing. No grades are given, per se, but receive a 'satisfactory' or 'unsatisfactory' assessment and the documentation becomes part of the students' portfolio. The theory is that this manner of evaluation simulates conditions of the 'real world'. The authors stated that the challenge was to design curriculum to "focus on the developing learner as an autonomous, holistic, problem-solving being" (1984,p.286).

This section of the paper has discussed the strategies of inquiry method of teaching and two specific parallel methods; guided design and problem-based learning. If the goal of education is to assist the individual and society with being thinkers, then inquiry strategies offer this opportunity. Inquiry strategies provide opportunities to be analytical, creative problem solvers. The strategies discussed focus on the process,

not just the product of acquiring knowledge. McCauley (1984) asserted that the foundation of scientific progress is not dependent upon mastery of all known facts nor on circumscribed never-changing theories. He stated that the "mastery of facts is a consquence of disciplined inquiry, not its goal" (p.57). Therefore, inquiry strategies allow students to go beyond facts and discover truths that give meaning to facts. McCauley (1984) provides an insight of four powerful outcomes of inquiry:

> the imagination to formulate new conjectures; the analytical ability to discover their structure, their relation to the the evidence, and the problem solving strtegies that motivate thlem; the judgment to recognize and devise telling criticisms; and the skill to communicate our ideas accurately to fellow inquirers (p.57)

Problems Involved with the Inquiry Approach

Thompson and Williams (1985) described a number of barriers to educational change relative to inquiry. While the authors' evaluations relate particularly to medical schools, they are applicable to other educational settings as well. The first concerns originate within the institution. When institutions have long standing traditions, it becomes more difficult to critically evaluate teaching strategies. The institutions become

complacent. Also, according to Thompson and Williams (1985), the institutions often lack perceptions of their students' actual competencies because there is little opportunity to evaluate a wide range of student skills and attitudes. Since the institution does not perceive a need there is resistance to change. Many institutions face the complexities of the philosophy of research to advance the knowledge base of the discipline and the need to produce professionals within the role as a training institution. Therefore, activities of faculty would need to change focus from research to teaching in the problem-based environment (1985).

A second concern involves the faculty themselves. According to Thompson and Williams (1985) faculty need to possess teaching skills attributed to professional educators. The authors state this may not be the case with teaching clinicians or researchers. In the area of methodology, faculty may have difficulties as facilitators; pacing discussion, structuring (yet not overdoing) the problem situation; focusing the group on task, fostering creativity without philosophizing and lecturing; enhancing group participation and working together (Woods, 1977). In terms of preparation, the faculty must have extra time to develop appropriate

problems/situations to present to students. Then there must be adequate time and effort to prepare flanking material, including the resources and/or resource persons, to aid the inquiry process. Further, it is a challenge to faculty to aid the students with the understanding of the process itself (1977). And finally, in many educational systems, reluctance to change may be that there is not recognition academically for this type of educational sophistication (Thompson/Williams, 1985).

Another concern is student based. While the outcomes of problem-based learning improve recall and memory as well as independent learning, they require greater effort and time. The student may see the process as inefficient when compared to traditional lecturing. Woods (1977) stated that students rarely come to the problem-based curriculum with strong skills in elementary logic and may be weak in communication skills as well as basic scientific knowledge. At the outset, the student may appear to lack motivation for self-directed learning, but this may be due to failure to realize that "problem solving is in itself a legitimate educational goal".(Woods, 1977,p.140)

Barrows and Tamblyn (1980) believed that the major difficulties relate to students and faculty lacking

understanding of the problem-based learning process as a whole. Students find it difficult to tackle the problem because they believe they need background knowledge first in order to work with the problem. So, they may waste time studying material not pertinent to the problem. The technique requires that the problem is taken on first in order to determine what the student knows and what needs to be learned. Further, poorly designed problems can defeat the whole process. The teacher may not recognize the importance of working the problem, the self-directed study that is necessary and the impact of the application of the information back to the problem (1980). This last feature of applying the information back to the problem, needs to be well understood. Otherwise, the student risks not being able to recall necessary knowledge when presented with a similar problem. Therefore, the integration of what has been learned with what is known is tantamount to understanding the consequences of the problem, ie; potential solution.

Problem-based Model in Developing Critical Thinking

Norris (1985) stated that critical thinking can be defined as making a rational decision about what to do or what to believe. While this may seem simplistic, it is a convoluted process of dialectical assessments, making

observations, inferences and then offering reasonable hypotheses. Beyer (1984) described critical thinking as the pinnacle of all thinking skills, ultimately analysis and generalization. He further pointed out, that students must not only practice thinking skills but that the skills must be taught along with subject matter in order for transfer to other situations. Only then will critical thinking become functional. The problem-based learning model offers opportunities to develop critical thinking as an outcome of the process. Barrows and Tamblyn (1980) suggested that the term clinical reasoning encompasses all thinking skills needed in analysis and evaluation to manage patient care.

An example of the different levels of thinking that are required in inquiry is discussed by Heins and Mackenzie (1987) in the teaching of Clinical Periodontics to dental students. The authors delineated a method they referred to as inquiry tutoring. The method is a theory based on a questioning technique to facilitate clinical decision making. The assumptions are that there are three levels of educational goals. The lowest level is for the student to gain facts and concepts comprising a base of knowledge. The second level involves the student developing the theories underlying the facts and

concepts. The top level allows the student to establish new theories from experiences and therefore is able to predict, analyze and evaluate more effectively. The process is similar to the problem-based model because it begins with the problem situation. In this process, the method begins with the student and the patient in the clinical setting along with the faculty member. The faculty member, being well versed in the questioning process, guides the student toward the hypotheses. Barrows and Tamblyn (1980) stated there is no better way for students to learn than with real patients as this process assures students will be introduced to pressures and responsibilites of caring for patients. Heins and Mackenzie (1987) reported that clinical faculty who are sensitized to this method are able to enthuse students to consider a cause and effect relationship and apply this reasoning skill in evaluating and managing patient care.

Whimby (1980) emphasized the importance of the small group strategy utilized in the problem based model. He comments that because thinking is done within an individual's head, there is a major barrier to understanding whether the person is learning or that the expert is not being observed. So, with the small group process, people think aloud and the expert provides a

model of the process with simulated patient problems. In this way, according to Whimby, students' analytical skills can be monitored and developed.

Zachry's (1985) assessment of inquiry methods was that these methods employ all cognitive abilities of the student. This occurs because students are active participants in the process and the skills are practiced until generalizations can be made to other situations. Students become motivated by involvment and expectations that are required from the process.

With problem-based learning, expectations are clearly delineated by the stated objectives. Mager (1970) asserted that when there is a discrepancy in the expected performance, often times, it is not that the person doesn't know how. Rather, the expected performance is more punishing than not performing. In other words, there is not a skill deficiency but for various reasons the consequences of performing the skill are not rewarding. Often it is an environmental condition, a threat to one's ego, etc. In problem-based learning, the student is helped to understand that there are ground rules. There are no right or wrong answers, and no one in groups is to be criticized. There is no criticism for naive comments or when students or faculty

lack prior knowledge of the problem under study (Barrows/Tamblyn, 1980). Acceptance of the ground rules helps to assure that positive consequences overrule negative effects of expected performances. Therefore, critical thinking will have a greater chance of occuring.

Scott,et al (1985) discovered in their research of an inquiry-oriented dental hygiene curriculum that students did indeed make changes in their behavior toward a more inquiry posture. Clinical productivity increased and students demonstrated more concern for patients and for patient follow-up when compared to students in the traditional curriculum. Of greater significance was that the authors stated faculty perceived that students had better problem-solving, higher-level thinking skills.

In summary, the problem-based learning model develops critical thinking skills that are desired attributes of the future dental hygienist. Thompson and Williiams (1985) asserted that problem-based learning not only facilitates the acquisition of knowledge, but also promotes the incorporation of analytical skills which are then used in a scientific manner to evaluate and manage patient care.

Summary

The task facing dental hygiene education is to

prepare Dental Hygienists with skills in problem-solving, decision-making, and creative and critical thinking. Being effective in these skills will improve the quality of care given by Dental Hygienists. These skills can be taught through methods of inquiry learning or with the problem-based learning model. Several strategies presented in this chapter have been shown to be effective methods to develop abilities to evaluate and manage patient care problems. The clinical reasoning process described by Barrows and Tamblyn (1980) is a scientific approach that has segments defined as: "perception of initial cues, assembling an initial concept of the problem, generating multiple hypotheses, employing an inquiry strategy, integrating the information elicited into a growing proglem formulation and closing with evaluative and therapeutic decisions" (p. 55). The process encompasses the overall goal of evaluation and management of problems which are major concerns to the clinician.

As future health care delivery systems become more complex, the dental hygienist must be able to face the challenges of diverse health care settings, the interprofessional relationships, the diversities of patient needs and the ability to adapt to these ever

changing needs and systems. Implementation of these inquiry methods should result in Dental Hygienists graduating who are prepared to meet these challenges. The graduates will be able to solve problems more effectively, and indeed be critical thinkers enhancing the quality of life for themselves and the public they serve.

Chapter III

Analysis

The purpose of this paper was to review the related literature and to: 1) discuss the historical perspective of inquiry learning; 2) identify the process of inquiry and the subsets of guided design and problem-based models; 3) describe the problems in utilizing the approach; and 4) discuss the problem-based learning model as a useful strategy to develop critical thinking. These four questions were identified and addressed in the paper. In response to the four questions, the information obtained from the literature will now be presented.

Question #1: What are the historical roots of inquiry learning?

The basis of inquiry learning lies in the very essence of education. Edcuation, according to Dewey (1938), involves the scientific method for acquiring knowledge. Inquiry is very much a scientific process. Further, thinking as a process involves forming concepts, interpreting data and applying principles as purported by Taba (1966). All three steps are integral to inquiry learning. Inquiry learning is a process that, according to Suchman (1966), is the basic means of

learning and has similar characteristics of the scientific method.

Suchman refined the inquiry approach into five phases: 1) presentation of a discrepant event or problem; 2) data gathering and verifying the conditions of the problem situation; 3) experimentation; 4) developing hypotheses; and 5) analysis and reflection back to the problem. His belief was that inquiry develops individuals to be creative and accepting of an ever changing body of knowledge.

Question #2: What is the application process of inquiry?

As previously discussed, the inquiry method not only assists students with the ability to inquire, but also to be analytical and solve prolems and situations in a manner that is humane, intellectual and aids in the perpetuation of society.

In Suchman's model, there are four primary parts: 1) the presentation of the problem which must be puzzling; 2) conditions for inquiry. The conditions are created by the teacher and are intended to allow for a free, conducive, focused, low pressure environment; 3) physical arrangements in the initial problem presentation should be that groups are set in a semicircle; and 4) the role of the teacher is to stimulate and challenge the

student to think while providing support.

Other views of the strategy also focus on the importance of the student learning the process itself. A part of that learning is the development of language to aid the student in the analysis and cause and effect relationships which generate ideas. Further, Bowman (1985) postulated that inquiry allows students to explore creative processes and improves thinking skills.

An alternate strategy is the guided design described by D'Amour and Wales (1977) promoting concepts of attacking open-ended problems to actively seek solutions. As a process of inquiry, guided design promotes interpretation of information and logical problem solution development. Like Suchman's inquiry method, guided design begins with a discrepant event presented to a small group of four students, who then role play to reach a solution. They are guided by a series of instructions which require that certain tasks are accomplished. Ultimately, the feedback process evolves to synthesis and evaluation of the problem.

Problem-based learning was described as another model of inquiry. The model was developed in medical education and is conducive to developing the skills needed by the Dental Hygienist of the future. The model

is based in the clinical reasoning process which is a scientific approach to problem evaluation and management. There are seven steps to the model described by Barrows and Tamblyn (1980): 1) identification of the learning objectives; 2) interaction with the problem either simulated or real; 3) identification of self-directed learning questions; 4) self-directed study; 5) application of the acquired information back to the problem; 6) review and synthesis; and 7) evaluation.

Advantages to the model are: 1) student motivation is high; 2) the learner is actively involved promoting application and transference of knowledge to similar problems; 3) there is greater internalization and retention of knowledge; and 4) the outcome is that the student has better skills in critical thinking.

Question #3: What are the problems in utilizing the approach of inquiry learning?

The problems in utilizing the inquiry or problem-based learning model center around three factors; the institution as a whole, the faculty and the student. Institutions may not perceive a need to radically change teaching strategies from mastery, direct or indirect learning models to the inquiry model. The more traditions that abound within the institutions, the more

difficult it becomes to evaluate the successes of given strategies in terms of the students' actual competencies. Thompson and Williams (1985) pointed out that the institution may well need to shift emphasis from research to teaching as the scholarly activities pursued by the faculty in the problem-based environment.

The faculty themselves will need to increase their educational skills. It becomes paramount that the faculty see themselves as facilitators of learning, not the fountain of knowledge that is often expected of both the facutly and students in the lecture/discussion classroom. Faculty must commit to the process itself with full regard for the additional time and effort that is needed to prepare materials that aid the inquiry process. Again, Thompson and Williams (1985) suggested that faculty may be reluctant to make the transition without academic recognition which typically does not accompany such an effort.

A third factor is the students. At the outset, students may well find the strategy inefficient when compared to the traditional lecture method. Initially, then students may appear to lack motivation for the tenacity required to learn the process and develop skills in basic logic, communication and scientific knowledge.

The entire process of problem-based learning must be inculcated by the institution, the faculty and the students. To do otherwise, will create ineffective outcomes for the transference of skills and information to the evaluation and management of patients for the rest of the individual's professional life.

Question #4: Can the problem-based learning model be useful in developing critical thinking skills required of dental hygienists in an ever changing society?

The development of critical thinking skills is a hierarchial process. The ability to think critically occurs as individuals learn the skills of memory, recall, decision-making and problem solving. Critical thinking is being able to analyze and evaluate to make generalizations. Students who learn by the problem-based model of inquiry must utilize the full range of thinking skills as the process unfolds. Barrows and Tamblyn (1980) stated that when students must work with an unknown problem, students will acquire knowledge by memory and recall with analysis and synthesis of the data. Then, the student can develop hypotheses, and apply deductive reasoning skills to the problem.

The crucial aspect of critical thinking rests with practicing the skill until it becomes internalized. In

the problem-based model, students are continually confronted with simulations or real patient problems to solve to the level of evaluation and management or to the clinical reasoning level. According to Zachry (1985), the active participation of the learner in the process assures that the skills are practiced until generalizations can be made to other similar situations. As the practice continues, the lower level skills become routinized requiring less time in arriving at the critical thinking level.

Health professionals, specifically Dental Hygienists, today and those in the future, must be prepared to accommodate rapid changes in society and technological advancements in prevention of disease. It appears that Dental Hygienists will be called upon to utilize skills at the critical thinking level. Critical thinking skills are necessary in order to integrate the needs of society with the preventive technology available in the application of knowledge for the evaluation and management of oral health care.

Chapter IV

Summary, Conclusions and Recommendations

Summary

This study investigated problem-based/inquiry learning as a teaching strategy for the future educational preparation of selected dental hygienists. The literature is essentially void of examples exemplifing the use of the model in dental hygiene education. However, patient care and community health care issues are, of course, not unique to medicine. Ultimately the strategies used in medicine embody the constructs of inquiry learning which lead to the development of critical thinking skills.

Conclusions

Conclusions drawn from this study are:

1) changes in the dental hygiene educational system will be required to prepare future practitioners with diverse and sophisticated thinking skills. The entry level of the baccalaureate degree will assist with the recognition of dental hygiene as a bonafide profession. But more importantly, the degree level will allow the development of educational requirements which emanate from changes in the dental hygienists' work environment and responsibilities. These changes focus on

the anticipated outcomes for graduates to be "thinking doers".

2) Inquiry as a scientific method to solving patient problems is an important aspect to the evaluation and management of oral health care. Such an approach prepares the practitioner with skills to apply various criteria to the data gathered, refine the criteria as necessary, develop alternative interventions and conduct trials to create solutions to the problem.

3) The problem-based learning model appears to be an extension of inquiry that streamlines the process for use applicable to medical or, in this case, dental hygiene education. The model appears totally applicable to the education of Dental Hygienists.

4) The outcomes of the model in developing clinical reasoning skills are interwoven with the development of critical thinking skills desired of the dental hygienist of the future. The very essence of clinical reasoning in the problem-based model demands that final outcome of the practitioner is to be able to analyze, synthesize and then generalize for the evaluation and management of health care problems, ie; oral health care, community orientated situations. These outcomes are the same expectations of critical thinking skill development.

Recommendations

The problem-based learning model has been identified and discussed in this study as evolving in a vertical fashion beginning with the process of thinking. From thinking, the teaching strategy of inquiry has been identified as a logical progression to acquire higher level thinking skills. The study further postulates that the problem-based learning model is an extension of inquiry. The primary aim of the problem-based model is the development of the professional who can evaluate and manage patients or community-based problems effectively, efficiently and with an awareness for the cultural, economic, familial and psychological needs of people (Barrows and Tamblyn, 1980).

Certainly, strategies to assist the student to become better critical thinkers capable of exhibiting behaviors that have been internalized through the professionalization process is needed today as well as for the dental hygienists of the future. For today's dental hygiene educator, the utilization of the problem-based model to accomplish this goal, can begin modestly. Any course within the dental hygiene curriculum has applicable content for the model. A primary change is to switch to student-centered learning

over teacher-centered learning. Once the faculty makes that assertion, then the next step must be to convert from a subject-based content to the problem-based approach. In the identification of the learning outcomes, types of problems will emerge. The problems can be patient oriented, health care delivery or community oriented, or a research problem depending upon what is appropriate for students acquisition of knowledge and subsequent application. The level of sophistication of thinking skills will increase as more problems are practiced and generalizations can be made to similar circumstances.

Closing Statement

While the predictions for the future education of the Dental Hygienist may be incomplete, it appears that projections provide a basis for educational reform. Certainly, reform will take on a much broader scope than the application of a model for learning superimposed on current curricular structure. None the less, the problem-based model offers dental hygiene education the opportunity to effectively implement strategies to prepare competent practitioners. These practitioners will be attuned to meeting the preventive oral health needs as related to the total health of the individual

and the public. Further, the problem-based model for learning provides opportunities for the development of critical thinking skills which will be necessary for the broader perspective of preventive practice of the future.

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