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Effects of the Dental Hygiene Curriculum on Student Creativity

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EFFECTS OF THE DENTAL HYGIENE CURRICULUM ON STUDENT CREATIVITY

by

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ABSTRACT

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CURRICULUM ON STUDENT CREATIVITY

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This investigation examined the influence of the dental hygiene curriculum on student creativity throughout the two years of dental hygiene study. A secondary purpose was to determine if various accredited dental hygiene programs differentially affect creativity in students. Torrance Tests of Creative Thinking was used to measure creativity in students from three dental hygiene programs in Virginia. Data were organized according to a 3 X 4 factorial research design, using dental hygiene programs and academic semester levels as attribute independent variables. Fluency, Flexibility, Originality and Total scores of the Torrance Tests of Creative Thinking were the dependent variables.

Two-way analysis of variance yielded significant differences between semester levels in Fluency, Flexibility and Originality scores. Differences in Flexibility and Originality scores occurred at all three programs. No significant differences were found on Total scores or between the three programs, $p < .01$. No interaction effects among semester levels and dental hygiene programs were revealed, $p < .01$.

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Chapter 1

INTRODUCTION

Researchers in psychology and education have developed a widespread interest in creativity and have explored creativity in relation to definition, human personality development, education, intelligence and creative abilities. Some of the objectives of this research have been to identify the potentially creative person and the personality characteristics, level of intelligence and creative abilities which comprise the creative individual. Another objective has been to identify the educational conditions (setting, curriculum and teaching methods) needed to encourage the creative thinking abilities of all students.

Creativity has been considered a person's most valuable resource in coping with everyday stresses, both personal and professional.[40] Osborn has stated that learning to work with a creative mind is a sure step "toward learning how to make a living in any vocation or profession".[24] Guilford[14] has elaborated on this idea considering creativity a topic of national concern that can be productively pursued.

Although numerous studies involving creativity and its role in the nursing curriculum have been conducted, only one study of creativity could be found in the dental hygiene literature.[20] If dental hygiene programs are to educate

students to be the creative, imaginative, and original thinkers necessary to function successfully in a complex health care system,[26] then more creativity research in dental hygiene is indicated. Creativity research involving dental hygiene education could be used in (a) fostering student creative thinking via dental hygiene curricula, (b) altering teaching procedures to develop more creative students, and (c) defining creativity's role in contributing to the success and gratification of dental hygiene professionals. Longitudinal studies of creativity are needed to investigate the developmental process of creative thinking and creative abilities.[20,45] This study investigated creativity in dental hygiene students over a two year period using the Torrance Tests of Creative Thinking (Verbal Forms A and B).

Statement of the Problem

This research was concerned with answering the following questions:

1. Does the type of the dental hygiene curriculum influence creativity in dental hygiene students?

2. Does the level of creativity in dental hygiene students change during the two years of the basic dental hygiene curriculum?

3. Do various accredited dental hygiene programs affect creativity in their students differentially?

4. What effect do dental hygiene curricula have on creativity in dental hygiene students at different semester levels?

Significance of the Problem

To meet the ever changing demands of society, man must make original and innovative adaptations to his environment. Creative, imaginative thinkers are necessary to make these adaptations.[24] To develop creative students, the proper educational and psychological climate suitable for creative achievement and thinking must be provided.[4,29,47] Students' creative thinking contributes to the acquisition of information which is essential in their application of knowledge to professional problems. If dental hygienists are to use their own abilities to solve these problems, then prospective hygienists must be creatively educated. Prolonged and enforced repression of creative desires can lead to actual breakdown of the personality;[24] therefore, enhancing the creative potential in dental hygiene students might aid them in their personal lives.

The dental hygiene curriculum has been viewed as one which is strictly structured, scientific and adheres to rigidly established curricular requirements.[20] These requirements include those established by the American Dental Association, Commission on Dental Accreditation[1] and guidelines recommended in Curriculum Guidelines for Dental Hygiene Education: Performance Standards Based on Task Analysis and Instructional Objectives.[3] The dental hygiene curriculum has even been considered dehumanizing and may be creating only "dental hygiene soldiers".[32] A structured curriculum characterized by single solution problem solving, quick recall of

memorized facts and routine use of standard procedures, such as in dental hygiene has been considered to inhibit creative thinking.[22,30,40]

Research has indicated that many colleges have been concerned because a large portion of creative students drop out of technical or scientific programs.[37] Complaints from creative students have included: (a) too much drill and rote learning, (b) too great a demand for memorizing facts, (c) faculty uninvolvement, and (d) unvaried teaching procedures.[18] If dental hygiene education does discourage creativity and thus causes creative students to drop out, then knowledge of student creative thinking ability could be used to adjust curricula and teaching methods to reduce the number of drop-outs.

A person does not learn to release creative potential simply while enrolled in a school of science or art. The will to be creative begins when the individual's curiosity is aroused and he/she is encouraged to be free and original.[30] When dental hygiene students are encouraged and their curiosity aroused, they can be taught to use their creative thinking abilities to attain educational and technical skills.[38] Learning occurs readily when situations are perceived as challenges. Such situations include problem solving, inquiry, brainstorming and experimentation.[29]

Research suggests that creativity can lead to understanding students' preferences for differential ways of learning.[42] If creative students prefer to learn in creative

ways such as experimentation, manipulation, inquiry and problem solving, then studying dental hygiene students' creative abilities and potentials might provide information for implementing appropriate teaching procedures.[42]

> If the intellectual capacities of the individual are to be fully developed, then the abilities involved in creative thinking cannot be ignored.[34]

One of the most common complaints concerning college graduates is that while "they can do assigned tasks with a show of mastery of the techniques they have learned, they are much too helpless when called upon to solve a problem where new paths are demanded."[14] For example, studies in nursing have found a wide range of concepts which work against creative behavior.[37] Some of these concepts are

> ....the stress on convergent thinking in the nursing process, the technical nature of many nursing tasks, the frequency of nursing problems which require only routine solutions, and the dependence of the nurse on the physician.[37]

The concepts can be applied to the hygienist who is under the supervision of the dentist and performs relatively routine and technical procedures in private practice. Understanding the creative potential of dental hygiene students may enable the private practice hygienist to be creative in the occupation and gain satisfaction from the career.

The degrees to which creativity affects nursing students is continually being explored. In contrast, little research has focused on dental hygiene students, even though the two program structures are similar.[20,37] Determining creative

abilities in dental hygiene students could affect admissions procedures, teachers' roles in creative teaching, students' preferences for various methods of instruction and career satisfaction and achievement after college. This study provides additional information on the effects of the dental hygiene curriculum on students' creative thinking ability.

Definition of Terms

The following terms were defined for this study:

> Creativity: "A process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results."[42]

Dental Hygiene Student: A female college student enrolled in an accredited dental hygiene program during the two years of the basic dental hygiene curriculum.

First Year, Fall Semester Student: A student enrolled during the fall semester of the first year of a dental hygiene program. The first measurement on the TTCT was taken on these students at this time.

First Year, Spring Semester Student: A student enrolled during the spring semester of the first year of a dental hygiene program. The second measurement on the TTCT was taken on these students at this time.

Second Year, Fall Semester Student: A student enrolled during the fall semester of the second year of a dental hygiene program. The third measurement on the TTCT was taken

on these students at this time.

Second Year, Spring Semester Student: A student enrolled during the spring semester of the second year of a dental hygiene program. The fourth measurement on the TCTT was taken on these students at this time.

Accredited Dental Hygiene Program: A program which includes at least two years of college education leading to a certificate, associate, or baccalaureate degree in dental hygiene and has been accredited by the Commission on Dental Accreditation.[2]

Dental Hygiene Curriculum: A series of activities to achieve desired learning objectives in an accredited dental hygiene program.

Torrance Tests of Creative Thinking (TTCT) Verbal Form: An inventory designed to measure creative thinking ability and which consisted of seven parallel tasks requiring the subject to think in divergent directions in terms of possibilities.[42] The TTCT was the dependent variable measure in this study.

Assumptions

The following assumptions were made:

1. TTCT is an appropriate instrument for measuring the fluency, flexibility and originality components of creativity in dental hygiene students.[42]

2. The Torrance Tests Scoring Service of Athens, Georgia, scored all TTCT tests accurately and according to the procedures stated in the TTCT Directions Manual and

Scoring Guide Verbal Test Booklet.[43]

3. Individuals tested did not have prior exposure to the TTCT.

4. Situation relevant variables were controlled by treating all groups equally and by providing adequate light, space and temperature control during data collection.

5. Characteristics such as race and socioeconomic level are not relevant variables affecting creativity.[38,39,43]

6. Subjects followed testing instructions and answered all questions to the best of their ability.

7. Inequality of sample size did not bias the research results. Although the three intact groups were composed of unequal numbers of subjects, all available subjects were included.

8. Minimal recall and practice effects were evident as a result of the nature of the test and the use of alternate Verbal Forms A and B.[42]

9. All subjects received the same verbal encouragement and motivation before each administration of the test.

Limitations

The following factors might have affected the validity of this study:

1. Random sampling techniques could not be used because subjects were members of intact groups.

2. Subject mortality attributed to student absenteeism during the testing session and attrition from the program might have threatened the validity of the results.

3. Reliability and validity of the results are only as accurate as the reliability and validity of the TTCT.[42]

4. History and maturation effects might have altered the results of this study.

5. The Hawthorne effect might have occurred because subjects were aware of their participation in the study.

Hypotheses

The statistical hypotheses tested follow:

1. There is no statistically significant difference between the TTCT Total creativity scores of first year, fall semester and second year, spring semester dental hygiene students, $p < .01$.

   a. There is no statistically significant difference between the TTCT Fluency sub-scores of first year, fall semester and second year, spring semester dental hygiene students, $p < .01$.

   b. There is no statistically significant difference between the TTCT Flexibility sub-scores of first year, fall semester and second year, spring semester dental hygiene students, $p < .01$.

   c. There is no statistically significant difference between the TTCT Originality sub-scores of first year, fall semester and second year, spring semester dental hygiene students, $p < .01$.

2. There is no statistically significant difference among the TTCT creativity scores of first year, fall semester; first year, spring semester; second year, fall semester; and

second year, spring semester dental hygiene students, $p < .01$.

a. There is no statistically significant difference among the TTCT Fluency sub-scores of first year, fall semester; first year, spring semester; second year fall semester; and second year, spring semester dental hygiene students, $p < .01$.

b. There is no statistically significant difference among the TTCT Flexibility sub-scores of first year, fall semester; first year, spring semester; second year, fall semester; and second year, spring semester dental hygiene students, $p < .01$.

c. There is no statistically significant difference among the TTCT Originality sub-scores of first year, fall semester; first year, spring semester; second year, fall semester; and second year, spring semester dental hygiene students, $p < .01$.

3. There is no statistically significant difference among the TTCT Total creativity scores of Old Dominion University (ODU), Virginia Commonwealth University (VCU) and Virginia Western Community College (VWCC) dental hygiene students, $p < .01$.

a. There is no statistically significant difference among the TTCT Fluency sub-scores of Old Dominion University, Virginia Commonwealth University and Virginia Western Community College, $p < .01$.

b. There is no statistically significant difference among the TTCT Flexibility sub-scores of Old

Dominion University, Virginia Commonwealth University and Virginia Western Community College, $p < .01$.

c. There is no statistically significant difference among the TTCT Originality sub-scores of Old Dominion University, Virginia Commonwealth University and Virginia Western Community College, $p < .01$.

4. There is no statistically significant interaction effect between academic semester levels and dental hygiene programs as measured by the TTCT Fluency, Flexibility, Originality and Total creativity scores, $p < .01$.

Methodology

A longitudinal 3 X 4 factorial analysis of variance design with repeated measures[48] was employed to determine whether creativity scores obtained varied as a function of a particular dental hygiene program attended (VWCC, ODU, VCU) and/or academic semester level of dental hygiene curriculum (first year, fall semester; first year, spring semester; second year, fall semester; second year, spring semester). The attribute independent variables were the academic semester levels of dental hygiene education (first year, fall semester; first year, spring semester; second year, fall semester; and second year, spring semester) and the type of dental hygiene program (VWCC, a two year core curriculum; ODU, one year pre-hygiene, two years core curriculum; and VCU, two year pre-hygiene, two year core curriculum). The dependent variables were the creativity subtest scores (Total, Fluency, Flexibility, and Originality) as measured by the TTCT. The

statistical biomedical package, BMD-P2V, was used for the data analysis.[17] Tukey's HSD Test was used to locate the significant differences among mean scores of each program for each of the four components of the TTCT.[48]

Chapter 2

REVIEW OF THE LITERATURE

While creativity has been studied extensively, minimal research has been conducted involving dental hygiene students, curricula or education. A review of the literature reveals numerous studies which provide information for exploring creative thinking in dental hygiene students.

Construct of Creativity

Approximately 50 definitions of creativity fused into the four terms of person, product, process, and press (interaction between human beings and their environment) have been reported.[13] Torrance[40] has defined creativity in terms of process, and Rogers[27] in terms of product and press.

The creative product has been defined as:

> ....intrinsically a configuration of the mind, a presentation of constellated meaning, which at the time of its appearance in the mind was new in the sense of being unique.[26]

If a creative product is a unique or novel response, then the dental hygiene curriculum, with its technical training, memorization of facts and structured outcome might discourage creativity among students.

Although creative accomplishments might occur at any age,[21] creativity appears to increase to its highest point when a person is in his/her 30's and declines thereafter.[21]

Lehman[21] believes that it is not age itself but the factors that accompany age that bring about a reduction in creative production. These factors include decline in physical vigor, motor precision and sensory capacity, and personal commitments and problems. Frequently, dental hygiene students are in their twenties; therefore, it is possible, theoretically, to encourage them to be creative and to attain their greatest creative potential before they reach their peak.

The creative product is considered more tangible and assessible than the creative process, yet the process is an important part of the total concept and merits further research. Torrance's broad definition of creativity emphasizes the searching and exploring aspect (divergent thinking) of the process.[13,42] As used in this study,

> ....creativity is a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.[42]

This definition allows for objective observations and measurements.[42]

Researchers have attempted to define the creative personality, yet most can only describe the characteristics of the creative person.[43] These characteristics include self-actualizing, energetic, industrious, assertive, independent in judgement and thinking, making mistakes, persistent, sensitive yet emotionally stable, remaining uncommitted and

receptive to experiences, and confident in one's own ability.[4,10,11,34]

From Guilford's structure of the intellect emerges the idea that creative thinking is not an entity in itself, but consists of primary patterns of abilities. According to Guilford and other researchers, these abilities include: sensitivity to problems, fluency, flexibility, originality, elaboration and redefinition.[4,10,35,38] Fluency is the ability to produce a large number of ideas.[4,10,35,38] Flexibility is the ability to produce a variety of ideas or use a variety of approaches.[4,10,35,38] Originality is the ability to produce ideas that are unusual and vary from the commonplace idea.[4,10,35,38] Redefinition is the ability to define or perceive in a way different from the usual, established or intended way.[4,10,35,38]

A high level of these abilities does not guarantee that the person will act in a creative manner; yet, the possession of these abilities does increase a person's chances of acting creatively.[42] The common assumption among psychological and educational researchers is that creative potential is not confined to a few individuals but is widespread in varying degrees in all people.[14,26,34,47] If dental hygiene programs are to increase the potential for student creativity, then knowledge of these abilities is needed to develop and implement new teaching methods and curricula to encourage creative abilities.

To promote creativity, the proper psychological climate in educational settings must be available.[4] Rogers[29] has stated that the creative individual needs a climate of psychological safety and psychological freedom. Diminishing the fear of failure, discouraging inhibitions and allowing room for acceptable mistakes and individual success enable the student the freedom and safety required to develop his or her creative potential.[40] Rogers[29] also has indicated that the only significant learning comes from the self-discovery and self-appropriation found in this creative climate.

Creativity also is affected by motivation, which maximizes the experience of one's own creative potentials.[23] Thus, when an investigator motivates and arouses interest in the subjects, subjects' scores will differ from those who were not given a motivational orientation.[23]

If students in dental hygiene programs were provided with psychological freedom and safety, and proper motivation, then dental hygiene students should experience more creative thinking than without this creative climate. This climate would allow the student to grow both personally and professionally and make the student more responsible for his own learning.[32]

Creativity is an underdeveloped concept even though extensive research has been conducted. Many investigators have provided definitions of creativity which differ on degrees of person, process, product and environment. No absolute need exists for all individuals to agree on a single

meaning of creativity; however, a clear understanding of what type of definition each investigator uses is essential for accurate interpretation of results.[13] Creativity is probably best viewed as a complex dimension covering many components of behavior including all the abilities required for initiating new ideas.[10]

If the creative potentials and personalities can be identified in dental hygiene students, then this knowledge can be used to better educate the students and expand their creative abilities. These abilities may enable students to be more involved in continual self-learning and become more satisfied in their personal and professional lives.

Creativity and Intelligence

Research studies have investigated the relationship between intelligence and creativity. These studies reveal controversy concerning the creativity-intelligence relationship attributed to the problems of defining and theoretically interpreting creativity and intelligence.[45] Intelligence tests are concerned with convergent thinking while creativity tests are concerned with divergent thinking. Convergent thinking proceeds toward one right answer and toward responses that fit to the already known and specified.[47] Divergent thinking moves away from the already known, breaking away from the common answer toward new ideas.[47] If these two constructs emphasize different thinking, then there seems to be little relationship between creativity and intelligence.

Torrance[40] and Getzels and Jackson, as reported by Razik,[27] obtained research results which indicate a valid difference between creativity and intelligence. Torrance[42] tabulated a median correlation coefficient of .21 between intelligence and verbal creativity. Razik[27] reports that Getzels and Jackson found some correlation between IQ and creativity scores but only up to a certain level of IQ. Torrance[40] confirmed Getzels and Jackson's findings and also found that no correlation between IQ and creativity exists above an IQ of 120. Other investigators support Torrance in concluding that there is a relationship at the lower levels but not at the higher levels of IQ.[28,47] When an individual's IQ is low, his other scores on tests of creative potential can only be low.[14] A certain amount of intelligence is necessary to be able to understand, read and complete the creativity tests. In contrast, when his or her IQ is high, there can be a wide range of scores on tests of creativity.[14] Therefore, a certain level of intelligence is necessary for creative potential as well as to take creativity tests.[19]

Barron reports that MacKinnon and Hall, in a 1968 study, suggested that intelligence is not unrelated to creativity but rather that:

> ....individuals in varying degrees of creativity in professions intrinsically creative in character are of high measured intelligence but their degree of creativity does not covary significantly with intelligence test scores.[6]

Therefore, if just a minimum IQ is necessary for creativity,

dental hygiene students would possess creative potential, because they usually possess at least average intelligence. Most dental hygiene students have shown average and above average IQ's by getting good high school grades and passing scores on college entrance exams. Dental hygiene students also must meet admissions criteria and score adequately on the Dental Hygiene Aptitude Test for acceptance into an accredited dental hygiene program.

Researchers reported that intelligence combined with creative teaching produces more academic achievement than either alone.[4] If this finding is valid, fewer dental hygiene students would drop out of the program because of academic deficiencies if they were taught in a creative manner.

Highly creative people, when given the opportunity and freedom to learn creatively, achieve as well as their more intelligent but less creative peers.[40] Thus, lowering academic admission standards while incorporating creative teaching would provide increased numbers of people qualified to become dental hygiene researchers, educators and practitioners.

Creativity and intelligence may be weakly correlated, yet the two constructs interact with one another.[6] A certain level of intelligence is necessary to be creative; yet, the possession of high intelligence is no guarantee of high creative ability. Creative people are not necessarily in the highest intelligence group, but usually will be in the upper half of the intelligence distribution.[22] The possession of

high intelligence, special talent or technical skills is not enough for outstanding success; creativity is a necessary element as well.[40]

Creativity and Education

Research studies continually emphasize the role of education in the development of creative potential. This challenge for educators in the development of creative potential is to admit students who have creative potential and to provide students with the intellectual environment and educational experiences that will maximize any creative potential they possess.[13] "Creativity, originality and inventiveness are the prime requisites for the crucial task of training the mind," yet few colleges carry this out.[26] Similarly, a conference sponsored by the National Science Foundation concluded that a need exists to "develop educational programs which require the student to exercise a high degree of originality."[24]

The abilities inherent in the creative personality can be increased through training. Increasing these abilities is a school's legitimate function.[26] One way to educate dental hygiene students creatively is the implementation or an 'engineering' of curricula which are flexible enough to teach the traditional and yet incorporate a more individualized approach.[32]

Research has indicated that a considerable part of creative behavior is learned.[49] Wing and Wallach[49] report

that Maltzman and his associates conducted a study in 1959, results of which support the hypothesis that "originality is a learned form of behavior which does not differ in principle from other forms of operant behavior."[49] Originality is considered to be a component of creativity.[42] Therefore, creativity might be enhanced by teaching original thinking.

"It appears that creative development can be enhanced through the use of discovery methods in a subject matter course."[7] These teaching methods would increase creative productivity and may even lead to better performance in the subject matter.[7] If this is the case, dental hygiene educators could teach creative problem solving and aspects of original thought to help students think creatively.

Students learn from each other during their college education; they can even learn more than they learn from their teachers because of the diversified range of students' abilities, knowledge and talents.[49] If creative students are admitted into the dental hygiene program, they might help other students to increase their creative potential.

Researchers have found that creative thinking abilities contribute significantly to gaining information and various other educational skills.[40] Even though it may be economical to teach by authority, studies have shown that many things can be learned more economically by creative teaching than by authority teaching.[40] Authority teaching does not provide students the ability to use information in creative ways. In contrast, creative education prepares self-initiating,

resourceful and confident people to face personal, interpersonal and professional problems.[14] If a dental hygienist is to broaden his or her scope of practice and the dental hygiene profession is to mature, then creative education is necessary.

For creative education to be conducive to learning, the conditions which facilitate freedom, openness, choice and responsibility must be known. Rogers concluded that the individual must be "confronted by resources, issues, and problems which are meaningful and relevant to him."[29] In such a setting, the student may experience much initial frustration, but gradually becomes a responsible, creative, genuine and integrated being, who can relate and grow in his/her life with others.[29]

When given a chance, "content will emerge as the individual engages in meaningful study and work."[29] This knowledge then becomes integrated with the individual.[29] In this instance, dental hygiene students can receive the needed facts and knowledge necessary for completing the program and still increase their creative potential. Experimentation with teaching methods which stimulate students to think independently, test their ideas and communicate them to others might provide more information concerning how to encourage creative talent.[47]

For colleges to develop creative students, faculty members must be creative.[18] Teachers must not only be information-givers, but they must be counselors, facilitators,

models and friends.[18] For this to happen, colleges must give assistance to prospective teachers, especially in the early teaching years, in using teaching methods which promote active involvement of students in planning and carrying out their own learning experiences.[18] Graduate dental hygiene programs then have the responsibility to educate creative teachers who in turn are able to promote creativity in students. Considering the need for creative teachers, it is interesting to note that Jarrett[20] found that dental hygiene instructors possess more creativity than their practitioner counterparts.

Interestingly, technical educators rather than liberal educators are showing more interest in creativity.[25] Nursing research involving creative students and creative education is gaining acknowledgement and understanding.[37] Torrance[44] found that senior nursing students score higher on the TTCT than freshman students concluding that nursing education "does not necessarily reduce the creativity of its students and eliminate the most creative students, as some critics have alleged."[44] Ventura[36] used the TTCT Verbal and Figural Form A to measure creative thinking abilities in nursing students. She concluded that there was a significant difference in scores among diploma, associate degree and baccalaureate degree nursing students. Diploma students differed significantly from the other two groups, scoring higher on verbal fluency, baccalaureate degree students differed significantly from the other two groups scoring higher on verbal

originality.[46]

Thomas[37] determined if a new process curriculum in nursing really does foster creativity. Her findings suggested that beginning students possess more creative abilities than graduating students. Yet, the new process curriculum students had lower TTCT scores than the old curriculum students. Therefore, while the old curriculum discouraged creative thinking, the new process curriculum did not foster more creativity.

Consistent with Thomas' study, other studies involving nursing education have concluded that the technical, one right answer, memorization of facts aspects of nursing programs tend to inhibit creativity.[37] Thomas'[37] study concluded that adequate creative curricula have not been developed.

Jarrett[20] conducted the only creativity study involving dental hygiene students and career choices. The results of her study concluded that creativity was not significantly inhibited by the structured curriculum.[20] This finding suggests that a science curriculum of dental hygiene apparently did not restrict the development of creativity, nor did it encourage creativity. If creative educators are needed to develop creative students, then this finding suggests that dental hygiene education should not inhibit student creativity because creative educators are found in the dental hygiene programs.

Studies have suggested that more creative students would be admitted to colleges if the admissions process was altered.[49]

Presently, students are accepted into dental hygiene programs on the basis of IQ, high school grades, college entrance exams, DHAT scores and college grades, if any. "IQ tests and high school grades both predict attainable college grades but not real life accomplishments."[47] If the goal of the program is to provide society with dental hygienists who will be productive and stay in the profession, then we need to accept students who possess characteristics that will allow them to achieve professional goals and solve future problems that they may encounter. Nonacademic creative accomplishments are "of sufficient intrinsic value to merit heavy weight in the admissions process, provided that the students selected also have shown academic aptitude and grade achievement levels"[47] sufficient enough to qualify students to undertake college work successfully.[47] If potential creative abilities and accomplishments of dental hygiene students could be determined, then the information could be used in the admission process.

The educational process may develop creative capacities for increasing students' ability to adapt to change and allowing them to identify patterns which are no longer functional.[16] Education of these students enables them to restructure their view of the environment in order to recognize and test new possibilities.[16] In creative education, the teaching methods, teacher-student relationship and creative teachers may be just as essential as a flexible, open curriculum structure. Educating dental hygiene students to think

more creatively than previous students may result in practitioners remaining longer in their job settings. Thus, dental hygiene students would acquire the necessary knowledge and skills yet would possess more creative abilities and talent to assist them in their professional and personal lives.

Chapter 3

METHODS AND MATERIALS

A two year study was designed to measure the construct creativity in dental hygiene students at four academic semesters, in three different dental hygiene programs. Creativity was measured by the Torrance Tests of Creative Thinking (Verbal Forms A and B).

Sample Description

The accessible population from which the sample was drawn consisted of all subjects who qualified as: (a) first year, fall semester dental hygiene students; (b) first year, spring semester dental hygiene students; (c) second year, fall semester dental hygiene students; and (d) second year, spring semester dental hygiene students, as defined previously. The initial samples comprised intact groups consisting of females in the 1981 graduating classes from Old Dominion University, Norfolk, Virginia (N = 42); Virginia Commonwealth University, Richmond, Virginia (N = 15); and Virginia Western Community College, Roanoke, Virginia (N = 16). The mean age for Old Dominion University students' at the first measurement was 20.85, the mean age for Virginia Commonwealth University students' was 20.33, and for Virginia Western Community College students' the mean age was 22.38 (see Table 1). Only the scores of those students who participated in all

Table 1

Ages of Students (at the First Measurement)
Who Completed All four Tests

	Range	Mean	Median
ODU	18-39	20.85	20.00
VCU	20-21	20.33	20.00
VWCC	18-29	22.38	21.50

four of the testing sessions were used in data analysis. Longevity of this research, student absenteeism from the testing sessions and student attrition from the programs produced some subject mortality resulting in a final sample of 26 ODU, 12 VCU and 8 VWCC dental hygiene students (see Appendix B).

No method for controlling subject variables, such as randomization, could be used because subjects comprised intact groups. Only females were studied because no males were accepted into the programs for the 1979 academic year.

Research Design

The longitudinal approach was employed to allow for an in depth study of the same subjects at different academic semesters over two years. A 3 X 4 factorial analysis of variance design with repeated measures was used to assess main and interaction effects among the independent variables (three dental hygiene programs and four academic semester levels of dental hygiene education) as measured by creativity scores of the TTCT Verbal Form (see Table 2). Specifically, the independent variables were classified as:

a. Dental hygiene programs

   1. Old Dominion University (one year pre-hygiene, two years core curriculum)

   2. Virginia Commonwealth University (two years pre-hygiene, two years core curriculum)

   3. Virginia Western Community College (two years core curriculum)

Table 2

3 X 4 Factorial Design with Repeated Measures

Program	First Measurement Fall Semester First Year	Second Measurement Spring Semester First Year	Third Measurement Fall Semester Second Year	Fourth Measurement Spring Semester Second Year
ODU	y	y	y	y
VCU	y	y	y	y
VWCC	y	y	y	y

y = TTCT Creativity Scores

b. Academic semester level of education

1. First year, fall semester
2. First year, spring semester
3. Second year, fall semester
4. Second year, spring semester

Control for situation relevant variables was accomplished by treating all subjects alike. All subjects had common educational backgrounds and progressed through the dental hygiene programs at approximately the same rate and over the same time. History and maturation effects were not controlled in the research design.

Methodology

Data were collected at four different times from three groups of dental hygiene students. The time interval between data collections was approximately one academic semester from the first to the second and the third to the fourth measurements. A time lapse of one academic semester and a summer was necessary between the second and third measurements because of the semester structure of the curricula. Prior to data collection, the dental hygiene directors at each program were contacted (Old Dominion University at Norfolk, Virginia; Virginia Commonwealth University at Richmond, Virginia; and Virginia Western Community College at Roanoke, Virginia) to arrange a time, place and date for each administration of the TTCT at each respective school. The following data collection procedures were carried out each semester unless otherwise

indicated:

(a) The investigator administered the TTCT to each sample group. Tests were given during the first two months of each semester to prevent conflicts with other school-oriented responsibilities.

(b) All subjects were asked to participate at all testing sessions (unless the student withdrew from the program).

(c) The TTCT Form A was given at the first and third measurements; Form B was administered at the second and fourth measurements. This procedure was used to minimize any possible practice effects frequently experienced from receiving repeated exposure to the same test.

(d) All tests were administered according to the TTCT Directions Manual and Scoring Guide Verbal Forms.[43]

(e) Each student was given a test booklet and a pencil.

(f) During a preliminary orientation, students were encouraged to approach the tasks with enthusiasm and to do their best.[43]

(g) All students were given the same motivational encouragement at each testing session, as indicated in the Directions Manual.[43]

(h) At the beginning of each test activity, the investigator read the instructions aloud and answered any questions.

(i) Using a stopwatch, five minutes were allowed for activities 1, 2, 3, 6 and 7; ten minutes were allowed for activities 4 and 5; 45 minutes were allowed to complete the

test activities.

(j) At the end of the testing period, all pencils and test booklets were returned to the investigator.

(k) The necessary materials for this study included a stopwatch, booklets, pencils, a copy of the Directions Manual,[43] a copy of the Norms-Technical Manual,[42] and an examiner's kit.[43]

Protection of Human Subjects

Prior to implementation of this study, the following provisions were made in accordance with the federal guidelines for the protection of human subjects:

1. Subject Population. Subjects for this study consisted of intact groups from the population of dental hygiene programs. Old Dominion University, Virginia Commonwealth University and Virginia Western Community College were selected on the basis of convenience and meeting this study's sample definitions.

2. Potential Risks. The only plausible potential risk to the subjects was temporary fatigue because of the length of the test.

3. Consent Procedures. Prior to the administration of the first test, all subjects were given an explanation of the study and asked to read and voluntarily sign a written consent form if they were willing to participate. The consent form explained the potential risks and benefits of the study (see Appendix B).

4. Protection of Subjects' Rights. The students were at the college level and accustomed to taking 45 minute tests;

therefore, the risk of fatigue seemed minimal. Subjects clearly understood that they could withdraw from the study with no penalities. Confidentiality of all students' scores was maintained throughout the data collection. Data were analyzed and reported in group form only.

5. Potential Benefits. The potential benefits resulting from this study include the discovery of information on creativity in dental hygiene students; a better understanding of the curriculum's effects on creativity; and information which might enable educators to alter their teaching procedures and curriculum design to enhance creativity in students.

6. Risk Benefit Ratio. The numerous benefits of this study outweigh the minor potential risk of temporary fatigue.

Instrumentation

The Torrance Test of Creative Thinking (Verbal Form) was the instrument employed to measure creativity in the dental hygiene students. TTCT is a data collection instrument which yields detailed information concerning the creative thinking process.[33] The Verbal Form of the TTCT consists of seven activities and can be administered in either Form A or Form B (an equivalent alternate form to Verbal Form A).[42] Even though creative thinking is manifested in forms other than verbal, some of the important products resulting from the creative thinking process are found in

the verbal form.[42] The TTCT comprises both a projective technique and a personality inventory.

The TTCT was used because of its availability for general research use, relative expense, availability of reliability and validity data, simplicity of scoring, and prior use with college level students.[42] The measurement of creativity by the TTCT was interpreted according to the definition of the construct as defined by Torrance.[42]

The use of the TTCT can provide valuable data that can contribute to understanding the human mind and its functioning and development; discovering effective bases for individualizing instruction; assessing differential effects of old and new curricular arrangements, materials or teaching procedures; and becoming aware of individual potentialities that might otherwise go unnoticed.[42] Specifically, the TCTT could provide a basis for evaluating the influence on student creativity of a scientifically oriented and highly structured dental hygiene program.

According to predictive validity studies, the TTCT adequately differentiates the highly creative person from the less creative and predicts future creative endeavors from TTCT scores. In an eight year study of 114 junior elementary education majors, Torrance, Tan and Allman[42] predicted creative teaching behaviors ($r = .62$) utilizing the subjects' previous TTCT scores. Torrance[42] predicted quantity and quality of creative achievements of 236 seventh to twelfth graders ($r = .51$), using the students TTCT scores through a

12 year study.

Activities. The Verbal Test of the TTCT consists of seven parallel activities that are models of the creative process. Each activity is designed to elicit different kinds of thinking involved in the creative process, yet all require the individual to think in divergent directions and in terms of possibilities.[42] Creative thinking ability is not a pervasive, unitary function, but involves a wide range of abilities;[42] therefore, more than one activity is needed.

The "Ask-and-Guess" activities (1, 2 and 3) view the subject's ability to develop hypotheses and think in terms of possibilities. According to Torrance[42] the processes of asking and guessing are important to creative scientific thinking. The "Ask" activity is designed to reveal the individual's ability to sense what he cannot find out from looking at the picture and to ask questions that will enable him to fill in the gaps in his knowledge. The "Guess Causes" and "Guess Consequences" activities are designed to reveal the subject's ability to formulate hypotheses concerning cause and effect.[42]

The "Product Improvement" activity (4) is a task permitting subjects to toy with ideas they normally would not take seriously. "It is a complex task with a high degree of face validity."[42]

The "Usual Uses" activity (5) tests the subject's ability to free his mind of a rigid and well-established

set. The ability to be flexible and open to all stimuli is an important aspect of creativity.[42]

The "Unusual Questions" activity (6) is utilized to measure divergent power. According to Burkhart,[42] divergent power is needed in combination with productive spontaneity for predicting high degrees of creative achievement. Divergent power is also of crucial concern for creativity in the classroom setting.[42]

The "Just Suppose" activity (7), a variation of the "Guess Consequences" activity, is an attempt to produce a higher degree of spontaneity.[42]

> In order to respond productively to this task the subject must 'play with' the possibility and imagine all of the things that would happen as a consequence. This kind of thinking seems to be highly important in creative behavior--.[42]

The data collected from this study provides insight into the creative thinking process of dental hygiene students. The breakdown of creativity to the components (Fluency, Flexibility and Originality) will provide further information concerning what particular aspects of the creative thinking process are altered, if at all, by the dental hygiene curriculum.

Scoring. Each of the seven activities of the TTCT Verbal Form is scored on three components: Fluency, Flexibility and Originality. Fluency is the "ability to produce a large number of ideas with words."[43] Flexibility is the "ability to produce a variety of kinds of ideas, to shift from one

approach to another, or to use a variety of strategies."[43] Originality is the ability to "produce ideas that are away from the obvious, commonplace, banal or established."[43]

In activities one thru five of the TTCT, Fluency, Flexibility and Originality are similarly scored. Fluency is scored by adding all the relevant questions listed. A relevant response would be one which cannot be answered by merely looking at the picture. Flexibility is scored by awarding one point for each answer which falls within certain categories and no point if more than one answer falls within the same category.[43] Originality is scored by assigning points to responses according to an index of possible responses listed in the scoring guide.[43]

In activity six, the Fluency score is the number of all questions asked, regardless of the quality of the question. No Flexibility score for activity six is determined because of Torrance's inability to develop an appropriate list of categories.

Originality is scored by finding the divergent power. The divergent power score is determined by a modification of the Burkhart's Object Question Test.[43] The Originality score in activity seven is determined according to criteria similar to activities one thru five. The Fluency score is determined by counting the number of different possible responses. Flexibility is scored by counting the number of shifts or changes in attitudes or focus, according to the scoring guide.[43]

The Torrance Tests Scoring Service of Athens, Georgia, commercially scored the TTCT booklets and provided raw and standard Fluency, Flexibility and Originality scores for each dental hygiene student. Total creativity scores were obtained by adding the individual Fluency, Flexibility and Originality standard scores of each student and dividing by three. Standard scores were used to make use of Total scores, and to make comparisons between scores from alternate forms of the test and among the three dental hygiene programs.

Torrance states that use of a total score

> ....does seem to give a rather stable index of the total amount of creative energy a person has available or is willing to use. Reliabilities are generally higher for such total scores than for the separate composite scores because a person may spend energies on one occasion in producing as large a number of responses as possible, giving little attention to the elaboration of responses. On a second occasion, he or she may use energies in elaboration of a few responses or in thinking of unusual or original ones.[42]

Utilizing the Total scores might equalize differences in subscores (Fluency, Flexibility and Originality) and provide a score representing the total amount of creative energy.

Reliability. TTCT reliability as rated in the Norm-Technical Manual[42] is satisfactory.[42] The concept of motivation is an important factor that must be considered in assessing the reliability of the TTCT. Torrance[15,42] has suggested that motivational conditions may affect the test-retest and equivalency of alternate forms reliability and validity of the TTCT. Halpin and Halpin[15] also have tested this idea and

concluded that it is extremely important for subjects to be motivated to do their best on the tests and all groups should receive the same amount of motivational encouragement to aid in the reliability of the TTCT. Any motivational, emotional or mental health factors will affect creative functioning and might contribute to a lowering of test-retest reliability.[42]

Even though Torrance[43] reports reliability between alternate Verbal Forms A and B as being adequate, few studies have tested this assumption. In five of the studies involving the alternate form test design, correlation coefficients ranged from .59 to .93 for Fluency, .35 to .84 for Flexibility and .59 to .88 for Originality.[43]

When utilizing the scoring guide for the TTCT, the interrater and intrarater reliabilities have been consistent and high ($r = .90$).[42] Low interscorer reliability in scoring originality most often occurs from "failure to scan adequately the listed originality weights."[42]

Validity. Various studies have been conducted to establish content, construct, predictive and concurrent validity. Predictive validity studies have been previously discussed. Creativity is not a single entity and can be approached from either the product, person, process or environment aspect. Previous studies establishing validity of creativity tests pertained only to the aspect involved in those tests.

A major problem in establishing content validity results from the "absence of a single generally accepted

theory of creativity which would serve to unify or direct efforts at specifying assessment procedures."[45] This problem has been pointed out by Treffinger, Renzulli and Feldhusen.[45] The absence of a single generally accepted theory of creativity has resulted in numerous tests of creativity being available with each test differing in a number of ways. Torrance[42] maintains that the tasks of the TTCT have a content-free characteristic; therefore, establishing content validity was unnecessary.

Construct validity involves a variety of populations because of test accessibility by many educational and age levels. In a study involving adults, Torrance and Hansen[42] compared highly creative basic business teachers with less creative ones, as identified by the TTCT. All teachers were measured on the Burkhart-Bernheim Measure of Divergent Power. The questions asked by the highly creative teachers were scored higher than the less creative teachers (mean of 58.83 compared to a mean of 2.67).[42] The percentage of divergent questions asked by the highly creative teachers was 10.9, whereas the less creative teachers received 0.8.[42] Torrance[42] has cited studies which also yield an adequate amount of construct validity for the TTCT.

In a study involving preferred ways of learning, Clark[42] found a correlation ($r = .32$) between composite creativity scores on the TTCT and a preference for open-structured learning experiences, which is an aspect of creativity.[42] MacDonald and Raths[42] also found that highly creative children

were more productive on frustrating and open tasks than were their less creative peers. Therefore, students with varying levels of creative thinking abilities react differently to different kinds of learning situations.

Torrance[42] and his associates have discovered few generally accepted criteria for TTCT concurrent validity using peer nominations, teacher nominations and other teaching measures. Peer and teacher nominations involved fellow students and teachers indicating to the researcher those students which they think show originality, ask a lot of questions, talk about unusual ideas and other aspects of creativity. In a study conducted in 1975, a minimal relationship was found to exist between the TTCT and the Welsh Figural Preference Test.[12] The assumption was made that the two scales which were designed to measure creativity shared little common variance.[12] In contrast, Yamamato[42] found the correlation between peer nominations and the TTCT to be statistically significant but not very high ($r = .24$). Torrance[42] believes such studies possess high enough coefficients to encourage further work with the TTCT. Studies involving teacher nominations have had sufficient concurrent validity results, even though teacher nominations have not been completely accepted as adequate criteria.[42] Most studies involving correlations between creativity test scores and other testing measures exhibit rather low correlation coefficients. Wallach and Kogan[45] have criticized creativity tests for correlating as well or better with IQ

measures than they correlate among themselves. The TTCT also tends to correlate poorly with other creativity tests.[12] Thus, TTCT concurrent validity is not universally accepted.

In summary, there is only limited evidence that creativity tests actually measure creative abilities.[10] "However, over the last few years tests of creativity have become progressively more valid and reliable."[10] Certain aspects must be kept in mind, concerning all reliability and validity studies. Most creativity criterion and tests will show considerable error variance due to function fluctuation.[14] Reliabilities of such tests probably will be generally low.[14,45] Investigators should realize that creativity tests are now in the stage of evolution, undergoing modification and adjustment.[10]

Most researchers believe that:

> ....measured creativity is a good approximation of true creativity (potential) and also that effective creativity (achievement) has some and, wishfully, single relations to true and measured creativity. We should not, however, expect perfect relations among these three, partly because of imperfections in measurement and partly because adjustment in the life situation involves factors, both psychological and sociological, other than creativity itself.[13]

Statistical Treatment

Intervally scaled raw data were converted to standard scores as recommended by Torrance.[43] All test booklets were commercially scored by the Torrance Tests Scoring Service of Athens, Georgia. Overall mean scores for each program at all four measurements were computed using the statistical biomedical package, BMD-P2V,[17] and the computer facilities at

Old Dominion University.

A 3 X 4 factorial analysis of variance design was utilized to determine main and interaction effects of the independent variables, four academic semester levels and three dental hygiene programs, on the dependent variables, Fluency, Flexibility, Originality and Total creativity scores. When significance was found, Tukey's HSD Test[48] was used to locate the significant differences among mean scores of each program for each of the four components of the TTCT. All analyses were made at the 0.01 level of significance.

Chapter 4

RESULTS AND DISCUSSION

The results of this study on creativity in dental hygiene students are presented for each hypothesis tested. Tables 3 through 6 contain the mean and standard deviations for Fluency, Flexibility, Originality and Total scores of the Torrance Test of Creative Thinking for the ODU, VCU and VWCC dental hygiene programs.

Tables 3 and 4 indicate that Fluency and Flexibility scores tend to decrease at the second measurement, slightly increase at the third measurement and decrease again at the fourth measurement. The scores in Table 5 indicate an increase in Originality at the second measurement, a decrease at the third (yet still above the first measurement), and an increase again at the fourth measurement. Due to the alternating increases and decreases of Fluency, Flexibility and Originality scores, the Total scores presented in Table 6 remain relatively stable at all measurements.

Results

Hypothesis 1. Data were analyzed to test the hypothesis that no statistically significant difference in creativity existed between the first year, fall semester and the second year, spring semester dental hygiene students. This difference was determined by Fluency, Flexibility and Originality

Table 3

Means and Standard Deviations for the Fluency Subtest Scores of the TTCT of Students at Three Dental Hygiene Programs

		Fall Semester First Year (First Measurement)	Spring Semester First Year (Second Measurement)	Fall Semester Second Year (Third Measurement)	Spring Semester Second Year (Fourth Measurement)
ODU	$\bar{x}$	104.69	97.69	102.27	95.69
N = 26	sd	23.45	26.35	23.86	25.91
VCU	$\bar{x}$	107.50	98.58	119.25	101.00
N = 12	sd	15.75	22.90	22.55	23.25
VWCC	$\bar{x}$	94.62	90.75	103.12	88.75
N = 8	sd	21.55	6.71	13.42	14.51

Table 4

Means and Standard Deviations for the Flexibility Subtest Scores of the TTCT of Students at Three Dental Hygiene Programs

		Fall Semester First Year (First Measurement)	Spring Semester First Year (Second Measurement)	Fall Semester Second Year (Third Measurement)	Spring Semester Second Year (Fourth Measurement)
ODU	$\bar{x}$	105.50	88.81	95.27	84.92
N = 26	sd	19.10	19.16	17.29	19.18
VCU	$\bar{x}$	108.83	92.00	106.00	84.50
N = 12	sd	17.27	19.36	20.09	20.64
VWCC	$\bar{x}$	99.12	81.50	98.75	79.00
N = 8	sd	30.29	10.01	12.38	13.60

Table 5

Means and Standard Deviations for the Originality Subtest Scores of the TTCT of Students at Three Dental Hygiene Programs

		Fall Semester First Year (First Measurement)	Spring Semester First Year (Second Measurement)	Fall Semester Second Year (Third Measurement)	Spring Semester Second Year (Fourth Measurement)
ODU	$\bar{x}$	107.19	118.42	109.96	122.69
N = 26	sd	23.73	26.72	26.76	31.93
VCU	$\bar{x}$	109.92	124.08	125.83	132.08
N = 12	sd	19.07	23.40	22.18	34.05
VWCC	$\bar{x}$	90.87	119.75	112.87	116.37
N = 8	sd	17.27	20.32	18.83	24.18

Table 6

Means and Standard Deviations for the Total Scores of the TTCT of Students at Three Dental Hygiene Programs

		Fall Semester First Year (First Measurement)	Spring Semester First Year (Second Measurement)	Fall Semester Second Year (Third Measurement)	Spring Semester Second Year (Fourth Measurement)
ODU	$\bar{x}$	105.76	101.74	102.40	101.07
N = 26	sd	20.16	23.54	22.12	25.01
VCU	$\bar{x}$	108.69	104.87	116.99	105.82
N = 12	sd	15.48	20.33	20.79	25.35
VWCC	$\bar{x}$	94.42	97.30	101.84	94.69
N = 8	sd	24.42	8.69	13.67	16.88

subtests and Total creativity test scores.

Using a 3 X 4 factorial analysis of variance design with repeated measures, data revealed no statistically significant differences between the first year, fall semester (first measurement) and second year, spring semester (fourth measurement) dental hygiene students on Fluency and Total scores (see Tables 7, 8 and Table 13, p. 57). In contrast, statistically significant differences were found between the first and fourth measurement on Flexibility and Originality scores of ODU, VCU and VWCC dental hygiene students (see Tables 9, 10, 11 and 12).

Hypothesis 2. Data were examined to determine if a statistically significant difference existed among the first, second (first year, fall semester), third (second year, spring semester) and fourth measurements of dental hygiene students based on Fluency, Flexibility, Originality and Total creativity scores. Analysis of each of the four components of the Torrance Tests of Creative Thinking (TTCT) are discussed separately.

Statistically significant differences were found in only 12 of 72 pairs of measurements. At VCU, differences were found for Fluency scores between the second and third measurements, and the third and fourth measurements (see Table 7). Tukey's HSD Test was used to locate the statistically significant pairs of treatment means.

Analysis of the data also revealed statistically

Table 7

Two-way Analysis of Variance with Repeated Measures on Mean Fluency Scores of Students at Three Dental Hygiene Programs

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F	p
Among Schools	3005.10	2	1502.55	.90	.41
Subjects within School (Error)	71945.51	43	1673.15	-	
Among Semesters	4174.37	3	1391.46	10.87	.01*
School X Semester (Interaction)	1427.84	6	237.97	1.86	.09
Subjects within School X Semester (Error)	16512.13	129	128.00	-	
Total	97064.96	183	-		

*Significant

Table 8

Tukey's HSD Test on Mean Fluency Scores of Dental Hygiene Students at Four Academic Semesters

ODU

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 104.69	-	7.00	2.42	9.00
$\bar{x}_2$ = 97.69		-	4.59	2.00
$\bar{x}_3$ = 102.27			-	6.58
$\bar{x}_4$ = 95.69				-

HSD = 9.76

VCU

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 107.50	-	8.92	11.75	6.50
$\bar{x}_2$ = 98.58		-	20.67*	2.42
$\bar{x}_3$ = 119.25			-	18.25*
$\bar{x}_4$ = 101.00				-

HSD = 14.37

VWCC

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 94.62	-	3.87	8.50	5.87
$\bar{x}_2$ = 90.75		-	12.37	2.00
$\bar{x}_3$ = 103.12			-	14.37
$\bar{x}_4$ = 88.75				-

HSD = 17.60

*Significant at 0.01

Table 9

Two-way Analysis of Variance with Repeated Measures on Mean Flexibility Scores of Students at Three Dental Hygiene Programs

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F	p
Among Schools	1341.15	2	670.58	.69	.50
Subjects within School (Error)	41516.76	43	965.51	-	
Among Semesters	11450.49	3	3816.83	25.28	.01*
School X Semester (Interaction)	823.83	6	137.30	.91	.49
Subjects within School X Semester (Error)	19477.78	129	150.99	-	
Total	74610.01	183	-		

*Significant

Table 10

Tukey's HSD Test on Mean Flexibility Scores of Dental Hygiene Students at Four Academic Semesters

ODU

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 105.50	-	16.69*	10.23	20.58*
$\bar{x}_2$ = 88.81		-	6.46	3.88
$\bar{x}_3$ = 95.27			-	10.35
$\bar{x}_4$ = 84.92				-

HSD = 10.60

VCU

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 108.83	-	16.83*	2.83	24.33*
$\bar{x}_2$ = 92.00		-	14.00	7.50
$\bar{x}_3$ = 106.00			-	21.5*
$\bar{x}_4$ = 84.50				-

HSD = 15.61

VWCC

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 99.12	-	17.62	.37	20.12*
$\bar{x}_2$ = 81.50		-	17.25	2.50
$\bar{x}_3$ = 98.75			-	19.75*
$\bar{x}_4$ = 79.00				-

HSD = 19.11

*Significant at 0.01

Table 11

Two-way Analysis of Variance with Repeated Measures on Mean Originality Scores of Students at Three Dental Hygiene Programs

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F	p
Among Schools	3715.26	2	1857.63	.94	.40
Subjects within School (Error)	85220.73	43	1981.88	-	
Among Semesters	9481.51	3	3160.50	13.67	.01*
School X Semester (Interaction)	1951.21	6	325.20	1.41	.22
Subjects within School X Semester (Error)	29833.70	129	231.27	-	
Total	130202.40	183	-		

*Significant

Table 12

Tukey's HSD Test on Mean Originality Scores of Dental Hygiene Students at Four Academic Semesters

ODU

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 107.19	-	11.23	2.77	15.5*
$\bar{x}_2$ = 118.42		-	8.46	4.27
$\bar{x}_3$ = 109.96			-	12.73
$\bar{x}_4$ = 122.69				-

HSD = 13.12

VCU

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 109.92	-	14.16	15.92	22.16*
$\bar{x}_2$ = 124.08		-	1.75	8.00
$\bar{x}_3$ = 125.83			-	6.25
$\bar{x}_4$ = 132.08				-

HSD = 19.32

VWCC

	$\bar{x}_1$	$\bar{x}_2$	$\bar{x}_3$	$\bar{x}_4$
$\bar{x}_1$ = 90.87	-	28.87*	22.00	25.50*
$\bar{x}_2$ = 119.7		-	6.87	3.37
$\bar{x}_3$ = 112.87			-	3.50
$\bar{x}_4$ = 116.37				-

HSD = 23.66

*Significant at 0.01

Table 13

Two-way Analysis of Variance with Repeated Measures on Mean Total Scores of Students at Three Dental Hygiene Programs

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F	p
Among Schools	2886.31	2	1443.15	1.01	.37
Subjects within School (Error)	61481.72	43	1429.81	-	
Among Semesters	933.27	3	311.09	2.30	.08
School X Semester (Interaction)	974.48	6	162.41	1.20	.31
Subjects with School X Semester (Error)	17410.34	129	134.96	-	
Total	83686.12	183	-		

significant differences between Flexibility scores. At ODU, differences were found between the first and second measurements, and the first and fourth measurements. At VCU, they were between the first and second measurements, first and fourth measurements and the third and fourth measurements. While at VWCC, the differences were between the first and fourth measurements and the third and fourth measurements (see Tables 9 and 10).

Statistically significant differences between Originality scores existed between the first and fourth measurement at ODU. At VCU, the differences also were found between the first and fourth measurements. While at VWCC, the differences were between the first and second measurements, and the first and fourth measurements (see Tables 11 and 12).

Even though some differences were found with Fluency, Flexibility and Originality scores, this was not the case for Total scores. Analysis of the data revealed no statistically significant difference among the Total scores at any of the three programs (see Table 13).

Hypothesis 3. Examination of mean scores on the Fluency, Flexibility, Originality and Total scores indicated that there was a generally consistent ranking of the programs for all four measurements. Ranking of programs from highest to lowest was as follows: VCU, ODU and VWCC. Of 72 paired measurements, the only variations from this ranking were that ODU scored slightly lower than VWCC on the third measurement

of Fluency and Flexibility, and slightly lower on the second and third measurements of Originality. ODU did score slightly above VCU on the fourth measurement of Flexibility (see Figures 1-4). The hypothesis that no statistically significant differences existed among the students of ODU, VCU and VWCC dental hygiene programs on the Fluency, Flexibility, Originality and Total scores was tested using a factorial analysis of variance with repeated measures with each of three schools being tested four times. Analysis revealed no statistically significant difference among the three accredited dental hygiene programs (see Tables 7, 9, 11 and 13).

Raw scores were converted to college norm standard scores with the mean score of 100 and a standard deviation of 20 to compare dental hygiene students with all college students who have taken the Torrance Tests of Creative Thinking. Another reason for conversion to standard scores was to compare and equate scores of the Verbal Form A to scores of Verbal Form B. On the average, VCU scored above the college norm, ODU fluctuated at the norm and VWCC scored below the college norm on the Fluency score. All three programs generally scored below the college norms of Flexibility and above college norms on Originality. On the Total score, VCU scored above, ODU slightly above and VWCC slightly below the college norm (see Figures 1-7, p. 60-66).

Hypothesis 4. Data were analyzed to determine if a statistically significant interaction effect existed between

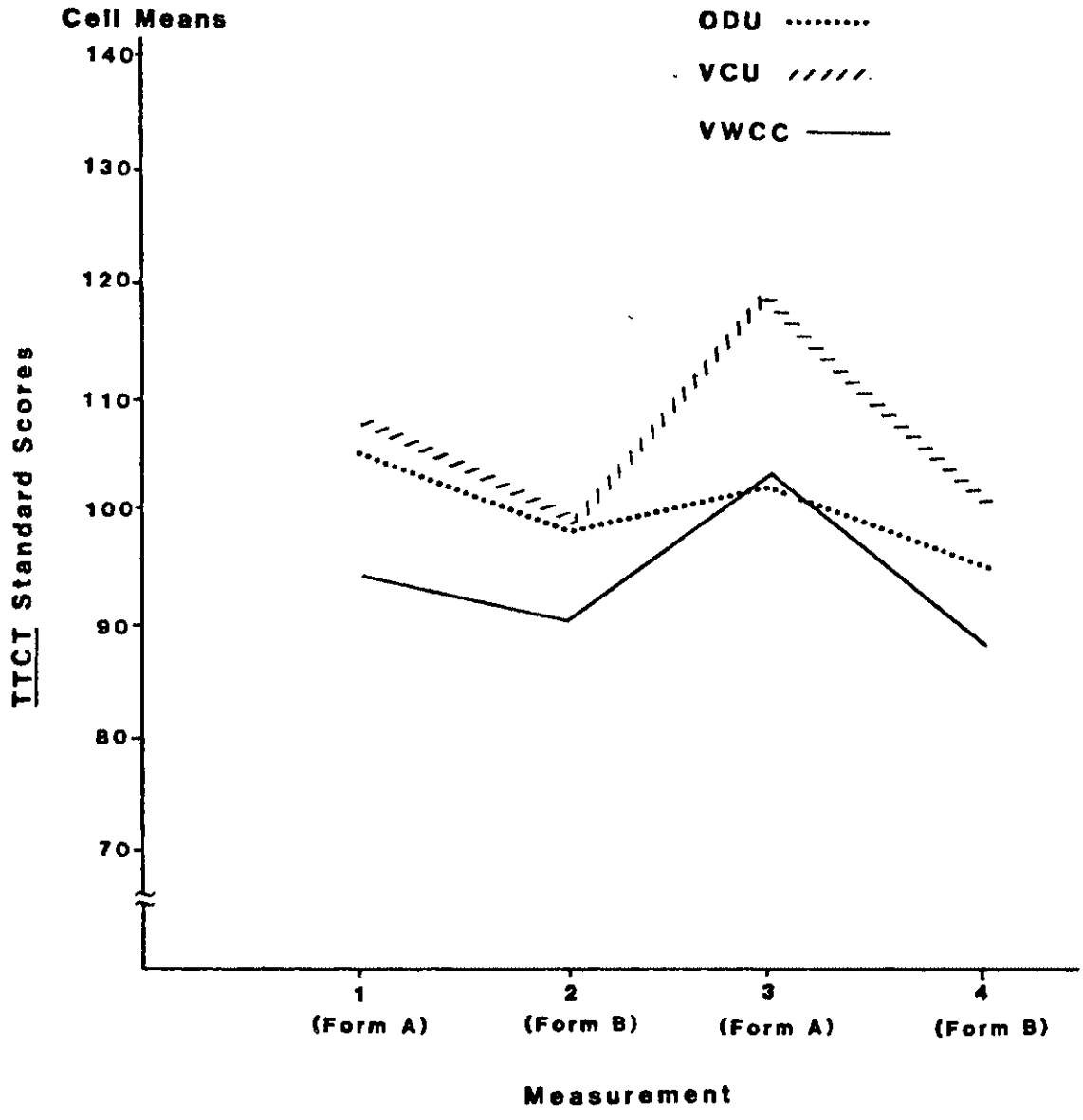

Fig. 1. First, Second, Third, and Fourth Measurements Fluency Scores of the TTCT for ODU, VCU, and VWCC Students

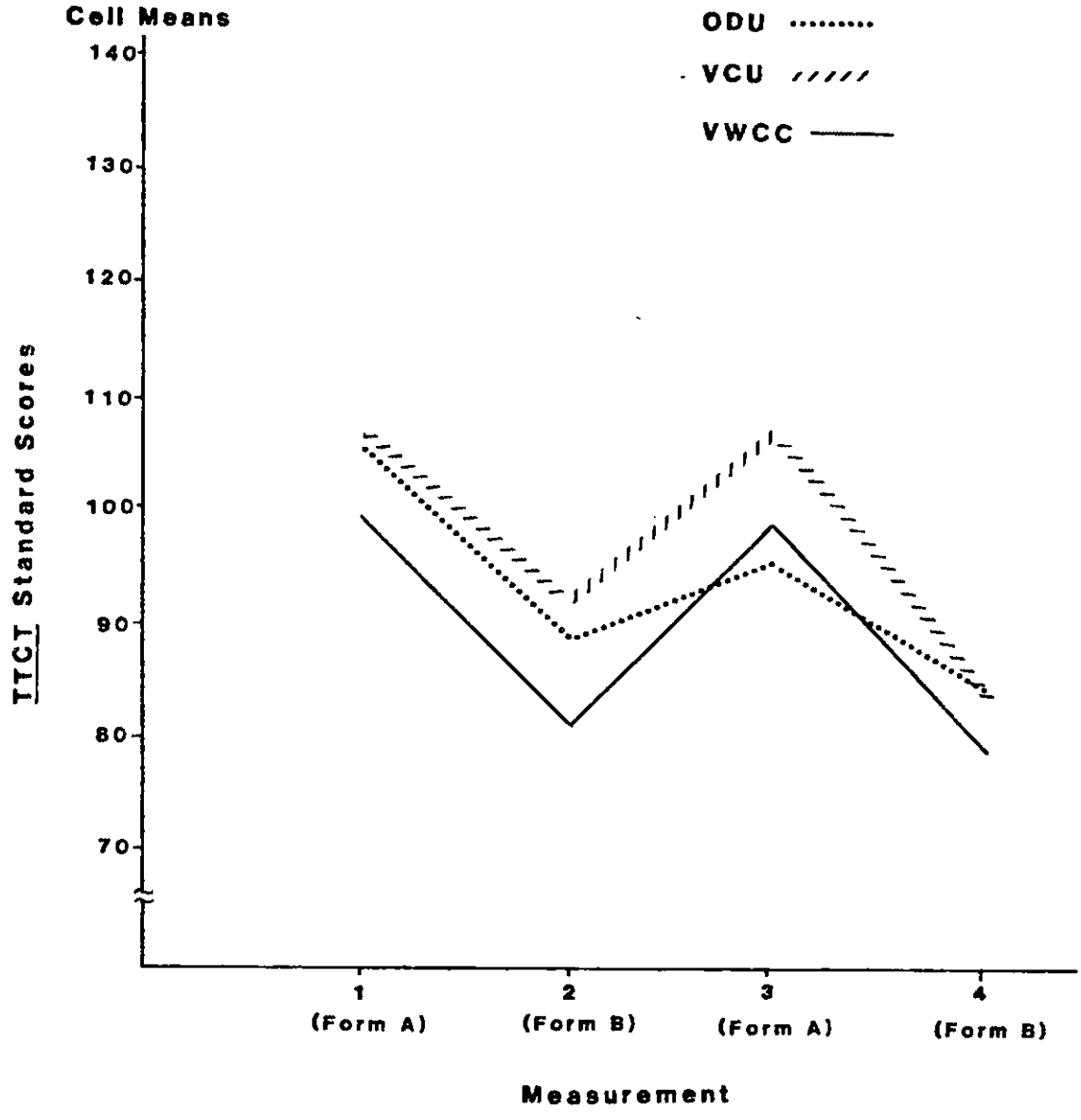

Fig. 2. First, Second, Third, and Fourth Measurements Flexibility Scores of the TTCT for ODU, VCU, and VWCC Students

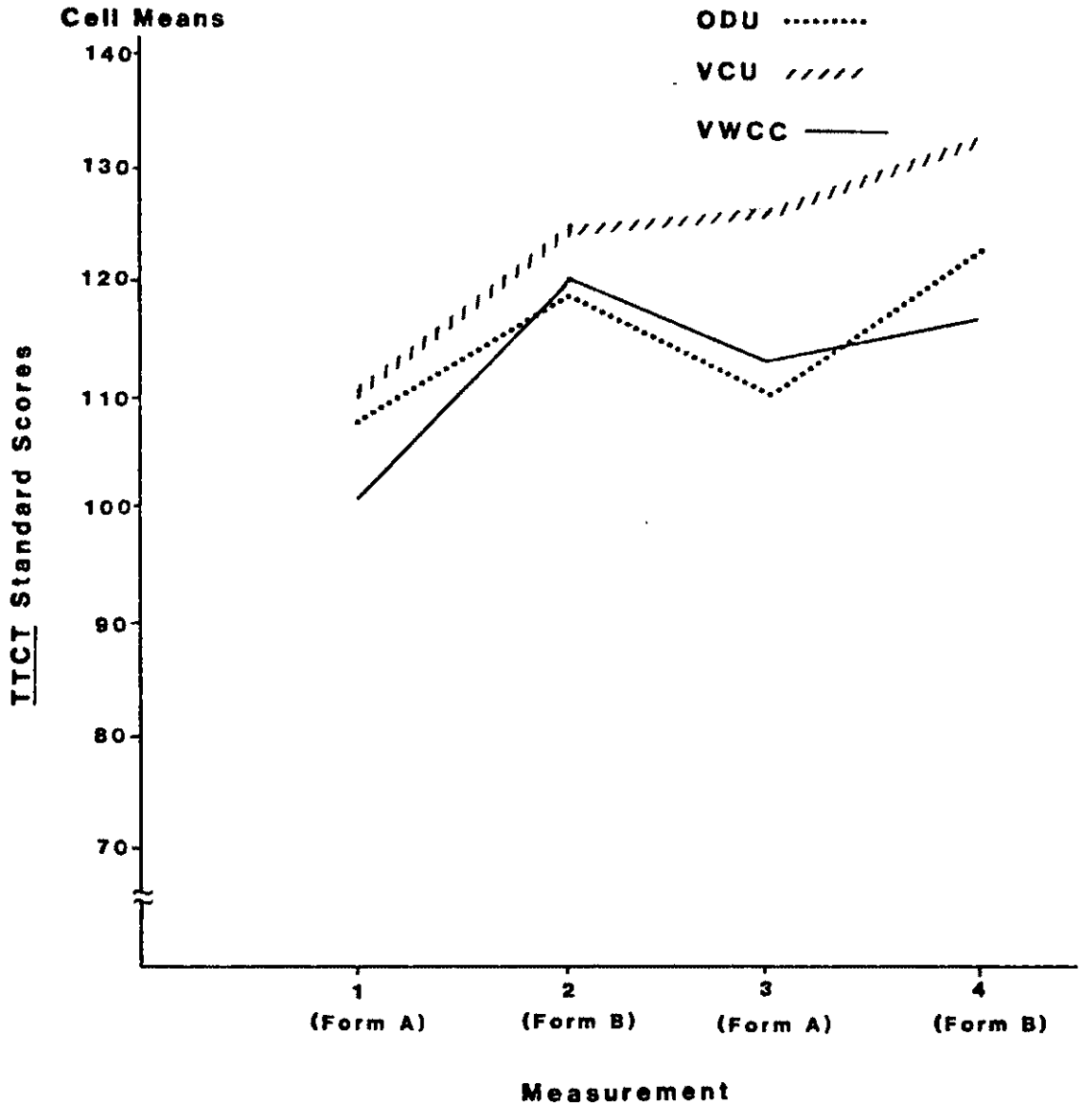

Fig. 3. First, Second, Third, and Fourth Measurements Originality Scores of the TTCT for ODU, VCU, and VWCC Students

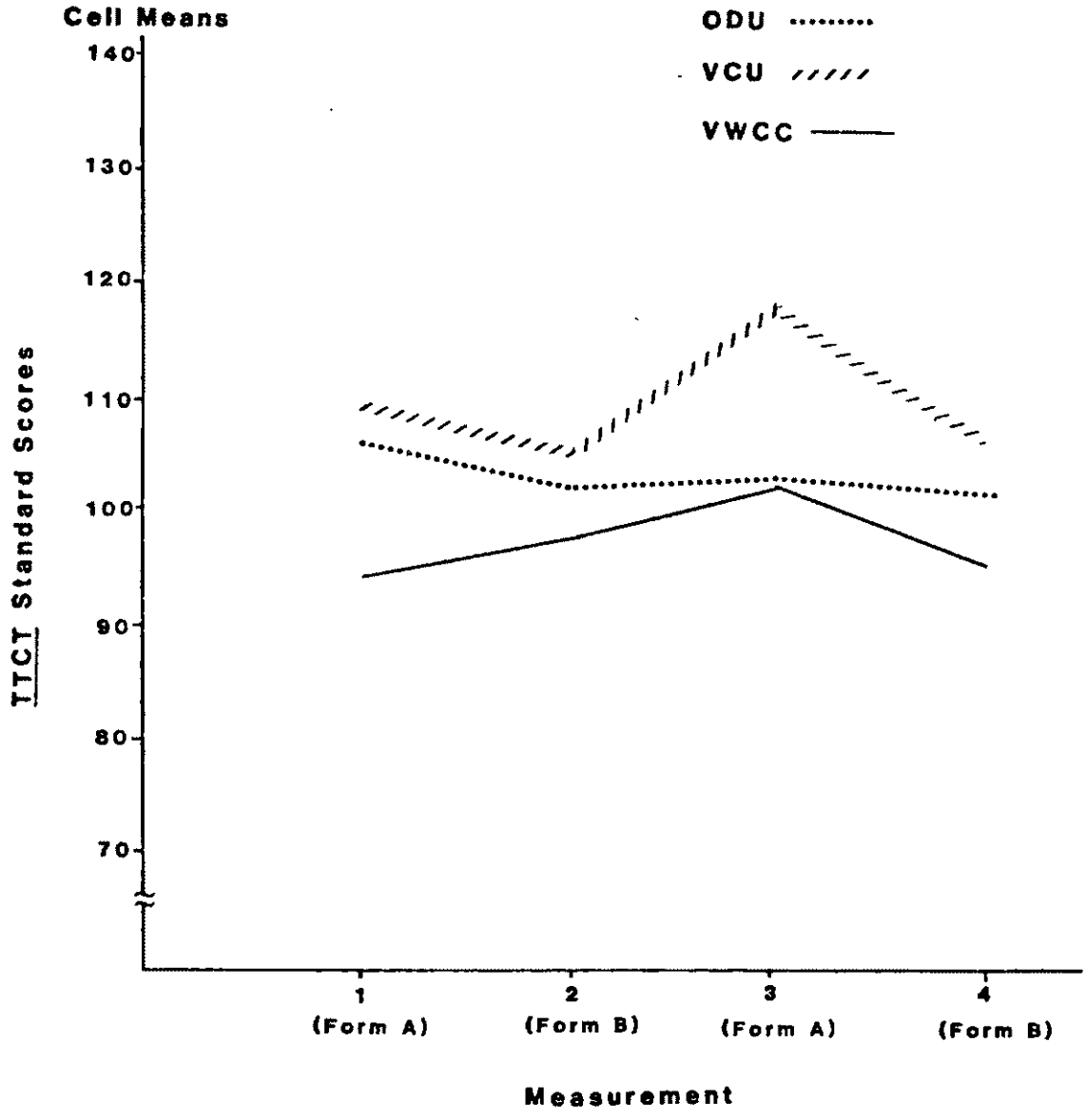

Fig. 4. First, Second, Third, and Fourth Measurements Total Scores of the TTCT for ODU, VCU, and VWCC Students

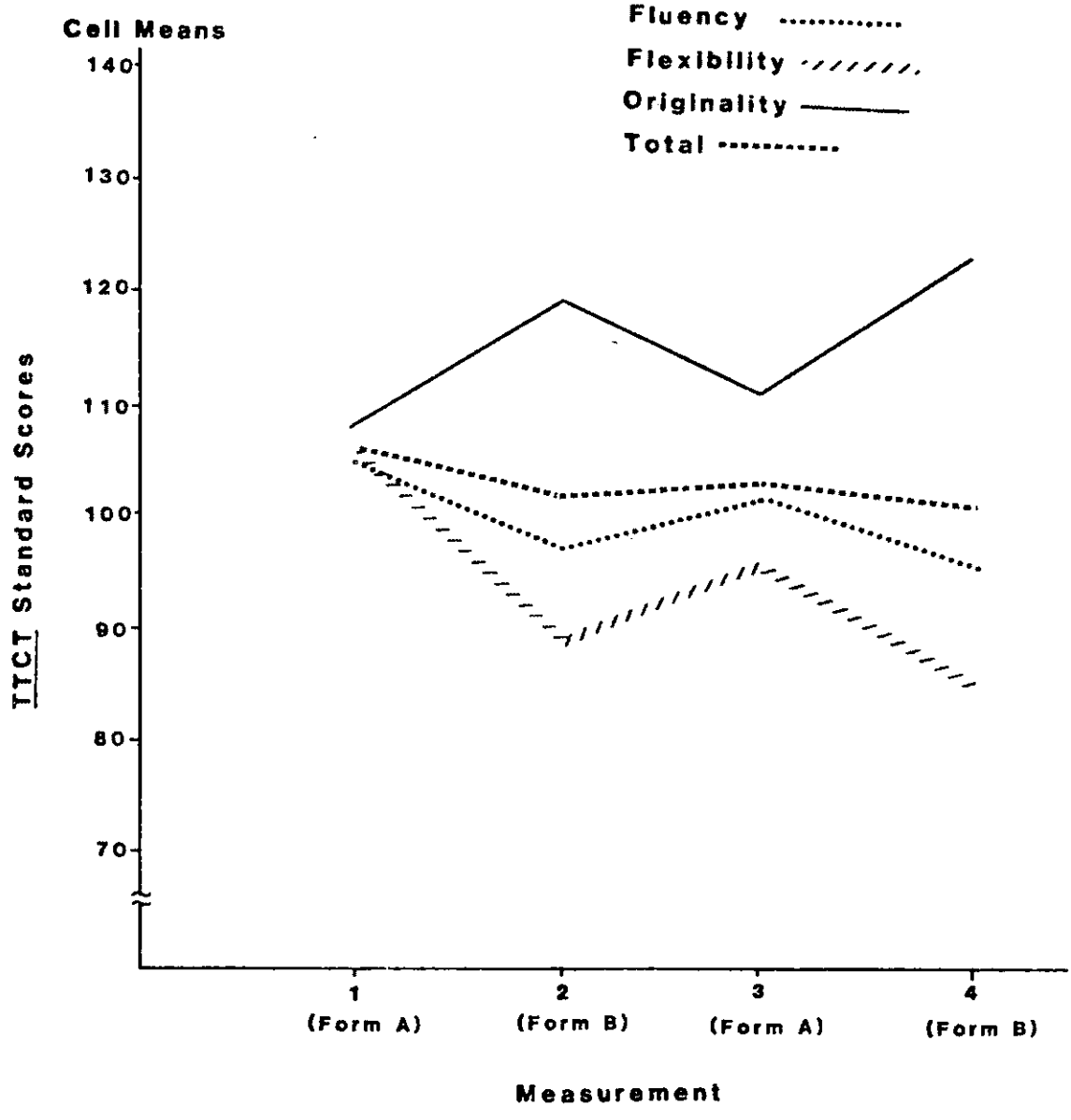

Fig. 5. Fluency, Flexibility, Originality, and Total TTCT Scores for ODU Students on Four Measurements

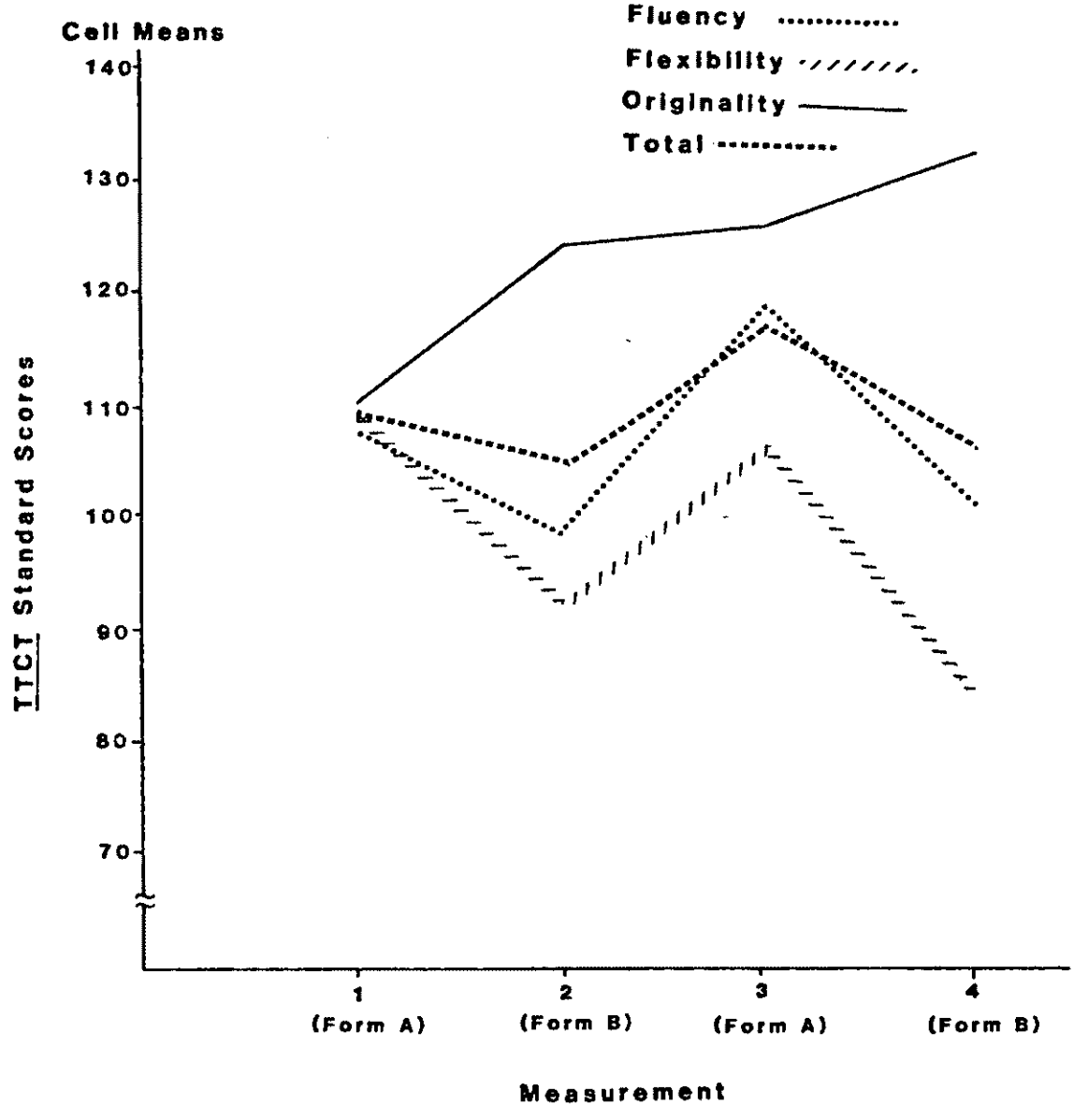

Fig. 6. Fluency, Flexibility, Originality, and Total TTCT Scores for VCU Students on Four Measurements

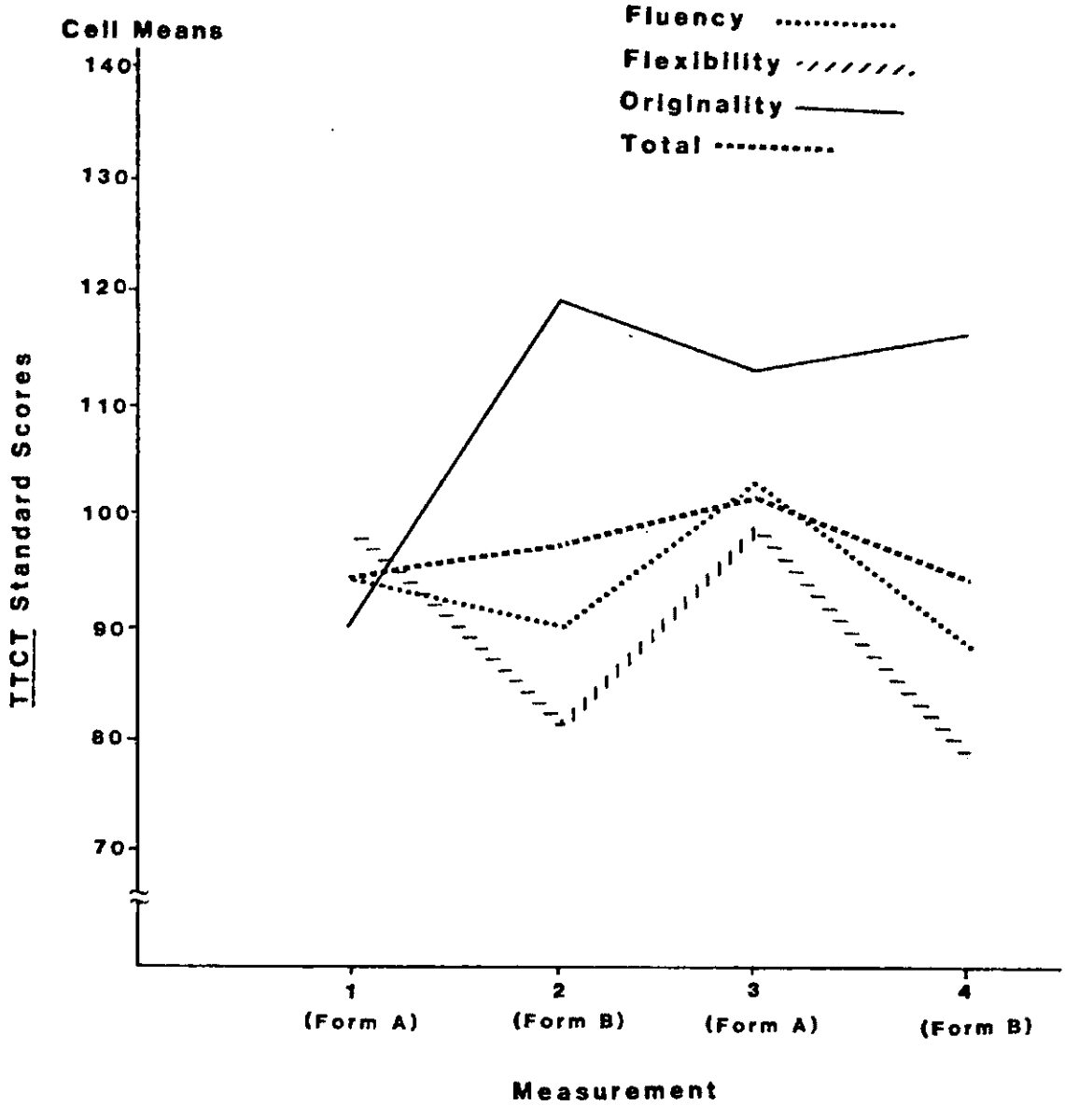

Fig. 7. Fluency, Flexibility, Originality, and Total TTCT Scores for VWCC Students on Four Measurements

four academic semester levels and three accredited dental hygiene programs as measured by the Torrance Tests of Creative Thinking. No statistically significant interaction effects were found on the Fluency, Flexibility, Originality or Total scores (see Tables 7, 9, 11 and 13).

Discussion

The Torrance Tests of Creative Thinking Verbal Form A was administered at the first and third measurement and the Verbal Form B was administered at the second and fourth measurement (see Figures 1-4, p. 60-63). Whenever a statistically significant difference was found, in any of the three programs, that difference was between Form A and Form B only. No statistically significant differences existed between the first and third measurement (Form A) or between the second and fourth measurement (Form B) in Fluency, Flexibility or Originality scores. Data suggest that the exhibited differences might be a result of a lack of reliability between the "equivalent forms" of the testing instrument, rather than a true statistically significant difference in the Fluency, Flexibility or Originality components of creativity.

Even though Torrance[42] reports reliability between alternate Verbal Forms A and B as being adequate, few studies have tested this assumption. Five of the studies which have used all or most of the tasks of Verbal Forms A and B report reliability coefficients ranging from .59 to .93 for Fluency, .35 to .84 for Flexibility and .59 to .88 for Originality.[42]

However, Torrance[42] does state that emotional, physical, motivational and mental health factors do affect creative functioning and development and might contribute to a lowering of reliability. Unless the same factors affected all three programs similarly and simultaneously, which is unlikely, lack of reliability in the equivalency of alternate forms seems to be a more feasible explanation for the statistically significant research findings.

Hypothesis 1. Findings from the analysis did not reject the null hypothesis that no statistically significant differences were found between the first year, fall semester (first measurement) and second year, spring semester (fourth measurement) dental hygiene students on Fluency and Total creativity scores. Results of the analysis suggest that the dental hygiene curriculum did not produce an increase or decrease in the Fluency component or Total creativity level of dental hygiene students at all three programs.

Findings from the analysis rejected the null hypothesis that there was no statistically significant differences between the first measurement and fourth measurement on the Flexibility and Originality creativity scores of dental hygiene students. Differences between the first and fourth measurement occurred at all three programs. During the course of the programs the Flexibility scores decreased and the Originality scores increased from the first measurement to the fourth measurement. Results suggest that the structure

of the dental hygiene curriculum does influence the Flexibility and Originality components of creativity in dental hygiene students.

A possible explanation for finding a difference in Flexibility and Originality scores is the lack of equivalency of alternate Forms A and B of the Torrance Tests of Creative Thinking. The differences found by the analysis were between Form A, which was given at the first measurement, and Form B, which was given at the fourth measurement. The structure of the dental hygiene curriculum might not appear to influence creativity in dental hygiene students, especially when considering the lack of equivalency of alternate forms and that no significant differences were found in Total or Fluency sub-test scores (see Figures 1-4, p. 60-63).

Hypothesis 2. The results of the analysis demonstrated no statistically significant differences among Total scores (combination of Fluency, Flexibility and Originality) at all three programs. These results indicate that the level of creativity in dental hygiene students does not change during the basic two year dental hygiene curriculum (see Table 13, p. 57 and Figure 4, p. 63).

Generally speaking, the Originality scores of all three dental hygiene programs increased while the Flexibility and Fluency scores decreased (see Figures 1-3, p. 60-62). When all three scores were combined and a Total score obtained, there was little fluctuation in mean scores, none of which

were statistically significant. Possibly students might have spent more energy on producing a large number of ideas on one measurement while producing responses of greater originality on another measurement. Utilizing the Total scores equalizes these differences and provides a score representing the total amount of creative energy spent.

Findings from the analysis rejected the null hypothesis that there were no statistically significant differences among dental hygiene students on the first, second, third and fourth measurements of Fluency, Flexibility and Originality scores. The only statistically significant difference located in the Fluency component was at VCU between the second and third measurement, and the third and fourth measurement. The results obtained at VCU at the third measurement might have been influenced by a motivational factor or an uncontrolled extraneous variable.

Results from this study indicate that the level of creativity, as measured by Flexibility and Originality scores in dental hygiene students changes during the basic two year dental hygiene curriculum. The changes seen were a decrease in Flexibility scores and an increase in the Originality scores. All differences in Originality and Flexibility scores were located between the first (Form A) and second (Form B) measurement, first (Form A) and fourth (Form B) measurement, and the third (Form A) and fourth (Form B) measurement. The fact that all differences were between Forms A and B suggest that the findings might be a result of

a lack of equivalency in alternate forms. Considering the lack of equivalency in alternate forms and the use of Total scores, the conclusion of no change in the level of creativity of dental hygiene students during the two year dental hygiene curriculum, although speculative, still warrants attention.

Hypothesis 3. Results of the data analysis failed to reject the hypothesis of no statistically significant difference among ODU, VCU and VWCC dental hygiene students on Fluency, Flexibility, Originality and Total creativity scores. Data indicate that the three accredited dental hygiene programs do not affect creativity in their students differentially. A possible explanation for this finding is that all three dental hygiene programs are accredited and follow similar educational formats and teaching methodologies. All of the programs are required to follow the curricular requirements established by the American Dental Association, Commission on Dental Accreditation and recommended to follow the guidelines proposed in ADHA's Curriculum Guidelines for Dental Hygiene Education: Performance Standards Based on Task Analysis and Instructional Objectives.[3] Since accreditation is a means of standardization for subjects taught and number of hours required for each area of emphasis, then accreditation inadvertently might be controlling the level of creativity throughout the dental hygiene curricula of the three programs. This area is in need of further research.

Even though the programs did not affect creativity in

their students differentially, there was a difference in the ranking of mean scores for each school. Generally, the ranking of mean scores on all four components of the Torrance Tests of Creative Thinking from highest to lowest follows: VCU, ODU and VWCC. A possible explanation for these unanticipated and therefore unhypothesized findings might be admission criteria and the type of students attracted by or selected into each program. Further research in the area of creativity, admissions criteria and admissions process might yield additional information to support this interpretation.

A second unexpected finding was that the Fluency, Flexibility and Originality scores for each school were all approximately the same at the first measurement but varied as the students progressed through the program (see Figures 5, 6 and 7, p. 64-66). The Fluency scores stayed relatively constant, Flexibility scores decreased and the Originality scores tended to increase. This finding suggests that at the beginning of the dental hygiene program, the students' creative energy and ability were relatively equal on all three components of creativity. Observation of Figures 5, 6 and 7 indicate that the programs might have influenced the Flexibility and Originality components of the Torrance Tests of Creative Thinking even though no statistically significant differences were found except between alternate forms of the testing instrument. The programs might be influencing Flexibility scores to decrease because of the rote-memory and one-right-answer which is sometimes found in dental hygiene education.[13] In

contrast, the program might be encouraging students to ask creative questions, work in a climate of psychological freedom, and use independent thinking; thereby influencing Originality scores to increase. Apparently, the programs are affecting the different components of creativity. Students begin the programs with Fluency, Flexibility and Originality scores relatively equal; however, their scores vary as they progressed through the program.

Hypothesis 4. Analysis of data failed to reject the null hypothesis of no statistically significant interaction effect between four academic semester levels and three accredited dental hygiene programs as measured by Fluency, Flexibility, Originality and Total creativity scores. No differential levels of creativity were found among the students from three different dental hygiene programs throughout four academic semesters. The test administrator gave all groups the same instructions and motivational encouragement at all four measurements, as indicated in the Torrance Tests of Creative Thinking Direction's Manual and Scoring Guide.[43] This factor might have contributed to the finding of no interaction effects.

Generally, the results of this study indicate that the level of creativity does not change during the basic two year dental hygiene curriculum. Nursing studies, which have curricula structures similar to dental hygiene, have suggested that some nursing programs produce no change in the level of

creativity, some promote creativity and others inhibit it.[37] Considering the similarities between nursing and dental hygiene programs, i.e., stress on convergent thinking, technical nature of duties and tasks, frequency of problems requiring structured solutions only and the dependence on the doctor,[37] it is interesting to note that certain nursing studies support this current study on dental hygiene programs. These factors are all consistent with discouraging creativity, yet creativity has stayed the same or even increased in some nursing studies. Thomas[37] reported that Hart found no statistically significant differences on verbal measures of creativity, i.e., Fluency, Flexibility and Originality. When using samples of nursing students, Torrance[44] found differences on verbal creativity in that third-year students scored significantly higher than first-year students. These studies indicated the curriculum did not inhibit, but enhanced creativity in some nursing students. Perhaps nursing and dental hygiene programs are stressing aspects of the program which might enhance creativity and not concentrating on the discouraging factors.

In comparison, some studies have suggested that nursing programs discourage creativity, thus conflicting with the current research findings. Abdel-Razik's and Eisenman's studies, as reported by Thomas,[37] and Thomas showed "a decrease in measured creativity in students moving through a nursing program...."[37] The contradictions in results of the various nursing studies--i.e., some programs encourage, some

discourage and some produce no change in creativity--indicate that different programs might affect the creativity of their students differentially. Ventura[46] compared nursing students in the last year of study in diploma, associate degree and baccalaureate degree programs to determine if there was a difference in creative thinking. Her findings suggest that nursing students enrolled in the three basic nursing programs differ significantly in their testing of creativity.

Another area of difference between nursing and dental hygiene programs is the ranking of different types of programs on creativity scores. The current dental hygiene study demonstrated a consistent ranking of dental hygiene programs on creativity scores. Generally VCU scored highest, ODU scored in the middle and VWCC scored lowest on all measures of creativity. Ventura's[47] study found that there were no specific ranking of programs on the creativity scores in the nursing programs she studied. No one type of program scored consistently higher or lower on all measures. This finding is not consistent with the current study and might indicate that the various degree granting dental hygiene programs and nursing programs differ.

The only study which could be found investigating creativity in dental hygiene students lends support to the current research. Jarrett, Johnson and Darby's[20] report on dental hygiene students supports the conclusion that the level of creativity remains relatively constant throughout the two year dental hygiene curriculum of the three programs (ODU,

VCU and VWCC also were used in their study). Neither study supports the hypothesis that a technically oriented, structured, science education, such as dental hygiene, discourages or inhibits creative thinking.[18] Perhaps the dental hygiene curriculum provides a psychological and educational climate which does not alter creative thinking.[4,29,47]

As presently researched, the three Virginia dental hygiene programs while not discouraging creativity, do not seem to provide a climate conducive to increasing the creative thinking abilities of their dental hygiene students. Similar to nursing studies,[37,45,46] further research might provide information indicating that different dental hygiene programs affect the level of creativity in their students differentially. The general indication is that, in the area of creativity, nursing and dental hygiene programs might not affect their students similarly.

Although every attempt was made to follow testing instructions according to the direction's manual,[43] it is important to consider certain limitations in the methodology of this study when interpreting the results. Each student had to complete all four tests in order to be included in the final analysis (see Appendix A). Low response rate was attributed to student attrition and absenteeism. Since only 46 of the 73 dental hygiene students in the study could be actually utilized, small sample size might have affected the results.

Only three dental hygiene programs in Virginia were

used in the study; therefore, findings can be applied only to these schools. Programs in various states with different laws governing dental hygiene practice might produce unique results. A larger number of schools and/or greater sample size is needed to generalize the research findings to all dental hygiene curricula.

An unequal class size factor was attributed to the use of intact groups and the capabilities of each program in accommodating the maximum number of students. ODU had twice as many students participating in the study as VCU and VWCC (see Appendix A). The use of unequal class size might have led to a larger error of measurement in some of the group means analyzed.

Observed statistically significant differences between measurements might have been the result of a lack of equivalency of alternate Forms A and B of the Torrance Tests of Creative Thinking. While results show statistical significance, they lack practical significance. For example, the analysis revealed that there is a difference in creativity scores and that the program is affecting the students' creativity, yet there might actually be no difference in scores thus the dental hygiene programs might not be producing a change in creativity as students progress through the program.

Chapter 5

SUMMARY AND CONCLUSIONS

Numerous studies have investigated the identification and development of creative thinking abilities in nursing, engineering and general college education students. The majority of research suggests that a technically oriented, science curriculum inhibits students' creativity.[22,30,40] The possibility of a dental hygiene curriculum inhibiting creativity has not been widely explored. Only one study could be found that investigated creative thinking in dental hygiene students.[37]

The purpose of this investigation was to examine the effects of the dental hygiene curriculum on students' creativity throughout the basic two years of dental hygiene study. A secondary purpose was to determine if various accredited dental hygiene programs affect creativity in their students differentially. Over a two year period, Verbal Forms A and B of the Torrance Tests of Creative Thinking were administered to intact groups of students at three dental hygiene programs in Virginia at four academic semester levels. A total of 46 students were present for all four tests; their scores were used in the analyses. Form A was administered at the first and third testing session and Form B was administered at the second and fourth sessions in order to reduce

possible practice effects. A 3 X 4 factorial research design with repeated measures was used. Data were analyzed using a two-way analysis of variance to determine main and interaction effects of the independent variables, four academic semester levels of the dental hygiene students and three accredited dental hygiene programs, on the dependent variables, Fluency, Flexibility, Originality and Total creativity scores of the Torrance Tests of Creative Thinking.

Data analysis revealed that many of the null hypotheses and subhypotheses were not rejected. The results obtained in this study demonstrated no statistically significant differences in Total creativity scores of students at ODU, VCU and VWCC. The only statistically significant difference in Fluency subtest scores was a VCU between the second and third, and the third and fourth measurements. This difference was attributed to an unknown extraneous variables. No statistically significant differences were found in Fluency subtest scores at either ODU or VWCC. Results of this investigation also demonstrated no statistically significant differences among the three accredited dental hygiene programs in Fluency, Flexibility, Originality or Total creativity scores. Also, no statistically significant interaction effects existed among the four academic semester levels and the three dental hygiene programs.

In the Flexibility and Originality subtest scores, results demonstrated that there were statistically significant differences at all three schools. All of the statistically

significant differences were between Verbal Form A and Verbal Form B of the Torrance Tests of Creative Thinking. One explanation is that the differences might be a result of the lack of equivalency of the alternate forms, rather than an actual statistically significant difference in creativity. Therefore, statistically significant differences in Flexibility and Originality scores might not have existed if only one verbal form of the testing instrument was utilized.

Findings of this study suggest the following conclusions:

1. The dental hygiene curriculum does not appear to influence creativity in dental hygiene students, i.e., there is not an increase or decrease in creativity of dental hygiene students.

2. The level of dental hygiene students' creativity does not appear to change throughout the basic two years of the dental hygiene curriculum (considering the lack of equivalency of alternate forms).

3. Various types of accredited dental hygiene programs do not affect creativity in their students differentially.

4. The dental hygiene curriculum has no interaction effect on creativity in dental hygiene students at different semester levels.

Implications of this study suggest that dental hygiene curricula might potentially influence student creativity. The technically oriented, structured science curricula of dental hygiene might differ enough from other types of science curricula to maintain creativity. The programs might be

providing creativity enhancing experiences to counter-balance the creativity discouraging aspects of the curriculum. Even though no decrease in creativity was found, neither do the dental hygiene programs appear to be encouraging creativity in their students.

Unhypothesized and nonsignificant trends in Flexibility and Originality scores were found. The Flexibility scores of all three programs tended to exhibit a decreasing trend and the Originality scores exhibited an increasing trend (see the first and third measurements, and the second and fourth measurements in Figures 1-4, p. 60-63). Certain aspects of the program might be influencing the Flexibility component of creativity to decrease. This decrease could be attributed to the rote-memory and one-right-answer philosophy which sometimes is found in dental hygiene education.[20,32] In contrast, the programs might be contributing to an increase in the Originality component of creativity by providing certain aspects of the learning environment which are conducive to encouraging creativity. Students might be provided with appropriate creative role models,[31] provided psychologically safe learning experiences,[29] encouraged to use the inquiry method and ask creative questions,[11] and taught by instructional methods which are conducive to enhancing creativity.[8,18,26,34,40]

Another unhypothesized finding suggests that there is a generally consistent ranking of programs according to students' Flexibility, Fluency and Originality scores.

Students at VCU generally scored higher than ODU and VWCC students. ODU students generally scored in the middle and VWCC generally scored lowest. In contrast to these findings, most research suggests that furthering one's formal education does not automatically increase creativity.[18,29,51]

Considering the results and limitations of this investigation, the following recommendations for future research are presented:

1. Conduct additional studies to determine if the dental hygiene curriculum can encourage or discourage creativity in students.

2. Replicate this study utilizing dental hygiene educators and graduate students.

3. Test the same students used in this study to determine if their creativity levels continue the observed trends.

4. Replicate this study by using Verbal Form A only or Verbal Form B only. (Even though Torrance[42] recommends that the alternate forms be used in studies of pre- and post-test designs both in descriptive studies and in experiments intended to bring about differential kinds of growth or change,[42] most studies[37,44,46] have not done so.)

5. Investigate the role of student selection and admission practices in relation to creativity in dental hygiene students.

6. Investigate the teaching methodologies and techniques which might be conducive to creativity for possible inclusion in the dental hygiene curriculum.

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Appendix A

Number of Students Participating in Each Administration of the TCTT

	ODU	VCU	VWCC
First Measurement First Year First Semester	41	15	14
Second Measurement First Year Second Semester	32	14	8*
Third Measurement Second Year First Semester	39	14	14
Fourth Measurement Second Year Second Semester	33	14	13
Total Number of Students Who Completed All Four Tests	26	12	8

*Low turnout because of inclement weather

Appendix B

Consent Form

I _____ DO / DO NOT give my consent to participate in this study.

I understand that I may leave this study at any time with no reciprocation.

I understand that the results of this study may be published or orally presented, but that I will in no way be individually identified.

Participation in this study is strictly voluntary and no monetary compensation will be given.

Any information received from this study will be utilized to develop researchers' understanding of thinking abilities.

I understand that I will be asked to participate in four similar activity sessions consisting of approximately one hour, over a two year period.