AN INVESTIGATION INTO THE TYPES OF JUNIOR HIGH SCHOOL SCIENCE CURRICULA PRODUCED THROUGH THE UTILIZATION OF MACDONALD'S THREE CURRICULUM DEVELOPMENT MODELS

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CURRICULUM STUDIORUM

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The special function of curriculum development is to select and organize the content of a curriculum so that the desired goals of the curriculum are most effectively achieved[1]. The importance attached to this function in science education can be seen in the large number of studies undertaken on the selection of content for science curricula in North America. An examination of these studies shows that a variety of methods and persons have been used in the selection of content. This can also be seen in the different propositions for curriculum development which have been made on this topic. It is in this area of content selection during curriculum development that concern has been expressed in recent years[2,3]. The methods and the persons utilized in both the studies and the propositions are not without their source for support. However, the resolution of this problem of the effect of different development models on curriculum content awaits further information, and it is in this area of concern that the present study aspires to make a contribution.

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[1] Robert S. Zais, Curriculum Principles and Foundations, New York, Thomas Crowell Co., 1976, p. 322.

[2] James B. Macdonald, "Curriculum and Human Interests", in Curriculum Theorizing: The Reconceptualists, Wm. Pinar, Ed., Berkeley, California, McCutchan Publishing Corp., 1975, p. 283.

[3] Elliot W. Eisner, and Elizabeth Vallance, Eds., Conflicting Conceptions of Curriculum, Berkeley, California, McCutchan Publishing Corp., 1974, p. 2, 14-18.

INTRODUCTION

The purpose of this study is to obtain information regarding the selection and organization of content in a science curriculum when different methods and persons are involved. The framework chosen to obtain this information is Macdonald's three curriculum development models[4]. Macdonald has suggested that curriculum developers derive considerable direction in the selection and organization of curriculum content from the value positions they hold. To illustrate the different value positions possible in curriculum development he makes reference to the basic positions one may take in the field of psychology[5]. He claims that it is these different value positions in curriculum development which affect curriculum thinking and thereby make for differences in curriculum decisions, in particular, those decisions pertaining to the selection and organization of the content for a curriculum. To substantiate his thinking with respect to curriculum development, Macdonald identified three "ideal types" of curriculum development models which influence the selection and organization of content for a curriculum that are in line with three models identified by Eisner and Vallance[6].

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4 James B. Macdonald, Op.Cit. p. 292-293.

5 Ibid. p. 284.

6 Eisner and Vallance, Op.Cit. p. 9-14.

Macdonald's three curriculum development models are known as the: 1) Linear-Expert, 2) Circular-Consensus, and 3) Dialogical. He claims that the basic value position inherent in the Linear-Expert model is control, and that this "control interest has mainly been associated with the subject matter or disciplines approach"[7]. This concept of curriculum development is concerned with the modes of inquiry and structures of a discipline. The value position inherent in the Circular-Consensus model is concerned with the problems of living, or social issues; it reflects a practical concern for knowledge rather than the more theoretical concern of the disciplines. The Dialogical model is concerned with the emerging needs of the student; its emancipatory interest fosters self-realization. Macdonald considers that it is the application of the values around the kind of human interest found in each model which leads to varying results in curriculum design.

This study, based on Macdonald's description of model typology, seeks to answer the question: Do the different value positions suggested by Macdonald to be inherent in each of his curriculum models result in different content and its organization? In particular, does the content selected and organized

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[7] James B. Macdonald, Op.Cit. p. 290.

for a junior high school physical-science curriculum differ depending on the type of curriculum development model used by the developer?"

This study is organized into five chapters. Chapter One reviews the literature and has two objectives. The first objective is to present Macdonald's curriculum development models which form the basic framework upon which this investigation into content selection is based. The second objective is to present a number of propositions for curriculum development which have been made by various curriculum conceptualists and which give support to the models identified by Macdonald. The chapter concludes with a summary of the models, the isolation of the problem under investigation, and a statement of the hypothesis relevant to that problem.

The second chapter presents an historical perspective of curriculum development in the sciences. The purpose of this chapter is to show how the constant change in social and cultural conditions affect values in curriculum thinking regarding the selection of content. Initially, it examines the background to the problem, followed by a number of studies which depict the type of methods and kind of persons utilized in content selection. The chapter concludes with an analysis of the various methods used in content selection as further evidence from the field for the need of this investigation. Chapter Three presents the design of the study which describes the methodological procedure used in the investigation. A major concern of this chapter was the compilation of a list of content selection criteria which form the framework of the questionnaire. Chapter Four presents the results obtained from the teachers' evaluation of science curricula which were representative of Macdonald's curriculum development models. The object of Chapter Five is to discuss the results of the science teachers' evaluation with reference to their implications for Macdonald's models and their practical applications in the field. The study closes with a presentation of the conclusions made from this investigation into the effect of different curriculum development models on the selection of content for a science curriculum.

CHAPTER I

REVIEW OF THE LITERATURE

The selection and organization of content is the special function of curriculum development. During this activity the problem of translating the aims of the curriculum into content requires the developers to make judgments about content priorities. Unfortunately, the kind of value perspectives of the developers involved in curriculum development have seldom been clearly delineated and, as different models are used in developmental procedures, this omission has created problems for those educators involved in curriculum implementation. Such problems existed during the past two decades when many science teachers became disenchanted with curricula they had initially welcomed.

Criticism of science curricula developed during this period alleged that excessive pressure on students studying science had resulted from stringent secondary school curricula[8]. Such curricula, it was claimed, lacked interdisciplinarity, reference to practical applications, or relevancy for the adolescents concerned with the influences of science and technology[9]. Declining enrollments and increasing failures among the most able students were

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[8] Philip Abelson, "Excessive Educational Pressures", in Science, Vol. 156, May 12, 1967, p. 741.

[9] Daniel Tanner, Secondary Curriculum: Theory and Development, New York, The MacMillan Co., 1971, p. 128.

attributed to the excessive pressures associated with physical-science curricula such as chemistry[10]. However, it is possible that such problems and criticism arose from a lack of knowledge of the different kinds of value perspectives that were involved in the curriculum development models used. The resolution of the problem regarding the effect of different curriculum development models on content selection awaits further information, and it is in this area of concern that the present study aspires to make a contribution.

The purpose of this study is to obtain information concerning the selection and organization of content for science curricula when different development models are involved. The framework chosen to obtain this information is based on Macdonald's three curriculum development models[11]. Support for the use of these models can be found in the different proposals for curriculum development made by various curriculum conceptualists and the fact that each model describes developmental procedures observed in the field. The support from both the theoretical and practical areas for the models gives credence to their worth in this study.

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10 L. Carroll King, "High Student Failure Rate Serious Problem", Chemical and Engineering News, Vol. 45, Feb. 20, 1967, p. 44.

11 James B. Macdonald, Op.Cit. p. 292-293.

REVIEW OF THE LITERATURE

This chapter presents a review of the literature in two sections. Section one presents Macdonald's curriculum development models which will serve as the framework for this investigation into the selection of content for a science curriculum. The second section presents a number of propositions for curriculum development which have been made by various curriculum conceptualists. Inherent in each proposition are value perspectives which support one of Macdonald's models. From an analysis of these two sections the problem will be isolated and the hypothesis stated.

1. Macdonald's Curriculum Development Models

Macdonald believed that it was not possible for curriculum developers to deal with the curriculum as a purely objective phenomenon. He claimed that from the outset the developer maintains a stance or an orientation to curriculum phenomena. Such orientations affect the decisions made in curriculum development and are reflected in the designs that result from such judgments:

> Thus, subject matter curricula are sets of value judgments that prize knowledge (cultural heritage) over social uses or personal interests. Problems of living designs prize society first; and emerging needs proposals have individual welfare primarily in mind[12].

In effect, the resulting curriculum designs are patterns of

[12] Ibid. p. 284.

value judgments and such patterns have also been recognized by Hyman[13], and, Eisner and Vallance[14].

The three "ideal types" of curriculum development model identified by Macdonald are known as: 1) Linear-Expert, 2) Circular-Consensus, and 3) Dialogical. He considered that inherent in each one of the three models are basic human intentions grounded in what Polanyi refers to as "tacit dimensions"[15]. It is the application of these values during developmental procedures which leads to varying results in content selection.

The three curriculum development models identified by Macdonald are related to "the cognitive human interests of control, consensus, and emancipation"[16]. These human interests are reflected in the following outlines of his models:

1. The Linear-Expert model is based upon the basic human interest of control. The developmental procedures in this model are dominated by experts who attempt to maximize control by the discipline. The whole process therefore

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13 Ronald T. Hyman, Ed., Approaches in Curriculum, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1973, p. 5.

14 Eisner and Vallance, Op.Cit. p. 1-12.

15 Michael Polanyi, The Tacit Dimensions, New York, Doubleday Co., 1966, p. i-xi, 1-108.

16 James B. Macdonald, Op.Cit. p. 292.

"is controlled and monitored with specific goals in mind, and it is the experts who make the initial and final decisions about the validity of the content and process"[17]. The nationally-developed science curricula produced in the United States ~~during the~~ 1960's are examples of discipline-controlled curriculum developments. Most of these curriculum projects were initiated by discipline scholars at the university level who prepared the materials and tried them out in the schools. The experts then obtained feedback regarding the results in the classroom; then rewrote, piloted, and finally revised the curriculum materials for broad distribution[18]. In this manner, the discipline scholars controlled the development of the curriculum and thereby maintained the integrity of the discipline.

2. The Circular-Consensus model is based upon the basic human interest of consensus. This model is commonly referred to as the "grass roots" approach to curriculum development since it involves teachers, administrators, and community in the developmental process, with experts on call if needed[19]. All members of this group are regarded as being of equal rank in the deliberation process. In this model, there is a

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[17] Ibid.

[18] Ibid.

[19] Ibid.

conviction that unless teachers are present and participate in the process of curriculum development, the curriculum materials which emanate from this process will be misused in the classroom[20]. It is recognized that there is some rhetoric of control in the developmental process of this model but that consensus and communication are the more important outcomes.

3. The Dialogical model is based upon the emerging needs of the student and is supported by two propositions found in the next section. The developmental process in this model involves the educator entering into a dialogue with students and it is from an assessment of the results of this discourse that the curriculum emerges. Initially, the teachers indentify student leaders with whom the educators engage in dialogue from which they attempt to establish their needs. The adults then attempt to provide a match between the cultural resources known to the adults and the expressed needs and interests of the students[21]. In this manner, the model actively involves the student in curriculum development[22]. During the developmental process used in this model the needs of the student are given priority over the social and discipline content of the curriculum.

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[20] Ibid.

[21] Ibid. p. 293.

[22] Ibid.

Inherent in each of these models are the values and perspectives of the curriculum developers which have an influence on their decisions for content selection. A number of different propositions that were made by curriculum conceptualists and which have the same important attributes as Macdonald's models will be presented in the next section.

2. Propositions for Curriculum Development

This section is devoted to presenting those areas of the curriculum literature which are related to this investigation since they deal with the selection and organization of content for a curriculum. In particular, it will present the different value perspectives found in the propositions made by various curriculum conceptualists which have a bearing on this study.

The first two propositions to be examined will be representative of those which emphasize the importance of the discipline's control over content selected for a curriculum. These propositions will be followed by two others which value the needs of society and see the role of consensus in curriculum development as an essential. Finally, two proposals which are concerned with the growth needs of the students and place emphasis on these needs will be examined. The section will close with a summary of those aspects of the various propositions for curriculum development considered pertinent to this study.

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Discipline-Oriented Conceptions of Curriculum

The following two propositions for curriculum development are concerned with one of the three sources recommended by Tyler[23], subject matter specialist. The first proposal is by Phenix[24], and the second by King and Brownell[25]. Both of these propositions stress the importance of the disciplines in curriculum development. The proponents consider that only knowledge found in the disciplines is suitable for a curriculum. Their argument is that since discipline scholars have an intimate knowledge of the disciplines which allows them to make intelligent decisions, they should control the process of curriculum development.

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23 Ralph Tyler, Basic Principles of Curriculum and Instruction, Chicago, University of Chicago Press, 1949, p. 1.

24 Philip H. Phenix, "The Disciplines as Curriculum Content", Curriculum Crossroads, H. Passow, Ed., New York, Teachers College, 1965, p. 189-196.

25 Arthur R. King, Jr., and John A. Brownell, The Curriculum and the Disciplines of Knowledge, New York, John Wiley and Sons Inc., 1966, p. 1-221.

The proposition made by Phenix[26] for curriculum development will now be examined. He viewed the discipline as "a conceptual system whose office is to gather a large number of cognitive elements into a common framework of ideas"[27]. He considered that the goal of a discipline is the simplification of understanding by the use of significant patterns and relationships. The systematic categorization found in the discipline "renders the profusion of cognitive experiences intelligible"[28] and thereby serves as a valuable resource of materials for curriculum development. An understanding of the categorization of knowledge found in the disciplines should allow the curriculum developer to make intelligent decisions in the selection and organization of content for a curriculum.

Evidence as to the usefulness of content for a curriculum is provided by the scholars who are intimately associated with the discipline. These scholars are referred to as specialized men of knowledge "who have identified and followed the ways of maximum learning of their discipline"[29].

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26 Philip H. Phenix, Op.Cit. p. 189-196.

27 Ibid. p. 142.

28 Philip H. Phenix, "The Architectonics of Knowledge", in Education and the Structure of Knowledge, Stanley Elam, Ed., Chicago, Rand McNally & Co., 1964, p. 45.

29 Ibid. p. 49.

Furthermore, Phenix claimed that the "systematic learning experiences of the men of knowledge would provide useful standards for anyone who sought understanding in their disciplines"[30]. Thus, those scholars who have an expertise associated with a discipline are extremely useful in the selection and organization of content for a curriculum.

The expertise possessed by the discipline scholars allows them to apply the principles of content selection outlined by Phenix. It is this knowledge which enables them to select:

> 1. Content of instruction which is drawn entirely from the fields of disciplined knowledge,
> 2. items of knowledge that are particularly representative of the field as a whole,
> 3. content that exemplifies the methods of inquiry and modes of understanding in the discipline, and,
> 4. materials that should arouse imagination[31].

These principles reveal Phenix's concern that only authenticated knowledge should be in a curriculum, and that key concepts economize learning[32]. The intimate knowledge of the discipline possessed by the discipline scholar allows him to satisfactorily apply these principles in the selection and organization of content for a curriculum.

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[30] Ibid. p. 50.

[31] Philip H. Phenix, Realms of Meaning, New York, McGraw-Hill, 1964, p. 10-12.

[32] Philip H. Phenix, Op.Cit. p. 189.

The second discipline-oriented proposition is by King and Brownell[33]. These curriculum conceptualists are in agreement with Phenix regarding the academic competence of an educator required to select content for a curriculum. They stated that the curriculum specialist should "function as the conscience of the discipline in the schools and as a conscience to the full body of the discipline about its responsibility to the young"[34]. In their opinion the curriculum specialist should function as a discipline scholar by making contributions at the university level and must also maintain the integrity of the discipline in the school's curriculum. As a person with expertise in the structure of the discipline, the scholar is expected to exert influence and play a dominant role in contemporary curriculum development. King and Brownell insisted that the curriculum specialist be academically able in the discipline for which the curriculum is being developed and serve as a resource person to the curriculum generalist whom they regarded as an administrator in the field of education.

In this distinction between curriculum specialist and generalist, King and Brownell maintained that the scholar's responsibility was to the discipline in curriculum development.

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33 King and Brownell, Op.Cit. p. 1-221.

34 Ibid. p. 166.

They considered that the content selected should be the fundamental ideas of the discipline and "the fundamental can only be established by thinkers in the discipline"[35]. As the thinker in the discipline, the curriculum specialist occupies an important role in content selection if the true nature of the discipline is to be reflected in the curriculum.

To maintain the true nature of the discipline the curriculum specialist must ensure that the curriculum be an epitome of the discipline in every respect[36]. It is thus essential that priority be given to the judgments of the specialists in the analysis, criticism and appraisal of content in curriculum development[37]. As the representative of the intellectual community, the specialist acts as the custodian of the fundamentals of the discipline. Therefore, the curricular decisions pertaining to the selection and organization of content for a curriculum belong to the specialist.

These discipline-oriented curriculum conceptualists are examples of that perspective of the curriculum which considers that only the knowledge found in the discipline is suitable for a curriculum. For that reason, the process of curriculum development should be dominated by experts who

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35 Ibid. p. 185.

36 Ibid. p. 190.

37 Ibid. p. 203.

are capable of making intelligent decisions pertaining to the selection and organization of content for a curriculum.

The human interests reflected in both of these conceptions of a curriculum are discipline-oriented. This orientation considers that the most powerful products of man's intelligence are to be found in the academic disciplines and that the curriculum is the medium through which the student can acquire this knowledge. Also, it is only possible to build such a curriculum when the developmental procedures are dominated by discipline scholars. Other propositions for curriculum development have a different viewpoint and value societal needs above those of the disciplines. Such values can be seen in the two following propositions which consider social values and representatives of the community employing a group process for curriculum development.

Societal Conceptions of Curriculum

The first proposition examined is that by Schwab[38] which strongly supports social values and the role of consensus in curriculum development. He considered that although the knowledge of the disciplines possessed by the

[38] Joseph J. Schwab, "The Practical 3: Translation into Curriculum", in School Review, Vol. 81, No. 4, August, 1973, p. 501-522.

scholars made them indispensable for the task of curriculum development, their lack of knowledge in four other areas prevented their being the sole arbiters. These areas are concerned with knowledge of the learner, the milieu, the teachers, and the curriculum. Schwab considered that all of these areas must be represented and the curriculum work involved must be done in collaboration[39]. Each member of the group involved in this model should recognize the concerns, values, and operations of the others and seek agreement among themselves in the judgmental factors in curriculum development.

Schwab recognized that such a group process in curriculum development will ultimately arrive at a body of educational alternatives from which choices must be made. The choices will not entirely satisfy the consensus and values of any one participant but will "satisfy the collective more than does any other constellation of educational means"[40].

Each person involved in the translation of the discipline into a curriculum must recognize that the scholarly materials are the resource and that the integrity

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[39] Ibid. p. 501.

[40] Ibid. p. 502.

of the discipline must be maintained. Schwab[41] considered the role of the scholar as one that ensures that all materials in the curriculum are authentic to the particular discipline and in no way distorted. Those persons with knowledge of the learner will be concerned with the problem of matching curriculum materials with the learner's needs and interests. The representatives of the milieu will use their knowledge to develop a curriculum which is relevant to the students' needs in the community. Those persons who have knowledge of the teachers are able to judge the various aspects of the curriculum with respect to what teachers can and are willing to do. Finally, the educator with expertise in curricular development will instigate and administer the translation of scholarly materials into a defensible curriculum.

This proposition for curriculum development saw representatives of the four commonplaces of equal rank which "must be included in the deliberating group from the start"[42]. They are: the learner, the teacher, the milieu, and the subject-matter. Basically this proposition involved the bringing together of the values inherent in each of the four common-places to ensure that they will be weighed against each other throughout the entire developmental process.

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[41] Ibid. p. 502-508.

[42] Ibid. p. 512.

The second proposition for curriculum development which is also supportive of the use of a group process and consensus is one made by Walker[43]. His naturalistic model for curriculum development has three elements: "The curriculum platform, its design, and the deliberations associated with it"[44]. He believed the curriculum platform to be the developer's ideas of what is, and a vision of what ought to be. Such ideas represent the values and beliefs that guide the development of the curriculum. However, the process of deliberation is seen as the important element of curriculum development since it is the process by which discussion among members of the group occurs and consensus is achieved.

The importance that Walker attached to the developmental process is seen in his perception of the main operations in deliberation. They are:

> formulating decision points, devising alternative choices at these decision points, considering arguments for and against decision points and decision alternatives, and finally, choosing the most defensible alternative subject to acknowledged constraints[45].

He considered that the decisions which result from such deliberation are more readily defended or justified. And,

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[43] Decker F. Walker, "A Naturalistic Model for Curriculum Development", in <u>School Review</u>, Vol. 80, No. 1, Nov. 1971, p. 51-65.

[44] <u>Ibid</u>. p. 52.

[45] <u>Ibid</u>. p. 54.

although such deliberation may take many forms, the most common practice today is argumentation and debate by a group of people. During such debate the beliefs and values of the individuals are communicated to the other participants; thus an understanding which may result in consensus is achieved.

These perceptions of curriculum development exemplify those propositions which view the role of education and curriculum content within the larger social context. Such a curriculum requires the use of a group process in which representatives of the various aspects of the community attempt to reach a consensus throughout the developmental processes. However, propositions for curriculum development made by other conceptualists regard the curriculum as the medium which aids the student in personal growth. Such propositions consider that the needs of the students should be a major influence in curriculum development. These will be examined next.

Humanistic Conceptions of Curriculum

The following propositions for curriculum development stress the need for the curriculum to accommodate the needs of the students. The main focus of this perception is concerned with the selection of content which encourages man's personal and interpersonal development. Such a concern for the student's development is shown by Sergiovanni and Starratt[46] when they claimed that: "the purpose of general education is to lead the human person to a discovery and appreciation for its own sake, of himself and others and the world about him"[47]. They considered that curricular programs should be developed so that the students can grapple with contemporary problems in a personally meaningful way. This activity should enable students to "continually seek for the human significance of what he learns in the realms of knowledge"[48]. It is therefore necessary to develop a curriculum which incorporates the pressing problems of the day and which is committed to the individual's personal development.

An important basic assumption that was made by Sergiovanni and Starratt is that "the educator's primary function is to become obsolete"[49]. They assumed that the mental growth of the students should allow them to pursue their own learning by using the knowledge and skills the educator has helped them acquire. This assumption is illustrative of their concern that the growth needs of the

[46] T. Sergiovanni and R. Starratt, Emerging Patterns of Supervision: Human Perspectives, New York, McGraw-Hill, 1971, p. 237.

[47] Ibid.

[48] Ibid.

[49] Ibid. p. 261.

student take precedence over all other curriculum considerations, thus:

> Curricular-instructional programs should be designed in conformity to the growth patterns of students. The human growth needs of the students should never be subordinated to objectives dictated by the needs of society and the demands of the disciplines[50].

They envisaged the continual growth of the individual in which he moves beyond independence to interdependence, to increased self-activity in the process of becoming a mature human person. The growth of the individual is thereby seen as a major curriculum concern. The selection and organization of content for such a curriculum should reflect this influence.

Sergiovanni and Starratt saw the student's concern as growth needs; for, "as the social needs become relatively satisfied, the student begins now to seek recognition for his own achievements"[51]. They based their perception of curriculum development on Maslow's description of human growth[52] in which an individual transcends those activities involved in "becoming" to that state in which he enjoys "being" who he is. The authors believed that by providing

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[50] _Ibid_. p. 262.

[51] _Ibid_. p. 264.

[52] _Ibid_. p. 243.

more experiences of achievement in the curricular-instructional program:

> The student could feel more enthusiastic about learning, (...) accept more autonomous responsibility for his learning, (...) and to seek fulfillment and self-actualization through learning activities[53].

The concerns of the student were seen to be a vital element in the school's curriculum if an emotionally healthy maturation of the individual is to occur.

Weinstein and Fantini[54] argued along similar lines and constructed a model for developing a curriculum of affect. They considered that education in a democracy should "have a broad human focus which is best served by educational objectives resting on a personal and interpersonal base and dealing with students' concerns"[55]. To achieve this end the content of the curriculum should be personally meaningful and relate cognition to the learner's concerns for himself and for others. Such a curriculum would enable the student to live harmoniously within the biosphere.

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[53] Ibid. p. 264-265.

[54] G. Weinstein and M. Fantini, Eds., Toward Humanistic Education, A Curriculum of Affect, New York, Praeger Publishing, 1970, p. 3-223.

[55] Ibid. p. 18.

Three major patterns of the learners' concerns were identified by Weinstein and Fantini[56]. The first major concern of the learners was about their self-image, how they were perceived by themselves and by others. The second was disconnectedness, a wish to establish links with others, with society, and to know where one fits into things. Control over one's life was the students' third concern. Weinstein and Fantini stated that these needs of the students must be "recognized and understood if the teacher is to develop a curriculum that meets the pupils' concerns"[57]. In this respect, curriculum developers must recognize that the student body is an essential resource for the development of a curriculum.

These two perceptions of curriculum development are illustrative examples of those propositions which consider that the needs and interests of the students are a controlling influence in the selection and organization of content for a curriculum. In effect, the curriculum developers should match the cultural knowledge and resources known to adults with the growth needs and interests of the students for whom the curriculum is intended.

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[56] Ibid. p. 35-36.

[57] Ibid. p. 39.

Summary

In summation, inherent in the three "ideal types" of curriculum development model identified by Macdonald are values and perspectives peculiar to a particular model and, therefore, different to those in his other two models. Furthermore, Macdonald considers that these different values and perspectives influence the decisions made in the selection and organization of content for a curriculum.

The various propositions for curriculum development examined in this chapter illustrated the particular values and perspectives of the conceptualist involved. Since these propositions reflect the same values and perspectives found in Macdonald's three development models this agreement is readily identified with and gives credence to the validity of the models.

Initially, the propositions made by Phenix, and King and Brownell, could easily be associated with the discipline-oriented approach to curriculum development in Macdonald's Linear-Expert model. Both the model and the propositions stressed the importance of the discipline's content and reflected values that prize knowledge over all other curriculum considerations. In this respect, knowledge of the discipline was seen as a controlling factor in which discipline scholars maintained the integrity of the discipline during content selection. Thus, agreement could be seen in both the models and the propositions for the primacy of knowledge to which all other curriculum considerations are subordinate. The level of agreement between the values and important attributes for both the propositions and the model indicates support for the credibility of Macdonald's Linear-Expert model.

Agreement could also be seen between Macdonald's Circular-Consensus model and the propositions made by Schwab and by Walker. Both the propositions and the model stressed the importance of social values and viewed the consensus of the participants as necessary for the selection of content in curriculum development. The values held by each participant should be clearly stated and carefully weighed in a deliberate attempt to reach a consensus during the developmental process. The emphasis on societal values and the role of consensus in the propositions provide credence for the above curriculum development model identified by Macdonald.

The humanistic propositions of Sergiovanni and Starratt, and Weinstein and Fantini, prized the emerging growth needs of the students as being the most important concern in curriculum development. These two propositions stressed the necessity to match the knowledge of the culture with the needs and interests of the students. Both the values and attributes inherent in these propositions are in very close agreement with Macdonald's description of his Dialogical model.

In this respect, the propositions give support to this curriculum development model identified by Macdonald.

In general then, the propositions give considerable weight to the notion that there are distinct models for curriculum development and that each model represents beliefs and values peculiar to that model[58,59,60]. Macdonald has claimed that it is these different value positions and perspectives in curriculum development which affect curriculum thinking and thereby make for differences in curriculum decisions, in particular, those pertaining to the selection of content for a curriculum. Such differences in curriculum decisions result in different curriculum designs. From these considerations it should be possible to identify and categorize science curricula according to the paradigm provided by Macdonald for each of his three curriculum development models.

The verification that Macdonald's models result in the selection of different content, and therefore different designs, awaits further information.

This study, based on Macdonald's description of model typology, asks the question: Do the value positions suggested by Macdonald to be inherent in each of his curriculum development models result in different content and content organization? In particular, does the content selected and organized for

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[58] James B. Macdonald, Op.Cit. p. 284.

[59] Ronald T. Hyman, Op.Cit. p. 5.

[60] Eisner and Vallance, Op.Cit. p. 1-12.

a junior high school physical-science curriculum depend on the type of curriculum development model used? Specifically, with reference to a list of criteria for the selection and organization of content that was compiled from the literature (see pages 80-85); does the content of the curriculum differ in the emphasis it gives to:

1. The contemporary content of the discipline?

2. Content that provides for the acquisition of new knowledge?

3. The investigative procedures common to the discipline?

4. Content associated with a social and cultural perspective of a nation?

5. An appropriate balance between the breadth of topics and the depth of their treatment?

6. Its coverage of a wide range of objectives?

7. Material deemed suitable for the intellectual development of the student?

8. Information which relates to the social and cultural norms of the students?

9. Content that meets the needs of the students?

10. Content that meets the interests of the students?

11. The logical development of the disciplines' content?

12. Content that can be utilized by the student in his everyday environment?

13. Material related to the nature of man's affairs?

14. Content which aids man in the growth needs of human development?

15. Knowledge which is sanctioned by governing authorities?

Unfortunately, the literature does not provide information which readily answers these questions, nor has it been verified that the different value positions result in different content. And, as there is now a growing awareness of the importance of content selection and the possibility that different value positions may influence content selection, this study will attempt to obtain such information. In this respect the following null hypothesis was made:

Hypothesis

The content and its organization in junior high school physical-science curricula will not vary depending on the developers' orientation (as identified by Macdonald in his curriculum development models).

The investigation that was conducted in order to test this hypothesis will be described in Chapter Three.

Chapter Two will provide an historical perspective of curriculum development in the sciences which provides further evidence that there are many kinds of curriculum development models.

CHAPTER II

AN HISTORICAL PERSPECTIVE

This chapter is divided into three sections. Section one presents the background to the problem. It illustrates how many factors influenced the changes made in science curricula during the past century. It also shows how professional organizations recognized the changing socio-economic conditions of the time and established special committees to make recommendations to accommodate the changes for a relevant curriculum. In this respect, it is possible to discern the change in values and perspectives that are inherent in the committees' recommendations for the selection of content. The values and the perspectives in the recommendations can be associated with the propositions and models for curriculum development which were presented in the previous chapter.

Section two examines a number of studies which illustrate the different methods that have been utilized in the selection of content for science curricula. These studies are representative of a large number of investigations undertaken in this area of concern and provide evidence of values associated with content that would satisfy the discipline, the needs of society, or the interests of students. The studies in this section will go beyond the junior high school level in order to present a comprehensive cross-section of the various methods and to accommodate the most recent studies in the selection of content for science curricula. In this respect, it should be noted that the junior high school science curriculum is general in nature and includes content found in, or closely associated with other science curricula. The content practices undertaken in these other areas influence the selection procedures for the junior high school science curricula. Furthermore, the methods used in content selection in one science can be found, or replicated, in another and may be considered common to the developments in all science curricula.

The third section presents the validation methods and criteria used in the selection of content for a science curriculum. The criteria for content selection presented in this section are important inasmuch as they can serve as the basis for a questionnaire on content selection. The chapter concludes with a summary.

1. Background to the Problem

Over the years many factors have influenced the selection and organization of content for a school's science curriculum. According to Underhill[61], the changing socio-economic condition was the major influence among many which affected these developmental activities.

Two definite influences on content selection and its organization can be identified during the 1850's. During the

[61] O.E. Underhill, The Origins and Development of Elementary School Science, Chicago, Scott Foresman & Co., 1941, p. i-xii, 1-347.

early years of this decade didactic literature was introduced into North America from Britain. Most of the material used with the didactic method was directed to children's observation and to the study of natural phenomena[62]. A second influential factor was the adoption of the "Pestalozzian object-teaching" method in the late 1850's. In this movement the object-study lessons were specially designed to cultivate the student's perceptive faculty by emphasizing the observation and description of animate and inanimate objects. Unfortunately, the object-teaching method proved to be ill-suited to the purpose and needs of teachers and pupils in a rapidly developing industrial society[63], and changes were made to accommodate the social and economic conditions of the time.

Developments in the fields of science and technology in the latter half of the nineteenth century were reflected in the steady growth of the number of natural science curricula offered by the schools[64]. These new curricula attempted to meet the social needs of a growing technological society and emphasis was placed on content selection that was conducive to the utility of the content for the market place. However, the

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[62] Herbert A. Smith, "Educational Research Related to Science Instruction for the Elementary and Junior High School: A Review and Commentary", in Journal of Research in Science Teaching, Vol. 1., No. 3., 1963, p. 200.

[63] Ibid. p. 200-201.

[64] R. Will Burnett, Teaching Science in the Secondary School, New York, Holt, Rinehart and Winston, 1960, p. 60-61.

preparation of scholars and informed citizens was not overlooked for:

> (...) there is considerable evidence that, although the sciences did not neglect the immediately practical, there was primary concern for the critical thought processes, attitudes, and fundamental understandings[65].

Even though the science curriculum was intended to be practical in terms of the environment the curriculum developers were also concerned with knowledge which might serve the student at a later date in higher education.

During the latter half of the nineteenth century, the college became a major influence over the selection and organization of content for high school science curricula:

> In 1872, Harvard College announced that physics and other high school sciences would be accepted for credit if the courses followed a prescribed outline of content. Other colleges quickly followed suit and until the beginning of the twentieth century, high school curricula, including science, were little but college preparatory[66].

To meet this end, college professors wrote the high school textbooks and developed science curricula in accordance with the standards and requirements set by the colleges. In this manner, high school science curricula were patterned after the college science courses[67], and gave emphasis to factual information.

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[65] Ibid. p. 63.

[66] Claude W. Gatewood and Ellsworth S. Obourn, "Improving Science Education in the United States", in Journal of Research in Science Teaching, Vol. 1., No. 3., 1963, p. 358.

[67] Ibid.

Concern was expressed at the turn of the century that the curriculum did not meet the divergent needs of the students, consequently, most of the students were unable to profit from a high school education[68]. In response to this expressed concern, a general science curriculum was developed that would: appeal to students' interests, needs, and environmental experiences, and stimulate interest in some of the specific sciences[69]. In this manner, the general science curriculum had an important function in terms of a general education. Not only did it point out the laws, generalizations, and principles of science, but it served as a period of exploration and orientation to science for students committed to study science at a higher level.

A rapid growth occurred in the school population between 1910 and 1930. This period saw a continuing emphasis towards general education and changes occurred in the control over the selection of content for science curricula. With the growth of the student population "college professors became preoccupied with their own burgeoning fields of endeavor and paid less and less attention to what was going on in the schools"[70]. As the influence of the colleges over

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68 Burnett, Op.Cit. p. 75.

69 Nathan S. Washton, Teaching Science Creatively in the Secondary Schools, Philadelphia, W.B. Saunders Co., 1967, p. 74-75.

70 Gatewood and Obourn, Op.Cit. p. 358.

science curriculum content decreased, teachers assumed responsibility for the development of high school science curricula, and the writing of textbooks. This controlling influence over the science curriculum by professional educators was maintained until the late 1950's[71].

Several important developments occurred during the 1930 to 1960 period of time when professional organizations undertook evaluations of the role of science in education. During the early 1930's considerable emphasis was placed on the implementation of those principles of science which were of significance to general education[72]. The literature of the professional organizations reflected this concern and in 1932, Part 1 of The Thirty-First Yearbook of the National Society for the Study of Education (N.S.S.E.) was devoted to A Program for Science Teaching[73]. The Committee which produced this report was composed of scientists and educators who advocated basing the selection of science content on personal and social criteria.

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71 Nelson B. Henry, Ed., Rethinking Science Education, Part 1, The Fifty-ninth Yearbook of the National Society for the Study of Education, Chicago, The N.S.S.E., 1960, p. 156.

72 Herbert A. Smith, Op.Cit. p. 204.

73 Guy Montrose Whipple, Ed., A Program for Science Teaching, The Thirty-First Yearbook of the National Society for the Study of Education, Bloomington, Illinois, Public School Pub. Co., 1932, p. i-xii, 1-370.

The report noted that attempts to determine the content for a science curricula had been made by:

> 1. Studies of interests of children and adults as revealed in the questions they ask in response to questions, and, 2. Studies of scientific principles that have recognition in newspapers, magazines, and other printed materials[74].

It was recognized that such studies have inherent weaknesses; in particular, one cannot ask the students questions about phenomena of which they are not aware; consequently, important areas of science may be omitted from a curriculum. Nevertheless, the studies were of a useful nature inasmuch as they "served an important function in keeping alive the feeling that courses do need revision and that the sources of these revisions must be sought through research"[75]. In effect, the N.S.S.E. felt the need for curriculum studies that would delve more deeply into the development of science curricula.

The Committee also considered that the experience and training of college and university teachers were too far removed from the practical classroom experience for which their school science curriculum textbooks were written. Much of the content found in the textbooks at this time was inappropriate and ineffective in the schools' science curriculum. The attempts by classroom teachers and administrators to improve

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[74] _Ibid_. p. 20.

[75] _Ibid_. p. 21.

content "very often resulted in the selection of subject-matter materials that are more appropriate to the interests and needs of the pupils"[76]; however, the Committee felt that some valuable and proven materials had also been omitted. To overcome the weaknesses in selecting content the Committee recommended the involvement of the following persons:

> 1. Subject-matter specialists who insure that the materials are accurate and up-to-date.
>
> 2. Classroom teachers and supervisors who refine the materials in the light of their appropriateness of content, and,
>
> 3. Specialists in the teaching of science who contribute a knowledge of developments in the field with respect to educational research[77].

The Committee considered that these persons were the best qualified to determine the content which was most likely to serve the need of the students.

A lack of guidance in the selection and organization of content for a science curriculum was also recognized by the increasing voluminousness of textbooks and syllabi produced[78]. To avoid such excesses in content the report stressed the necessity to concentrate on the "big ideas" of science and outlined fourteen guiding principles for the selection of general science content. Five of the principles focused on content and learning activities which should be

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[76] Ibid. p. 110.

[77] Ibid.

[78] Ibid. p. 111.

useful to the student during his daily interaction with the environment; they were:

> 1. The course shall consist of a variety of physical and mental activities that shall lead to those knowledges, skills, interests, and attitudes essential to desirable mental and practical adjustments to the environment.
>
> 2. The content of the course shall bear direct significance to life's problems and activities.
>
> 3. The learning activities shall call for experience with materials and forces of everyday life.
>
> 4. The activities shall be such that they lead to the comprehension of the elementary generalizations of science that have important social implications.
>
> 5. The activities shall include abundant opportunities to apply the acquired knowledges, skills, and attitudes in life situations[79].

These selected principles also illustrate the Committee's concern that the selection of content be based on personal and social criteria which were in line with the educational thinking of the time.

The N.S.S.E. devoted Part 1 of its Forty-sixth Yearbook, 1947, to Science Education in American Schools[80]. The Committee for the Society's Yearbook recognized a need for some reorientation in science curricula to accommodate the developments in science and the prevailing social-economic

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79 *Ibid*. p. 208-209.

80 Nelson B. Henry, Ed., *Science Education in American Schools*, The Forty-sixth Yearbook of the National Society for the Study of Education, Chicago, University of Chicago Press, 1947, p. i-xii, 1-306.

conditions. The Society simply stated:

> It is imperative that the science curriculum be reviewed in the light of ~~the~~ advancement in scientific knowledge in areas directly related to impending problems of readjustment entailed by the social and economic dislocations of modernized warfare[81].

Furthermore, the report was concerned that any reorientation which may occur in the science curricula should take cognizance of the associated research and experimentation.

After conducting an analysis of contemporary research in science education it was suggested that the criteria to be used for the selection of content for junior high school science should:

> 1. Be in harmony with the accepted objectives set up for the pupils.
>
> 2. Lead to the inculcation of appropriate scientific attitudes and the understanding of the methods of science.
>
> 3. Encourage the belief in, and practice of, desirable social ideals involving science.
>
> 4. Be of direct use to pupils in their daily living.
>
> 5. Be appropriate for the ability level of the pupil.
>
> 6. Aid pupils in the interpretation of the local and world environment.
>
> 7. Be in harmony with the needs and interests of the pupils[82].

These criteria were condensed from related research activities by the Society's Committee which was concerned that the

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[81] Ibid. p. vii.

[82] Ibid. p. 159.

teaching of general science should deal with the personal-social needs of the individuals and the problems of everyday living. Also, that the content of a general science curriculum should be conducive to the "growth of skills in the use of the elements of scientific method"[83] in problem solving.

It was pointed out that it was not possible to use all of the methods of science on every occasion when new content was introduced, but that educators should assume responsibility for matching content with problem-solving techniques. Furthermore, if "skills in problem-solving, like other skills, are developed only by repeated use day after day in the classroom"[84], then scientific methodology should be practised and encouraged in the daily life of the student. To achieve this end, the Committee outlined the specific skills in problem solving under the following titles:

1. Sensing a Significant Problem.
2. Defining Problem Situations.
3. Studying the Situation for All Possible Clues and Facts Bearing upon the Problem.
4. Making the Best Tentative Explanation or Hypothesis.
5. Selecting the Most Likely Hypothesis.
6. Testing the Hypothesis by Experimental or Other Means.
7. Accept Tentatively or Reject Hypothesis and Test Others.
8. Drawing Conclusions.
9. Applying Principles[85].

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83 Ibid. p. 166.

84 Ibid. p. 166-167.

85 Ibid.

This emphasis on the methods of science and their usefulness in the solution of problems encountered in daily life is a theme to be seen more frequently in the more recent evolution of science education in which importance is attached to the functional aspects associated with content[86].

In 1960, Part 1 of the Fifty-ninth Yearbook of the National Society for the Study of Education was devoted to Rethinking Science Education[87]. Its purpose was to evaluate the increasing significance of science in our culture and to redefine the role of science education. The Committee was concerned that:

> Through the practical applications of scientific discovery our civilization is undergoing constant change. In turn, these changes bring about situations which threaten the well-being of future generations. The welfare of our civilization is now almost wholly dependent upon scientific progress. Society must respond with adequate and intelligent control[88].

The selection and organization of content for the school's science curriculum should accommodate the needs of the students for the changing conditions of a society increasingly dependent upon science.

The report was general in nature and suggestive rather than prescriptive as in the two earlier reports on sciencee education. No attempt was made to identify specific

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86 Burnett, Op.Cit. p. 82.

87 Henry, Op.Cit. p. i-xii, 1-306.

88 Ibid. p. 17.

objectives or the associated content for a particular grade level. The report suggested that the general science curriculum should draw upon all of the various disciplines of science for its content. The organization of the curriculum should "relate to the broad areas of human activity in which the selected content and methods of science play important roles"[89]. This reflected the concern of the Committee that the process element of science, the attitudes and investigative procedures, are as important as its product element, the content.

Another change occurred in the Committee's concern for improving secondary school science. In the selection of content and the organization of science curricula, the report noted that:

> For the past twenty-five or thirty years science curriculum materials, such as courses of study, textbooks, and the like, have generally been written by secondary-school science teachers and science educators in the colleges and universities. However, within the past few years scientists in greater numbers than ever before have become concerned about the secondary-school science curriculum[90].

The report recognized the criticism of the past, that scientists who had developed high school science curricula had been too far removed from the realities of the classroom for the content to be relevant to the needs, interests, and

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89 Ibid. p. 158.

90 Ibid. p. 156.

abilities of the students. Nevertheless, the Committee pointed out: "it is now quite evident that, to bring about the needed reorganization and revitalization of science courses in secondary schools, cooperation of the scientist will continue to be necessary"[91]. The degree of cooperation was never clearly defined and, in the main, the science curricula produced during this time were dominated by university scholars.

The roots of the curriculum-reform movement of the sixties were actually formed during the latter half of the 1950's. The modern science curricula that were developed revealed the various influences that were acting upon content selection, and the report noted that:

> Although high-school science teachers and educators have assisted with the development of these courses, the scientists have played a major role in defining the purpose of the course and the organization within which they will be developed[92].

This trend, along with the change of emphasis in content to be selected, continued throughout the sixties. To understand science it was considered necessary to think like a scientist by undertaking an investigation which utilized the materials, concepts, and methods unique to science. The content of the science curriculum, the product element of

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91 *Ibid*. p. 157.

92 *Ibid*.

science, was to be acquired by the student using the process element of science in the form of the inquiry method. The identification of such content therefore became a prime aim for the science curriculum developer[93].

The Physical Science Study Committee (PSSC) physics project emphasized the inquiry method and was the first of the major science curriculum reforms to get under way on a large scale[94]. Initiated by scientists at The Massachusetts Institute of Technology, the PSSC received its initial support from The National Science Foundation in 1956. The curriculum development was undertaken by a group of scientists, science educators, science teachers, and psychologists.

> In the early stages (though not at the very beginning) physicists found that the changes they wished to effect in high school physics were of such a fundamental nature that a fresh start was the only sensible strategy. A prime aim was to present physics as a system of inquiry[95].

The decisions regarding the content and its organization for this course were dominated by the scientists who had initiated the project. Their knowledge of the structure of the discipline allowed them to identify the content for a physics course, and to organize it in such a way that students were to acquire their knowledge of the content through investigative procedures[96].

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[93] Gatewood and Obourn, Op.Cit. p. 362.

[94] Ibid. p. 363.

[95] Ibid. p. 362.

[96] Ibid. p. 363.

The literature reviewed so far illustrates how changing environmental factors influenced the selection and organization of content for a science curriculum. The changing socio-economic conditions in the 1850's resulted in a change in curriculum content. The didactic literature brought to North America from Europe was no longer suitable for the needs of a developing technological society and it was replaced by content that was utilitarian in nature. It was also recognized that high school science curricula patterned after college science courses failed to meet the needs of those students who were not college bound, or interested in science. Teachers were considered to have an understanding of the personal and social needs of the students but unfortunately the curricula they developed omitted many important science topics. One key issue became apparent, there was a growing recognition of the importance of content selection and a need for studies that would provide guidance in this important area. Studies that were undertaken in content selection are reviewed in the next section.

2. Methods and Sources Used in Studies on Content Selection

One fairly common method used in studies on content selection was the construction of an initial list of science concepts from an analysis of textbooks used in general science. Studies which used the analysis of content in a textbook method were undertaken by Pettit[97] in 1940, and others. The general format of such an analysis was to determine the extent to which agreement existed among the textbook authors as to what content should be included, the topics used to develop common units, and the degree of emphasis given to the various concepts found in the textbooks[98]. A study was then made by the researcher of the data collected from the analysis to determine the existence of commonalities that would aid in the development of a general science curriculum.

Another method used in studies on content selection for a science curriculum was the analysis of content present in a combination of science textbooks and successful science courses. Such studies were undertaken by Cureton, 1927[99],

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97 Donald D. Pettit, "The Content of Junior High School Science", in School Science and Mathematics, Vol. 40, Nos. 7 & 8, Oct. 1940, p. 643-654, Nov. 1940, p. 763-776.

98 Ibid. p. 644.

99 Edward E. Cureton, "Junior-High-School-Science", in The School Review, Vol. 35, No. 10, Dec. 1927, p. 767-775.

Robertson, 1935[100], Martin, 1945[101], and others. The analyses conducted were similar to those for general science textbooks, only this time a number of courses of study would also be analyzed. The data collected were then carefully examined to determine commonalities which became the new general science curriculum.

Curtis, 1929[102], developed a method whereby he combined the topics found in three syllabi with the subject matter elements revealed by fourteen published and one unpublished analyses of materials appropriate for inclusion in the general science curriculum.

Other ways to determine the content for a general science curriculum were also employed. Novak, 1942[103], conducted an analysis of newspapers. The major criterion of

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[100] Martin L. Robertson, "The Selection of Science Principles Suitable as Goals of Instruction with Elementary School", in Science Education, Vol. 19, Feb. 1935a, p. 65-70. and April, 1935b, p. 1-4.

[101] W.E. Martin, "A Determination of the Principles of the Biological Sciences of Importance to General Education", in Science Education, Vol. 29, April, 1945a, p. 100-105, and May, 1945b, p. 152-163.

[102] Frances D. Curtis, "A Synthesis and Evaluation of Subject-Matter Topic in General Science", A Program for Science Teaching, G.M. Whipple, Ed., Reported in Part 1 of The Thirty-First Yearbook of The National Society for the Study of Education, Bloomington, Illinois, 1932, p. 113.

[103] Benjamin Novak, "Science in the Newspaper", in Science Education, Vol. 26, Oct. 1942, p. 138-143.

importance in this study was the relative amount of space given to a specific topic in the newspaper. Ruffner, 1940[104], found that the science interests of the students allowed her to determine the areas to be included in a general science curriculum. Matteson and Kambly, 1940[105], used the results of test items which revealed the knowledge of science possessed by students entering grade seven to determine the content. The topics not known by the students were to form part of the content for a junior high school science curriculum.

Janke in 1969[106], Roth, 1969[107], and Thompson in 1970[108], went directly to the scientists themselves to produce a list of concepts as the concept which would form the base for a science curriculum.

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104 Frances E. Ruffner, "Interests of Ninth-Grade Students in General Science", in Science Education, Vol. 24, Jan. 1940, p. 23-29.

105 Harvey D. Matteson and Paul E. Kambly, "Knowledge of Science Possessed by Pupils Entering Seventh Grade", in School Science and Mathematics, Vol. 40, No. 3, March, 1940, p. 244-247.

106 D.L. Janke, "The Concept Currency of K-12 Science Textbooks Relative to Earth Science Concepts", Unpublished Ph.D. Thesis, University of Wisconsin, 1969, p. 1-148.

107 R.E. Roth, "Fundamental Concepts for Environmental Management Education (K-16)", Unpublished Ph.D. Thesis, University of Wisconsin, 1969, p. 1-202.

108 B.E. Thompson, "A List of Currently Credible Biology Concepts Judged by a National Panel to be Important for Inclusion in K-12 Curricula", Unpublished Ph.D. Thesis, University of Wisconsin, 1970, p. 1-338.

These studies usually resulted in the formation of a list of hundreds of topics, as in the Curtis[109] study, which listed eighteen hundred fifty topics. Such lists reflected the desire of educators to identify the "big ideas" and "functional principles" suggested in The Thirty-First and Forty-Sixth Yearbooks of the N.S.S.E. Once the list had been derived, there was a need to evaluate the concepts regarding their suitability for a specific course. In the case of the science textbook, or the combined textbook-syllabi studies, the judgment was made relative to the degree of existing commonality. In a similar manner, the number of words and space devoted to the topic in newspapers, or journals, likewise determined the suitability of the topic for inclusion in a science curriculum. Other studies have utilized the experience of juries composed of university professors, (Martin, 1945[110], Roth, 1969[111]), elementary and high school teachers or laymen, (Smith, 1951[112], Trainor, 1964[113]),

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[109] Francis D. Curtis, Op.Cit. p. 113.

[110] W.E. Martin, Op.Cit. p. 100-105, p. 152-163.

[111] R.E. Roth, Op.Cit. p. 1-202.

[112] H.F. Smith, "A Determination of Principles Desirable for A Course of General Science at the Junior High School Level", in Science Education, Vol. 35, Dec. 1951, p. 279-284, and Vol. 36, Feb. 1952, p. 32-47.

[113] V.F. Trainor, "A Determination of Science Concepts that Should be Taught in the Junior High School", Unpublished Ph.D. Dissertation, University of Connecticut, 1964, p. 1-356.

and science educators, (Blanchet, 1949[114], Bryant, 1959[115]).

These studies were inadequate in their methodology which seriously affected their outcome. They lacked a broad perspective representative of different viewpoints considered necessary in curriculum development. For example, those studies which made use of material found in textbooks or syllabi failed to recognize the importance of the representatives of the discipline and their expertise in selecting contemporary content for the curriculum. In those studies concerned with newspaper and journal articles there was the omission of tried and proven classroom materials that are usually found in textbooks. Collectively, these studies reflect the researcher's beliefs in the significance of published materials and show little regard for the needs, interests, or viewpoints of others.

114a W.W.E. Blanchet, "Investigation of Student Opinion Concerning Survey Courses in Science", in Science Education, Vol. 32, Feb. 1948a, p. 24-32.

114b ---------------, "Subject Matter Topics Contained in Textbooks in Survey Courses in Science", in Science Education, Vol. 32, March, 1948b, p. 88-93.

115 P.P. Bryant, "Science Understandings Considered Important for Children and the Science Required of Elementary Teachers", Unpublished Ph,D. Dissertation, George Peabody College for Teachers, 1959, p. 1-289.

Craig's study, 1927[116], used many sources and was undertaken in order to design a course of study in science for the Horace Mann Elementary School in New York City. The following three criteria were utilized in the selection of science content. The content should:

1. greatly influence the thought reaction in many fields,

2. conform to those goals that are important in establishing economy,

3. conform to those facts, principles, generalizations, and hypotheses of science which are essential to the interpretation of common natural phenomena[117].

The principles of science which were selected as content in this study were dereived from many sources such as the Nature Study Review, journals, textbooks, and courses of study. An initial list of two hundred principles was constructed from these resource materials. Each principle on the list was then evaluated by one hundred eighty-eight laymen who judged the importance of the principle according to the role it had played in their own lives. The degree of importance attached to a principle was recorded on a one-to-five point scale.

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116 Gerald S. Craig, Certain Techniques Used in Developing a Course of Study in Science for the Horace Mann Elementary School, New York, Columbia University, 1927, p. i-vii, 1-73, IL.

117 Ibid. p. 56-57.

Another important phase in the study involved the questions students ask about science. Students in ten schools were requested to list the questions about science that they would like answered. The resulting list included questions involving the phenomena studied in astronomy, biology, chemistry, geology, and physics. A visual comparison was then made between the principles on the initial list and the frequency of the questions asked by the students regarding those principles.

An analysis of a random sampling of authoritative treatises of science (in the main, these were textbooks), was then undertaken to determine whether the two hundred principles could be distinguished into constituent elements or meanings for teaching. The science textbooks used in the study were then examined to determine the frequency with which each listed principle appeared in them to establish their relative importance.

From the results of his study, Craig recommended the use of many criteria including the three he had employed; also, that many sources should be used to derive the content for a science curriculum. He concluded that definite items or objectives of interpretations of natural phenomena should be utilized as the constructional units for building the curriculum. He found that the studies on the children's questions, and the educated laymen's judgments, indicated the greater value of the interpretation of the natural phenomena.

The purpose of Bingham's study, 1961[118], was to determine what science should be taught in the junior high schools of Hillsborough County, Florida. He conducted his study along similar lines to Craig's by following the recommendations relating to sources for selection of content, many criteria, and student needs. The laymen's judgments were replaced by those of teachers.

A group of twenty-one science teachers, mostly at the junior high school level, worked with the investigator in the study. As a group they surveyed contemporary text-books in general science, biology, and physical science, then checked contemporary developments in leading scientific journals. From their analysis they prepared a list of one hundred twenty-one questions which included the content they had selected as being of possible significance, the content that appealed to students, and content which teachers felt should be taught in the junior high school.

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[118] N. Eldred Bingham, "A Study Made in Hillsborough County, Florida, to Determine What Science to Teach in the Junior High School", in Science Education, Vol. 47, No. 3, 1963, p. 226-236.

Criteria were formulated from relevant literature and used for judging the worth of content for inclusion in a junior high school science curriculum. These criteria dealt with the development of basic intellectual understandings, interests, attitudes, and skills needed in solving health, safety, and economic problems of the individual in society. Four hundred eighty-one students responded to the questionnaire of which three hundred sixty-eight were junior high school students, and one hundred thirteen were accelerated senior high school students. Ninety junior and senior high school science teachers responded to the questionnaire. The results of the questionnaire showed areas of agreement between teachers and students as to what should be taught, and some disagreement in other areas. For example, students showed a high level of interest in the reproduction of plants, animals, and humans; however, the teachers felt that only plant reproduction should be taught.

The results illustrated that there was a wide difference in the background and interests of the students. This difference also occurred within the group of teachers. The study indicated that teachers should continue to teach those topics which were of immediate concern to students.

It was concluded by Bingham that the method utilized in the study to determine content for a science curriculum was suitable for use in science curriculum development. Furthermore, the study had value in pointing out those subject matter areas where more emphasis should be placed.

Craig's study generated considerable interest in the selection of content for science curricula and shortly after his study was published a number of similar studies were undertaken in the various disciplines of science. Robertson, 1934[119], investigated a number of these studies, and thereby used them as a source of content.

The purpose of Robertson's study was to determine the content which would serve as suitable goals of instruction by answering children's questions and contributing to their understanding of scientific principles. Three criteria had to be met by a study in order that it could be included in his investigation. These criteria were concerned that the purpose of the study had been to select and construct a detailed list of scientific principles. The report of such a study must also indicate the rank order of the frequency of appearance of the principles in the materials analyzed. Ten studies were found which met the criteria and lists of major and minor principles were obtained from these sources.

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[119] Martin L. Robertson, Op.Cit. p. 3.

To determine if the principles of science present in the studies were important ones, Robertson formulated criteria to determine the validity of the principles. To be a scientific principle it should be a clear statement of a process or interaction which was capable of illustration, but not part of a larger principle or a definition. Each statement which, in the opinion of any one of six subject matter specialists, was not true was discarded or reworded. This evaluation resulted in a list of two hundred forty-three principles. These principles were then submitted to a panel of twenty supervisors and professors in the teaching of elementary school science who evaluated each principle as to its appropriateness as a goal of science instruction. The evaluation of each principle was recorded on a five-point scale. The final list of principles which was to serve as goals of science instruction numbered one hundred thirteen.

To obtain a list of subject matter topics Robertson selected those studies with a detailed list of science topics. A further consideration for acceptance was that the list of topics must have been arrived at by a technique of research accepted by a graduate committee of a reputable institution. Five studies were found which satisfied these criteria.

Collectively, the five studies included data derived from thousands of children's questions, analyses of nearly one hundred fifty courses of study, extensive reviews of authoritative opinions of laymen, experts, and analyses of science magazines. The data from each of these five sources were then tabulated and resulted in two thousand, three hundred twenty-four topics. Seven qualified experts and the investigator then determined the relative value of each topic.

To determine the need for the principles of science in answering the questions of children, six thousand, four hundred twenty-nine questions were obtained from students in Michigan schools. The principles and the number of questions asked about each principle were then tabulated. The rank of each principle was determined by the number of questions asked about all the principles. It was found that ninety-three and two-tenths of all the questions students asked were related to the principles determined in the study. As a whole, more questions were asked about biological than physical topics. In effect, Robertson's study attempted to determine the basis for the selection of course content as used by Craig, and replicated in others which he selected for his study.

It should be noted that whilst the studies undertaken by Craig, Bingham, and Robertson, employed many sources, and thereby used a broader perspective than those previously mentioned, they nevertheless neglected important areas of interest. For example, in Craig's study, the influence of teachers and discipline scholars was minimal when compared to that of the laymen and the students. It is recognized that the layman's opinion is an important one but so is that of the teachers who know the needs, interests, and abilities of the students which is important in selecting content for a curriculum. Likewise, the children's questions are a useful guide in content selection for a curriculum, but how can they ask questions about things of which they have no knowledge such as the fundamentals of the disciplines whose worth is known to the scholar?

A lack of balance can also be seen in the influences bearing on curriculum development in Bingahm's study in which the opinions of the laymen were replaced by those of the teacher. And, whilst contemporary developments in leading scientific journals were checked for the study, no discipline scholars were directly involved in the developmental procedures. The omission of laymen and scholars who are representative of society and the discipline respectively may now be seen as a serious weakness, inasmuch as the interests of society and the disciplines were not represented in the study. Such weaknesses are therefore inherent in

Robertson's study which incorporated studies with serious omissions regarding important areas of interest in curriculum development.

Textbook Studies

In the past, considerable use has been made of science textbooks to establish the worth of topics and principles for inclusion in a science curriculum. The reasoning behind most content analysis of textbooks was that the material therein had been substantiated by authoritative expertise and had met the test of time. The utilization of textbooks as a source of information is common to many studies on content selection.

Heiss, 1932[120], made use of the content found in textbooks to ascertain the basic facts, principles, and applications around which the general science courses were built. He conducted a content analysis of seven general science textbooks published between the years 1923 to 1927. The data obtained from the textbooks were then grouped under unit headings to show the frequency of their occurrence in the texts. No material was considered basic or included

[120] Elwood D. Heiss, "An Investigation of Content and Mastery of High School General Science Courses", Unpublished Ph.D. Thesis, Teachers College, Columbia University, 1932. Reported in, Francis D. Curtis, Ed., Third Digest of Investigations in the Teaching of Science, Philadelphia, Penn., Blackiston Sons Co. Inc., 1939, p. 54-57.

in the grouping unless it had occurred in at least a majority of the texts. Heiss found that there was a considerable degree of uniformity in unit content material in the textbooks he examined.

It was also considered that textbooks had been prepared after many years of study, that they were usually based on a contemporary course, and that the content therein was therefore teachable. Pettit, 1939[121] recognized this influence of textbooks and undertook a series of studies on general science textbooks used in grades seven, eight, and nine. The investigator wished to determine the extent of agreement for concepts, commonality for units, the degree of emphasis given to commonly used concepts, and to the sciences used in presenting given topics. It was hoped that the findings would contribute to the solution of the problem of what the content of a junior high school curriculum should be.

Five textbooks were analyzed by Pettit for grade seven, four for grade eight, and four for grade nine. The results of the analyses were tabulated according to the units found in the textbooks. He noted that there appeared to be uniformity of opinion as to what the content should be; however, he found that twenty-nine of the units on science were unique, that is, found in only one text. Although

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[121] Donald D. Pettit, Op.Cit. p. 643-654, p. 763-776.

agreement appeared to be present at the unit level, the actual content found in each unit differed considerably.

In a similar manner, Pettit analyzed and tabulated his findings on the topics used in the development of the units in junior high school general science textbooks, and also the total number of concepts evident. He found that of the total of one hundred fifty-five topics appearing in the five general science textbooks for grade seven, only eleven per cent were used in the majority of texts. Also, no topic was common to all five of the textbooks. Of the total of six hundred fifty concepts appearing in all of these textbooks only eighty-six of the concepts were found to be common to three or more of the texts. The results of the study dealing with grade seven general science textbooks showed that there was a complete lack of uniformity in the choice of units, topics included and used under the units, and in the concepts employed in the development of the topics. Pettit concluded that the teacher is justified in organizing a general science grade seven course to suit local needs rather than rely on a textbook. The results of the content analysis of the grades eight and nine general science textbooks were similar in nature to those in grade seven. Pettit found little agreement among the authors as to what content should be included in a general science course at the different grade levels.

Wolford, 1935[122], attempted to determine the extent to which the subject matter in textbooks was applicable or adaptable to a general science curriculum in the Southern Appalachian Region. The investigator studied the organization of the material in textbooks in order to classify the material in the study. An analysis was conducted on ten general science textbooks to determine the subject matter and the extent to which their authors agreed on what content was essential in a general science curriculum. A further analysis was then conducted on eight other general science textbooks, none of which was more than six years old. A comparison was then made of these analyses regarding the content and organization of subject matter. The amount of space devoted to each subject matter unit and to each activity situation was determined in square inches of space in each textbook. Wolford found there was little agreement among authors as to what should be included in a general science textbook, and that no textbook had been prepared that was specially adapted to a particular region.

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[122] Feaster Wolford, "Methods in Determining Types of Content For a Course of Study for Eighth-Grade Science in the High Schools of the Southern Appalachian Region", Unpublished Ph.D. Dissertation, Cornell University, 1935. Reported in, Francis D. Curtis, Ed., Third Digest of Investigations in the Teaching of Science, Philadelphia, Penn., Blackiston Sons Co. Inc., 1939, p. 47-49.

More recently, Hankins, 1968[123], conducted a study to ascertain what the content should be in a biology curriculum for the purpose of general education at the freshman college level. The subject matter of twenty textbooks designed for use in college introductory biology was analyzed, summarized, and classified under eleven broad content areas. Current opinions were sought on the content obtained from these textbooks by using a random sample of one hundred fifty research biologists, college and university teaching biologists, science educators, and science historians.

There were three parts to Hankin's study in which three different groups of scholars, one group for each part, were asked to judge the selected content areas by means of a mailed questionnaire. Questionnaire 1 was sent to fifty research biologists for their opinions on content emphasis, inclusions, and omissions. Questionnaire 2 was sent to fifty biologists and sought their opinions regarding the extent to which a contemporary biology course should reflect the recent dependency of biology on mathematics. Questionnaire 3 was sent to forty biologists and ten science historians who were asked to judge the emphasis placed on the

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[123] Lela R. Hankins, "A Determination and Selection of Biology Content of Significance for a Freshman Level General Education Course", Unpublished Ph.D. Dissertation, Oregon State University, 1968, p. 1-191.

contributions and methodology of men of science. The data were analyzed by means of descriptive percentages. Ten major conclusions were made from the results of the study. The major content emphasis was focused on environmental biology which was closely followed by evolution, energetics, and metabolism, in that order. The results indicated that biology principles and evolutionary approaches should be utilized in the organization of the content, but that topics related to health and disease should not be included in the curriculum.

Collectively, the textbook studies illustrated that wide variations existed in the expectations of what content should be in a textbook. As textbooks were usually the main source of subject matter their content should be relevant for a science curriculum. The studies examined showed a general lack of agreement among the authors as to what content should be included. This can be observed in the studies which indicated considerable differences in the content included in textbooks supposedly covering the same subject matter at a particular grade level. The studies also revealed that even when there was agreement on the content in different textbooks, the degree of emphasis or adequacy of coverage varied considerbly. These differences were most noticeable at the factual, conceptual, or principle level. Also, that many of the topics included in textbooks were found to be irrelevant for particular environmental regions. This wide variation between the content in textbooks and the expectations of experts in the field affected the effectiveness of the textbook influence on content selection for a science curriculum.

The Use of Discipline Scholars

During the past decade, there has been a growing tendency to break away from the influence of previously published material. The identification and extraction of concepts from textbooks may not be entirely free of the investigator's preferences. In an attempt to eliminate the possibility of the investigators' bias, recent studies made use of an increasing number of discipline scholars whose collective expertise allowed them to establish the credibility of the concepts suitable for a science curriculum.

The purpose of Roth's[124] study was to develop a taxonomy of fundamental concepts for environmental management in grades K-16. He also attempted to determine whether or not biases existed among selected representatives of the

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[124] R.E. Roth, <u>Op.Cit</u>. p. 1-202.

various disciplines or the ecological regions relative to the selection of content. A survey technique was employed which used written questionnaires and personal interviews to obtain and validate concepts deemed appropriate for environmental education.

An initial list of ninety-eight concepts was constructed by Roth from his analysis of the related environmental management literature. The list of concepts was then submitted to a panel of University of Wisconsin discipline scholars for their judgment as to the credibility of the statements. The scholars were requested to delete or add concepts to the list and to make corrections to statements in which errors were present. The discipline scholars on the panel were then interviewed and asked to explain any changes they had made. A list of one hundred fifty-seven concepts evolved from this evaluative procedure.

The revised list was then submitted to the judgment of the discipline scholars who were requested to judge the appropriateness of the concepts for inclusion in a K-16 curriculum. To be included in the list these concepts must have been judged as desirable for inclusion in a curriculum by at least seventy-five per cent of the scholars. A list of one hundred twenty-eight concepts emanated from this evaluation.

This list was next judged by a national panel of three hundred fifty discipline scholars. Their evaluation resulted in one hundred eleven of the concepts meeting the criterion of being acceptable to ninety per cent of the respondents. These concepts were then organized into a taxonomic list according to topic on the basis of a weighted item-mean score. An examination of the seventeen unacceptable concepts and the frequency of their rejection by professional or ecological region provided little evidence to support any speculation of the existence of possible bias. Roth concluded that the discipline scholars from forty discipline areas, and twelve ecological regions of the United States, were in agreement on the majority of concepts which should be emphasized in environmental management education.

The published material-scientist relationship technique was continued by Janke, 1969[125], who reversed the procedure used by Roth. Janke undertook the study to determine the degree of agreement between science textbooks and discipline scholars in earth science relative to the earth-science concepts to be included in a K-12 science curriculum.

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[125] D.L. Janke, Op.Cit. p. 1-148.

An initial list of earth-science concepts was constructed by requesting scientists on the University of Wisconsin panel of discipline scholars to state those concepts which they felt to be most important in their specialty. This resulted in an initial list of seventy-one concepts which was then submitted to a second panel of one hundred fifty-four experts. Each evaluator was requested to add or to revise any of the concepts which in his judgment were suitable for inclusion in a K-12 science curriculum. Six concepts which were considered unacceptable or undesirable for inclusion in the list were deleted. The revised list of concepts was then judged by three hundred twenty-six discipline scholars on a national panel. This final evaluation resulted in a list of fifty-two earth-science concepts judged as being important for inclusion in a K-12 science curriculum.

The final list of earth-science concepts was then compared with data obtained from a concept analysis of elementary, general, physical, and earth-science textbooks. The results indicated that a majority of the concepts indentified by the earth-scientists were probably included in any one, or a combination of the textbooks analyzed. It was found that the scholars from the earth-science disciplines were in general agreement as to what earth-science concepts should be included in a grades K-12 science curriculum.

Previously published materials, particularly text-books, have wielded considerable influence over studies involved in the construction of lists of concepts deemed suitable for science curricula. Thompson, 1970[126], avoided this influence by using a national panel of university biologists, science educators, and high school biology teachers, to construct a list of currently credible biology concepts for Grades K-12 curricula.

A panel of University of Wisconsin discipline scholars was formed which involved scientists engaged in each one of the forty-four biology or biology-related academic specialities. Personal interviews were held with each university scholar during which the purpose of the study was explained. The concepts of biology submitted by the scientists were recorded and classified by area after being examined for similarity. The selected concepts were then edited to ensure consistency of style. The initial list developed by the Wisconsin panel contained one hundred fifty-one biology concepts.

The initial list was then sent to the Wisconsin panel for each concept to be judged for credibility and precision. In addition, the importance of each concept was

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126 B.E. Thompson, <u>Op.Cit</u>. p. 63.

to be rated on a scale weighted from one, unimportant, to five, important. The frame of reference by which each concept was rated for importance was: "This concept should be encountered by each child sometime between kindergarten and graduation from high school"[127]. Additional concepts could also be added by each discipline scholar and this evaluation process resulted in a second list of one hundred fourteen biological concepts.

The second list of concepts was then submitted to a national panel of three hundred eighty-seven biologists, science educators, and biology teachers. All evaluated biological concepts on the list returned by the national panel were examined for ratings given, content modification, and the addition of concepts. The second list of biological concepts as modified by the national panel then became the final concept list considered suitable for a curriculum. Thompson found that all three groups in the national panel were similar in their rating of biology concepts. He concluded that the final list of concepts resulting from the study demonstrated the practicability of identifying, formulating, and evaluating science concepts by the method utilized.

[127] Ibid. p. 60.

The studies by Roth, Janke, and Thompson, illustrate curriculum development that is controlled by the disciplines. In each of these studies the discipline scholars stated those concepts which they considered were relevant, and in so doing, collectively, formed the list of concepts to be judged as suitable for a science curriculum. Large numbers of discipline scholars were used to select and evaluate the science concepts and, in effect, they dominated these studies. In this manner, the interests in content selection expressed by the laymen, the students, and except for Thompson, the teachers were minimal. Thus, the interests of society and the growth needs of the students were omitted in the selection and organization of content for a science curriculum.

3. Validation of Content Selected for a Curriculum

Studies that have been conducted on the selection of content for a science curriculum have used two distinct steps in the validation process. Initially, the concept would be identified and a list of science concepts formulated. The initial list was then scrutinized by the investigator, sometimes aided by selected specialists, to verify the precision of each concept. The revised initial list was then sent to a panel of experts to judge the validity of each statement, and where necessary, delete or alter a concept. In this manner, each concept was validated for accuracy by specialists.

Ashbaugh's study, 1968[128], is an example of this method of validation. He formulated an initial list of concepts in geology by identifying each concept in the literature. These concepts were then categorized and critically appraised for accuracy and clarity by a panel of judges. The panel was composed of professors of geology and education, curriculum directors, and classroom teachers.

A study which used a process of validation similar to Ashbaugh's had been previously conducted by Robertson[129] in 1935. With the aid of three science teachers, the investigator formulated an initial list of principles derived from a survey of ten studies. Collectively, these studies had analyzed seventy-five textbooks. The initial list was then refined by a panel of six university professors and the investigator. Each statement, which in the opinion of any one of the subject matter specialists was not true, was discarded or reworded to make it a true statement of the principle.

128 A.C. Ashbaugh, "Selection of Geological Principles for Intermediate Grades", in Science Education, Vol. 52, No. 2, March, 1968, p. 189-195.

129 Martin L. Robertson, Op.Cit. p. 3-19.

The method used in fairly recent studies by Hankins[130], Roth[131], and Janke[132], followed the same pattern; the identification of science concepts in the literature, then judgment as to the precision and acceptability of each statement by a panel of experts. Thompson[133] changed the format of this procedure by removing any reference to the literature and using the expertise of the discipline scholars at all levels. Collectively, these studies show a steady increase in the number of discipline scholars involved in curriculum development. Recent studies have also attempted to minimize or eliminate possible biases of individuals by requiring that science concepts should be credible to a large number of experts.

Once the validity of the science concept had been established its importance or appropriateness for a particular science curriculum was then determined. In Ashbaugh's study[134], the appropriateness of each concept was determined by testing the teachability of the selected concepts in the schools. He found that thirty-seven of the forty selected concepts were adequate for an elementary science curriculum.

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130 Lela R. Hankins, Op.Cit. p. 1-191.

131 R.E. Roth, Op.Cit. p. 1-202.

132 D.L. Janke, Op.Cit. p. 1-148.

133 B.E. Thompson, Op.Cit. p. 1-338.

134 A.C. Ashbaugh, Op.Cit. p. 189-195.

However, in most studies the appropriateness of content was usually determined with the aid of previously established criteria.

Criteria for Content Selection

Several methods have been used in research studies by which the appropriateness of the content for a curriculum was determined with the aid of criteria. These methods show a variety in the type and number of criteria used.

Craig's study[135] made use of three criteria to construct a list of two hundred principles (see page 47). Each principle was then evaluated by one hundred eighty laymen and the results compared with the frequency of occurrence of questions the students asked about each principle. Since the principles had to meet the criteria before their inclusion in Craig's initial list, the criteria were a controlling influence.

In a similar manner, Robertson[136] formulated three criteria which previously conducted studies were required to meet prior to being accepted into his investigation (see page 51). He then formulated other criteria to determine

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135 Gerald S. Craig, Op.Cit. p. 56-57.

136 Martin L. Robertson, Op.Cit. p. 65-70.

the validity of each principle (see page 53) found in the ten accepted studies prior to having a panel of four evaluate their importance.

The criteria used for the selection of content for discipline-oriented curricula were basically concerned with the structure of the discipline under study. However, in studies concerned with general education considerable emphasis was given to criteria associated with the social and cultural needs of the students. The criteria in Bingham's[137] study reflected social concerns that were prevalent in the literature of the time.

A profusion of criteria evolved from the many studies undertaken for the selection and organization of content for science curricula in the early thirties. The professional organizations recognized the importance of criteria and examined many lists of criteria to determine if commonalities and agreement existed. From their investigation they constructed a list of criteria to serve as a guide in curriculum development (see page 36).

Lists of criteria for the selection and organization of content are present in today's curriculum literature. These criteria are concerned with the same aspects of content selection as those found in the nineteen-thirties and they will be referred to later in this study.

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137 N. Eldred Bingham, Op.Cit. p. 226-236.

Summary

In this historical perspective of content selection and organization for science curricula it was possible to discern various influences acting upon curriculum development. Initially, this perspective illustrated how changing socio-economic conditions influenced the selection of content for a science curriculum; e.g., developments in the fields of science and technology resulted in the selection of content that would aid the student in his environment. Emphasis on content that is of a utilitarian nature since it accommodates the needs and interests of society can be identified with Macdonald's Circular-Consensus model.

The high school science curricula that were developed as college preparatory courses gave emphasis to the discipline's content. In this respect they can be readily associated with the discipline-oriented conceptions of curriculum and Macdonald's Linear-Expert model. It should also be noted that when concern was expressed at the turn of the century for curricula that would meet the divergent needs of the students that these were concerns easily associated with Macdonald's Dialogical model.

In general, the historical perspective presented in this chapter illustrated that varying degrees of emphasis have been given at different times to the control of the disciplines, the needs of society, or the needs and interests of the students during the past century. It is therefore possible to associate these changes in emphasis with the values and perspective found in each one of Macdonald's curriculum development models. This perspective thereby gives credence to each one of the models identified by Macdonald.

The studies examined illustrate that different methods have been used in content selection for science curricula. Also, that persons with different backgrounds were involved in these methods. It may be assumed that when laymen, teachers, or university scholars were utilized in these studies that it was in response to an expressed need, usually by professional societies, for functional science, science for a general education, or discipline content necessary to prepare students for higher learning. Thus, over the years, the influence of the professional literature could be seen in the research studies undertaken. In the main, these studies concluded that the methodology utilized was suitable for the selection of content for a science curriculum. And, as the methods and persons used were intended to produce a particular type of curriculum, e.g., discipline-oriented curricula to aid students interested in further education, then the studies examined can be associated with certain conceptions and models for curriculum development.

Both the professional literature and the studies give credibility to the fact that different curriculum development models do exist. Furthermore, that inherent in each model are the values and perspectives that are unique to that particular model. However, there is a lack of information regarding the effect these models have on the selection of content for a science curriculum. The question may now be posed: Is the content selected using one particular curriculum development model significantly different to that produced using a different model? If the resulting content is different, how is it different? This study was undertaken to secure such information, and, as both the literature and the studies give support to the credibility of Macdonald's models they were chosen as the basic framework for this investigation. The specific subject-matter area chosen to obtain this information was the junior high school physical-science curricula since there exists an abundance of science curriculum materials in this area. The procedure used in this investigation is to be found in the next chapter.

CHAPTER III

DESIGN OF THE STUDY

The purpose of this chapter is to outline the procedures established to obtain information regarding the content and its organization in various junior high school physical-science curricula representative of Macdonald's curriculum development models. This chapter consists of five sections; namely, the question for study; a description of the selection of curricula for each model; the development and validation of the questionnaire used in the collection of data; the methodological procedures; and the procedures employed in the analysis of the data.

1. Question for Study

As discussed in the first chapter, one important aspect of Macdonald's curriculum development models is that they provide a meaningful framework which can be used to obtain information regarding the selection and organization of content for different science curricula. Macdonald considers that each one of his models is representative of the value perspectives held by the persons involved in the developmental activity. It is the application of values during the developmental procedures that leads to various curriculum content[138].

The concept of particular content being produced by using a specific curriculum development model is a useful one. The categorization of curricula according to curriculum development models such as Macdonald's suggests a number of possibilities in educational practice. From the viewpoint of the potential consumer of a curriculum, knowledge of the value perspectives inherent in a model, and the associated design, could provide a useful guide during selection procedures. Hence, this part of the study asks the following questions: Do the different value positions suggested by Macdonald to be inherent in each model result in different content and content organization? In particular: Does the content selected and organized for a junior high school physical-science curriculum differ depending on the type of curriculum development model used?

To answer these questions, the procedure outlined in the remaining sections of this chapter was initiated and carried out. The next section describes how the curricula were selected and matched with Macdonald's three development models.

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[138] James B. Macdonald, <u>Op.Cit</u>. p. 290-291.

2. Selection of Curricula

Enquiries made in the Provinces of Ontario and Québec indicated which textbooks were used for their junior high school physical-science curriculum. This science curriculum is part of the general education program, therefore, an abundant supply of materials is available to meet the needs and interests of the large number of students required to study this curriculum. Consequently, this area was chosen as the one which would most likely yield examples of curricula that could be matched with Macdonald's development models.

The science curricula used in this study included materials published since 1965 and utilized in the schools in the Provinces of Québec and Ontario. Ten English speaking school boards were randomly selected in Québec, and twenty in Ontario. A letter (see Appendix 1) was sent to the Superintendent of Instruction and Curriculum for each of these school boards informing them of the study and requesting information on their junior high school science curriculum. After a period of four weeks a follow-up request (see Appendix 2) was sent to those schools that had not replied to the initial request. A list of junior high school physical-science texts was compiled from six responses received from the Province of Québec, and seventeen replies received from Ontario school boards.

The instrument used to categorize the science curricula according to Macdonald's models was a two-page questionnaire (see Appendix 3) developed from the description of each model. Prior to its use, the questionnaire and a copy of Macdonald's description of each model were presented to a group of five university science educators and ten high school science teachers for their evaluation and comments. Suggestions which were offered by this group concerned the layout of the questionnaire and the wording of three questions. The questionnaire was revised accordingly.

The questionnaire and a letter explaining the nature of the study (see Appendix 3) were sent to each curriculum developer, or co-developer whose name appeared on the list of physical-science curricula being used in Québec and Ontario schools. Thirty-seven of the forty-three curriculum developers were the authors or co-authors of the textbooks used in the above schools. Seventy-one per cent of these curriculum developers responded to the questionnaire with every curriculum on the list represented in these replies. The responses received from the curriculum developers were examined by ten high school science teachers who categorized them according to Macdonald's description of each model (see Appendix 4).

Two curricula were categorized as belonging to the Linear-Expert model, and two for the Dialogical. The two best curricula, i.e., those for which there was the highest level of agreement regarding their category, were then selected by the researcher from the nine categorized as Circular-Consensus by the high school science teachers.

A need existed to develop an instrument for the evaluation of the curricula representative of each of Macdonald's curriculum development models. The development and validation of that questionnaire is the subject of the following section.

3. Development and Validation of the Content Questionnaire

The instrument used to obtain data was a single-page questionnaire (see Appendix 5) developed from a cumulative list of criteria for content selection and organization obtained from many professional sources (see Figure 1).

Figure 1 is representative of the many lists of criteria examined for commonality and agreement as to the criteria that should be used in the selection and organization of content. Hurd's[139] and Henry's[140] lists were considered important

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[139] Paul deHart Hurd, "Toward A Theory of Science Education", Theory Into Action, Washington D.C., National Science Teachers' Assn., 1964, p. 11.

[140] Nelson B. Henry, Op.Cit. p. 159.

CRITERIA	G. Inlow[141]	D. Manning[142]	R. S. Zais[143]	H. Taba[144]	P. deHart Hurd[145]	R. C. Doll[146]	V. E. Anderson[147]	R. C. Cook & R. C. Doll[148]	G. Beauchamp[149]	N. B. Henry[150]
SANCTION	X						X			
HUMAN DEVELOPMENT	X		X		X		X	X	X	X
NATURE OF MAN	X	X			X		X	X		X
UTILITY	X	X	X	X				X	X	X
SEQUENCE	X		X	X				X	X	X
INTERESTS		X	X	X		X	X	X	X	X
NEEDS	X		X	X	X	X	X	X	X	X
SOCIAL & CULTURAL NORMS	X	X	X	X		X	X	X	X	X
APPROPRIATENESS	X	X	X	X	X	X	X	X	X	X
OBJECTIVES	X	X	X	X	X	X	X	X	X	X
BREADTH & DEPTH	X	X	X	X	X	X		X		
SOCIAL & CULTURAL	X	X	X	X	X	X	X	X	X	X
INQUIRY				X	X	X	X	X	X	X
FUNDAMENTAL	X	X	X	X	X	X	X	X	X	X
CONTEMPORARY	X		X	X	X	X	X	X	X	

AUTHORS

FIGURE I - COMMONALITY OF AUTHORS' CRITERIA

141 Gail Inlow, The Emergent In Curriculum, New York, John Wiley and Sons, Inc., p. 23-26.

142 Duane Manning, Toward A Humanistic Curriculum, New York, Harper & Row, Publishers, Inc., 1971, p. 117-122.

143 Robert S. Zais, Curriculum Principles & Foundations, New York, Thomas Crowell Co., 1976, p. 342-348.

144 Hilda Taba, Curriculum Development: Theory & Practice, New York, Harcourt, Brace & World, Inc., 1962, p. 265-278.

145 Paul deHart Hurd, Op.Cit., p. 11.

146 Ronald C. Doll, Curriculum Improvement: Decision-Making & Process, 2nd. Ed., Boston, Allyn & Bacon, Inc., 1970, p. 149.

147 Vernon E. Anderson, Principles & Procedures Of Curriculum Improvement, New York, The Ronald Press Co., 1965, p. 466-469.

148 Ruth C. Cook & Ronald C. Doll, The Elementary School Curriculum, Boston, Allyn & Bacon, Inc., 1973, p. 461-464.

149 George A. Beauchamp, The Curriculum Of The Elementary School, Boston, Allyn & Bacon, Inc., 1966, p. 315-319.

150 Nelson B. Henry, Op.Cit., p. 159.

references as they were developed specifically for science. The remainder of the authors whose lists of criteria were used are those whose texts dealing with curriculum development have been widely read in the field of education. From the analysis of these lists each criterion was given a title, then condensed into a simple descriptive sentence form, followed by an explanation as follows:

1) Contemporary Knowledge. Content includes valid contemporary knowledge. The content would be found within the present structure of the discipline; therefore, it is valid and up-to-date.

2) Fundamental. Content is fundamental to the discipline. The content is logically basic to a discipline and its importance lies in the fact that it includes other ideas which aid in understanding more complex knowledge of the discipline. In this respect it forms a foundation upon which an understanding of the discipline can be built.

3) Inquiry. Content allows the student to be engaged in the methods of the discipline. The content involves the investigative procedures used in the discipline such as the scientific method in science and thereby illustrates the nature of the discipline.

4) Social and Cultural. Content develops a social and cultural perspective of a nation. The content should aid the student in understanding the social and cultural realities of the nation's environment.

5) Breadth and Depth. Content exhibits balance between breadth of topics and the depth of their treatment. The content is organized to present a wide range of topics each of which are given a depth of treatment considered adequate for the grade level. In this manner a balance between breadth of the number of topics presented and the depth of treatment given to each topic is maintained.

6) Wide Range of Objectives. Content embodies a variety of objectives. The content will provide for a number of different aims and goals of education associated with the cognitive, affective, and psychomotor domains.

7) Appropriateness. Content is appropriate to the intellectual development of the student. The content is suitable for the mental development of the student for whom it is intended.

8) Social and Cultural Norms of the Student. Content relates to the social and cultural norms of the student. It reflects the sociological climate of the students' immediate environment such as the classroom, school, home, and local community.

9) Needs of the Student. Content meets the cultural needs of the student. The content will meet the demands and expectations made on the role the student is expected to play in the cultural environment.

10) Student's Interests. Content allows movement from the student's interests toward logically developed subject matter. The content will accommodate the interests of the student, arouse curiosity, and move towards the ordered structure of the discipline.

11) Sequence. Content is organized in accordance with the logical structure of the discipline. The content will be organized in a manner that is consistent with a simple learning hierarchy.

12) Utility. Content can be applied by the student to everyday life. The content provides information that is useful to man in his everyday activities, such as maintaining household appliances and items found in a technological society.

13) Nature of Man. Content relates to the nature of man's affairs at the local, national, and international levels. The content provides information that has no particular geographical boundaries and deals with the nature of man, his problems of survival, usage of non-renewable resources, overpopulation, poverty, disease control, and the need for a rational interaction with the natural environment.

14) Human Development. Content deals with moral values, ideals, social problems, and controversial issues, and thereby aids in human development. The content allows for discussion and consideration of the many viewpoints possible for a particular issue and is relevant for the rational, healthy, physical and mental growth of the student.

15) Sanction. Content is sanctioned by governing authorities. The content has the approval of educational authorities and only this content should appear in the school's curriculum.

Validation

To validate the final content questionnaire, a three-phase procedure was employed with each phase reducing and consolidating the initial questionnaire. Initially, three questions were constructed by the researcher to represent but not specifically identify each of the fifteen content selection criteria. These questions were then randomly organized to form a list of forty-five questions. The lists of criteria and questions were sent to a panel of ten graduate students in curriculum studies and fifteen science teachers, with the request to match the questions to the criteria. The respondents had been chosen to represent the theoretical and practical implications of curriculum development. They were also asked to select and circle the number of questions best suited to each criterion and to comment on the form and wording of the criteria and questions.

Suggestions made by the panel resulted in changes in the form and wording of criteria and questions. From the results of the matching exercise the list of questions was reduced to thirty, two for each criterion.

The modified lists of criteria and questions were then sent to a second panel of fifteen science teachers and five university professors in science education for matching and evaluation. From the results obtained, fifteen questions with an eighty per cent or better level of agreement were selected, one for each criterion, for the final list. This list had the approval of five university professors in education, and was used as the final questionnaire.

The final questionnaire, along with a letter, simple directions for the completion of the questionnaire, and a personal data sheet formed an instrument package sent to the study participants (see Appendix 6). The letter outlined the purpose of the study to the participants and gave instructions for the return of the questionnaire. In the directions the respondents were asked to study a segment of a junior high school physical-science curriculum which had previously been selected by two university professors as representative of Macdonald's development models. The respondents were then asked to rate on a four-point scale the degree of evidence that existed in the curriculum for its content or organization. They were requested to complete the personal data sheet for sex, academic background, years of teaching experience, and the grade levels in which they were teaching science.

Prior to its general distribution, the instrument package was sent to a panel of five university professors for their evaluation as to clarity of purpose, and possible ambiguity. Suggestions which were offered by this panel concerned the length of the letter and the organization of the directions. The letter and the directions were revised accordingly. The procedures for the distribution and return of the questionnaire are presented in section four.

4. Methodological Procedures

A letter was sent to the head of the science department of one hundred twenty-one English speaking high schools in the Province of Québec informing them of the nature of the study and asking for volunteers to participate.* Of these high schools, fifty-seven indicated an interest in participating in the study and a list of these schools was prepared. From this list thirty-seven high schools were randomly selected, and, depending upon the number of teachers willing to participate, were sent two, three, or four different instrument packages.

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* It should be noted that due to a continuing postal dispute the questionnaire was limited to the Province of Québec.

Each participant was required to evaluate only one of the six science curricula which had been categorized to represent one of the three curriculum development models. Thus, 1 and 1a represented the Linear-Expert; 2 and 2a, the Circular-Consensus; and 3 and 3a, the Dialogical model. As only one curriculum was placed in a package there were six different packages. To avoid possible collaboration between respondents different numbered packages were delivered at different times.

An evaluation of a complete science curriculum by study participants would involve a lengthy and time consuming procedure, therefore, only a segment of each curriculum was used in this study. The six science curricula were examined for commonality of topic by two university professors, ~~and~~ this resulted in a segment of each of the science curricula being selected to represent a particular model.

Four weeks after the initial distribution of the instrument packages, a special request was made to the schools for an early return of the questionnaire. Many of the schools were located in the Montréal area and arrangements were made for a personal pick-up of the completed questionnaires.

There was a final return of approximately ninety-one per cent. The sample consisted of one hundred one science teachers representing the English speaking high schools in the Province of Québec. Section five of this chapter outlines the procedures employed in the analysis of the data.

5. Collection and Analysis of Data

The high school science teachers were requested to rate the degree of evidence present in their curriculum segment regarding its content and organization with reference to specific items in the questionnaire. The responses made by the teachers were recorded on a one-to-four point scale. To gain a first impression of the pattern of response for each item, the data collected from the teachers' evaluation were examined for frequency of response according to personal data using contingency tables.

In order to obtain simultaneous tests of the mean vectors within each of the personal data groupings (sex, academic background, teaching experience, and level of teaching), multivariate analyses of variance were then performed using Finn's Multivariance Program[151]. The computer printout also provided the univariate analysis for each of the items representative of selection criteria.

To procure information relative to Macdonald's three curriculum development models and content selection, a two-way multivariate analysis of variance was conducted using model (three levels), and curriculum segment (two levels), as the

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[151] Jeremy D. Finn, MULTIVARIANCE: UNIVARIANCE AND MULTIVARIATE ANALYSIS OF VARIANCE, COVARIANCE, AND REGRESSION, Chicago, Illinois, National Education Resources, 1972, p. 320.

factors. The design was a two-way analysis of variance with the levels of segment nested within each model.

To facilitate the interpretation and analysis of the differences between individual items a discriminant analysis was then undertaken.

This chapter has outlined the design of the study formulated to obtain information on the content and its organization in each of the curricula representative of Macdonald's three curriculum development models. Chapter Four will present the results of the data collected.

CHAPTER IV

PRESENTATION OF THE RESULTS

This chapter presents the findings of the investigation which was conducted to determine whether the content selected and organized for a science curriculum differed according to Macdonald's curriculum development models.

All of the selection criteria from the questionnaire were used except one. Item number ten in the questionnaire represented the criterion of sanction. As more than ninety per cent of the respondents stated that they were unable to make a judgment for this item, and as there was little support for this criterion in the literature, it was removed from the study. Items numbered 11-15 inclusive in the questionnaire were changed to items 10-14, and only those evaluations made on the fourteen items were considered as being representative of the study.

The results are presented under the following headings: the frequency of response according to personal data of the respondents, the evaluation of the selection criteria according to personal data, and the evaluation of the selection criteria with reference to the models and their segments.

1. Frequency of Response According to Personal Data

This section presents the pattern of responses made by the science teachers in their evaluation of the curricula representative of Macdonald's three curriculum development models. To examine the whole curriculum would have been too lengthy for the purpose of this study; therefore, the science teachers were merely requested to examine a segment of a physical-science curriculum that was associated with one of these models. They were then requested to complete a questionnaire by indicating on a four-point scale the extent to which content of the curriculum segment gave evidence of the presence of selection criteria.

To determine whether the personal background of the respondents had any effects on their evaluation they were also asked to complete a personal data sheet. The results obtained from these data sheets were categorized according to four personal data groupings. These groupings were: sex, academic background, years of teaching experience, and the grade level taught by the respondents. The four contingency tables, numbered one to four, which illustrate the pattern of response made by these different groupings are to be found in Appendix 7.

The tables imply that there was a close agreement in the science teachers' evaluation of the content in the curriculum regardless of the groupings they were associated with. In general, the data presented in these four tables suggest that no differences exist in the respondents' evaluations which may be attributed to their different backgrounds.

The evaluations made by the science teachers were concerned with the content and its organization in a physical-science curriculum. The respondents were asked to evaluate the degree of evidence present in curriculum content that related to certain criteria for content selection. The next section will present the data related to this evaluation.

2. Evaluation of the Selection Criteria With Respect to Personal Data Groupings

Criteria for the selection and organization of content for a science curriculum were incorporated in the questionnaire distributed to science teachers in the Province of Québec. The teachers were requested to evaluate the content in a segment of a science curriculum that was representative of one of Macdonald's development models.

A single factor multivariate analysis of variance was then undertaken for the four personal data groupings of the respondents. The tables which present the findings of these analyses together with their associated tables showing the mean values and standard deviations for each of the groupings are to be found in Appendix 8. These tables are numbered five through twelve.

The data obtained from the multivariate tests for each one of the groupings; sex, academic background, years of teaching experience, and level of teaching, indicate that no significant differences exist. These findings support the hypothesis of no differences among the personal data groupings with respect to their evaluation of content in science curricula. This level of agreement can also be seen in the associated tables presenting the mean values for each item according to personal data groupings. In general then, no significant differences exist in the evaluations made by science teachers which may be attributed to their personal backgrounds.

3. Evaluation of Selection Criteria for Models

The primary objective of this study was to obtain information regarding the selection and organization of content in science curricula relative to Macdonald's three development models. It was decided that such information could best be procured by using two science curricula for each one of the three models. To gain this information, two-way multivariate analysis of variance was conducted, using model and the segments of the curriculum (which were part of each model) as the factors. Thus, the design used in this study was a two-way analysis of variance with the levels of segment nested within each model. The data obtained from these analyses were tabulated and will now be examined.

Tables XIIIa and XIIIb present both multivariate and univariate results for the two-way (model by curriculum segment within model) analysis of variance. The multivariate analyses resulted in both main effects showing significance. The probabilities associated with each effect in the multivariate analyses were as follows: for model, 0.0122; and for segment within model, 0.0030.

The multivariate analysis of variance data for model are shown in Table XIIIa and indicate the presence of significant differences for the curriculum development model factor. It should be noted that the hypotheses are rejected or retained on the basis of the multivariate F-ratios which provide a simultaneous test of significance. However, when these are significant, following the recommendations of authors like Finn[152], the univariate F-ratios can be examined since they

[152] Ibid.

may provide useful descriptive information. The reason for undertaking such an examination in this study was to obtain information that might aid in the understanding of the different aspects associated with each of the three development models.

The univariate analyses in Table XIIIa show that specific differences occur for items 1, 3, 6, 7, 9, and 11, which represent criteria for contemporary knowledge, inquiry, appropriateness, student's interests, utility, and the nature of man, respectively. The first two of these criteria are concerned with the discipline's content, whereas the others are associated with the humanistic concerns of the curriculum.

Table XIIIb reports the results for segment within model. The multivariate analysis shows a $p<0.0030$ for differences for the segments within model. If for descriptive purposes the univariate analyses are examined, then items 1, 3, 6, and 7 seem to provide the reasons for the group mean vector differences. These items represent selection criteria concerned with contemporary knowledge, inquiry, appropriateness, and the student's interests. The first two of these selection criteria are concerned with the discipline's content, the others are of a humanistic concern.

TABLE XIII a

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE FOR MODEL

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
MODEL					ERROR		
MULTIVARIATE	28	---	1.8256	0.0122*	MULTIVARIATE	142	---
UNIVARIATE					UNIVARIATE		
ITEM 1	2	1.6444	3.6224	0.0310*	ITEM 1	84	0.4539
2	2	0.0778	0.1725	0.8419	2	84	0.4507
3	2	2.1778	4.6667	0.0120*	3	84	0.4666
4	2	0.5778	1.0111	0.3682	4	84	0.5714
5	2	1.4444	1.9972	0.1421	5	84	0.5730
6	2	2.7444	4.5741	0.0131*	6	84	0.6000
7	2	3.7000	6.0077	0.0037*	7	84	0.6158
8	2	1.3778	2.2429	0.1125	8	84	0.6142
9	2	1.8778	3.2060	0.0456*	9	84	0.5857
10	2	0.2333	0.3603	0.6986	10	84	0.6476
11	2	2.4333	3.5818	0.0322*	11	84	0.6793
12	2	1.3000	2.4303	0.0942	12	84	0.5349
13	2	1.3444	1.8656	0.1612	13	84	0.7206
14	2	0.7444	1.4842	0.2326	14	84	0.5015

Number of responses = 90

* Indicates $p < 0.05$

TABLE XIII b

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE FOR SEGMENT

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
SEGMENT					ERROR		
MULTIVARIATE	42	---	1.8332	0.0030*	MULTIVARIATE	211	—
UNIVARIATE					UNIVARIATE		
ITEM 1	3	1.5111	3.3287	0.0235*	ITEM 1	84	0.4539
2	3	0.5889	1.3063	0.2778	2	84	0.4507
3	3	2.3556	5.0476	0.0029*	3	84	0.4666
4	3	0.2111	0.3694	0.7753	4	84	0.5714
5	3	1.4333	2.5014	0.0650	5	84	0.5730
6	3	2.2444	3.7404	0.0142*	6	84	0.6000
7	3	3.6556	5.9356	0.0011*	7	84	0.6158
8	3	1.5444	2.5142	0.0640	8	84	0.6142
9	3	1.1778	2.0108	0.1187	9	84	0.5857
10	3	0.6778	1.0466	0.3764	10	84	0.6476
11	3	0.3222	0.4743	0.7011	11	84	0.6793
12	3	0.1889	0.3531	0.7870	12	84	0.5349
13	3	1.0778	1.4956	0.2217	13	84	0.7206
14	3	1.0000	1.9937	0.1212	14	84	0.5015

Number of responses = 90

* Indicates $p < 0.05$

Following the results for segment it was considered necessary to undertake a more specific analysis to determine the significance of the segments within each level of the factor model. This is a more appropriate analysis than looking at the overall effect for segment within model since the study involved a nested design. It was also decided to use a significant level of .01 in this analysis to ensure a more stringent test of difference should one occur. Tables XIVa through XIVc provide these results.

Table XIVa presents the results of the analysis of variance for the curriculum segments within Model One. This model is known as the Linear-Expert and attempts to control the developmental procedures in the selection and organization of the discipline's content for a curriculum. The multivariate F-ratio indicates that a significant difference exists between the two segments although none are reported for the univariate analyses at the .01 level.

The analysis of variance for the segments in Model Two are recorded in Table XIVb. This model is referred to as the Circular-Consensus which uses consensus in its developmental procedures and is concerned with the needs of society. The multivariate F-ratio indicates that there is a significant difference between the segments. The univariate analyses suggest that difference occurs between the segments for items 1, 3, 6, and 7. These items represent content selection

TABLE XIV a

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE FOR THE CURRICULUM SEGMENTS WITHIN MODEL ONE - (LINEAR-EXPERT)

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
SEGMENTS 1 & 2 WITHIN MODEL 1					ERROR		
MULTIVARIATE	14	—	2.4988	0.0061*	MULTIVARIATE	71	--
UNIVARIATE					UNIVARIATE		
ITEM 1	1	1.2000	2.6434	0.1078	ITEM 1	84	0.4539
2	1	0.5333	1.8131	0.2799	2	84	0.4507
3	1	2.1333	4.5714	0.0355	3	84	0.4666
4	1	0.0333	0.0583	0.8098	4	84	0.5714
5	1	3.3333	5.8172	0.0181	5	84	0.5730
6	1	0.3000	0.5000	0.4815	6	84	0.6000
7	1	3.3333	5.4124	0.0225	7	84	0.6158
8	1	4.3333	6.5659	0.0122	8	84	0.6142
9	1	0.5333	0.9106	0.3427	9	84	0.5857
10	1	0.8333	1.2868	0.2599	10	84	0.6476
11	1	0.8333	1.2266	0.2712	11	84	0.6793
12	1	0.1333	0.2493	0.6189	12	84	0.5349
13	1	1.2000	1.6652	0.2005	13	84	0.7206
14	1	0.5333	1.0633	0.3054	14	84	0.5015

Number of responses = 90

* Indicates $p < 0.01$

TABLE XIV b

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE FOR THE CURRICULUM SEGMENTS WITHIN MODEL TWO - (CIRCULAR-CONSENSUS)

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
SEGMENT 1 & 2 WITHIN MODEL 2					ERROR		
MULTIVARIATE	14	--	2.5632	0.0050*	MULTIVARIATE	71	—
UNIVARIATE					UNIVARIATE		
ITEM 1	1	3.3333	7.3427	0.0082*	ITEM 1	84	0.4539
2	1	1.2000	2.6620	0.1066	2	84	0.4507
3	1	4.8000	10.2857	0.0019*	3	84	0.4666
4	1	0.3000	0.5250	0.4708	4	84	0.5714
5	1	0.8333	1.4543	0.2313	5	84	0.5730
6	1	4.8000	8.0000	0.0059*	6	84	0.6000
7	1	7.5000	12.1778	0.0008*	7	84	0.6158
8	1	0.3000	0.4884	0.4866	8	84	0.6142
9	1	2.7000	4.6098	0.0347	9	84	0.5857
10	1	0.0	0.0	1.0000	10	84	0.6476
11	1	0.1333	0.1963	0.6589	11	84	0.6793
12	1	0.3000	0.5608	0.4561	12	84	0.5349
13	1	1.2000	1.6652	0.2005	13	84	0.7206
14	1	0.8333	1.6614	0.2010	14	84	0.5015

Number of responses = 90

* Indicates $p < 0.01$

criteria concerned with contemporary knowledge, inquiry, appropriateness, and student's interests.

The analysis of variance for the segments in Model Three are presented in Table XIVc. The third curriculum development model is known as the Dialogical which is concerned that the content meets the needs of the students. The multivariate analysis indicates that no significant difference exists between the segments in this third model.

Additional information regarding the differences that occur between the segments within Models One and Two is to be found in Table XV which presents the mean values for the segments in Models One, Two, and Three. It should be noted that the mean values of the segments within Models One and Two are disparate as would be expected from the findings of the analyses of variance.

A possible explanation for the differences between the segments within Models One and Two may be found in the literature and the selection (categorization) procedures in this study. The difficulty in finding curricula with identical, or even similar content, has been previously noted in the review of the literature (see p. 57-58). In this present study it was noted that when the ten high school teachers categorized the curricula according to Macdonald's description for each model, their agreement was stronger for one of the

TABLE XIV c

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE FOR THE CURRICULUM SEGMENTS IN MODEL THREE - (DIALOGICAL)

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
SEGMENTS 1 & 2 WITHIN MODEL 3					ERROR		
MULTIVARIATE	14	--	0.7193	0.7482	MULTIVARIATE	71	—
UNIVARIATE					UNIVARIATE		
ITEM 1	1	0.0	0.0	1.000	ITEM 1	84	0.4539
2	1	0.0333	0.0739	0.7864	2	84	0.4507
3	1	0.1333	0.2857	0.5944	3	84	0.4666
4	1	0.3000	0.5250	0.4708	4	84	0.5714
5	1	0.1333	0.2327	0.6308	5	84	0.5730
6	1	1.6333	2.7222	0.1027	6	84	0.6000
7	1	0.1333	0.2165	0.6430	7	84	0.6158
8	1	0.3000	0.4884	0.4866	8	84	0.6142
9	1	0.3000	0.5122	0.4762	9	84	0.5857
10	1	1.2000	1.8529	0.1771	10	84	0.6476
11	1	0.0	0.0	1.0000	11	84	0.6793
12	1	0.1333	0.2493	0.6189	12	84	0.5349
13	1	0.8333	1.1564	0.2853	13	84	0.7206
14	1	1.6333	3.2563	0.0748	14	84	0.5015

Number of responses = 90

TABLE XV

THE MEAN VALUES FOR ITEM 1-14 FOR EACH SEGMENT WITHIN MODELS ONE, TWO, AND THREE

		MODEL ONE		MODEL TWO		MODEL THREE	
		LINEAR-EXPERT		CIRCULAR-CONSENSUS		DIALOGICAL	
ITEM		SEG.1	SEG.2	SEG.1	SEG.2	SEG.1	SEG.2
1	CONTEMPORARY	3.4000	3.0000	2.4000	3.0667	3.0000	3.0000
2	FUNDAMENTAL	3.0667	3.3333	2.9333	3.3333	3.2667	3.2000
3	INQUIRY	3.6667	3.1333	2.5333	3.3333	3.3333	3.4667
4	BREADTH & DEPTH	2.6666	2.7333	2.6667	2.8667	3.0667	2.8667
5	SEQUENCE	3.4667	2.8000	2.6667	3.0000	3.2667	3.1333
6	APPROPRIATENESS	2.7333	2.5333	2.1333	2.9333	2.8667	3.3333
7	STUDENT'S INTEREST	3.0667	2.4000	1.9333	2.9333	3.0667	3.2000
8	OBJECTIVES	3.0000	2.2667	2.6000	2.8000	3.1333	2.9333
9	UTILITY	2.3333	2.6000	2.4000	3.0000	2.8667	3.0667
10	STUDENT'S NEEDS	2.2000	2.5333	2.3333	2.3333	2.0000	2.4000
11	NATURE OF MAN	1.6000	1.9333	2.0667	1.9333	2.3333	2.3333
12	HUMAN DEVELOPMENT	2.3333	2.2000	2.2667	2.4667	2.6000	2.7333
13	SOCIAL & CULTURAL	2.2000	2.6000	2.2000	2.6000	2.6000	2.9333
14	SOCIAL & CULTURAL NORMS	2.3333	2.6000	2.5333	2.8667	2.5333	3.0000

Number of responses = 90

curriculum segments than for the other. The differences between the segments within Models One and Two were, therefore, not unexpected.

From these observations, it was concluded that since the Model Hypothesis involved averaging across segments that were significantly different for two of the three models, the hypothesis should focus on the segment best representative of each one of the three models. These are the segments for which the science teachers had 100%, or close to 100% agreement during the segment-model categorization process.

Emanating from these concerns for the segment factor, a multivariate analysis of variance was then undertaken using the segments best representative of the three models. The results of these analyses will now be presented.

Table XVI reports the multivariate analysis of variance for the best representative curriculum segments in all three models. The data from this analysis indicate that a significant difference exists in the content associated with the three curriculum development models. The univariate analyses suggest that differences occur among the models for those items representative of selection criteria 1, 3, 5, 6, 7, 9, 11 and 13. These items are concerned with contemporary knowledge, inquiry, sequence, appropriateness, student's interest, utility, nature of man, and, social and cultural, respectively.

TABLE XVI

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE FOR THE BEST REPRESENTATIVE CURRICULUM SEGMENTS IN MODELS

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
MODELS					ERROR		
MULTIVARIATE	28	--	3.1737	0.0002*	MULTIVARIATE	58	--
UNIVARIATE					UNIVARIATE		
ITEM 1	2	3.8000	6.3333	0.0040*	ITEM 1	42	0.6000
2	2	0.2667	0.3962	0.6754	2	42	0.6730
3	2	5.4889	13.7222	0.0001*	3	42	0.4000
4	2	0.2000	0.2958	0.7455	4	42	0.6761
5	2	2.4222	4.8910	0.0124*	5	42	0.4952
6	2	5.4000	7.5600	0.0016*	6	42	0.7142
7	2	7.2667	8.9066	0.0006*	7	42	0.8158
8	2	0.6889	1.0905	0.3454	8	42	0.6317
9	2	2.4667	4.0052	0.0256*	9	42	0.6158
10	2	0.1556	0.2085	0.8127	10	42	0.7460
11	2	2.0667	3.6369	0.0350*	11	42	0.5682
12	2	0.9556	1.5926	0.2155	12	42	0.6000
13	2	2.6889	5.1963	0.0097*	13	42	0.5174
14	2	1.7556	3.1965	0.0511	14	42	0.5492

Number of responses = 45

* Indicates $p < 0.05$

Additional information regarding the differences illustrated in Table XVI can be seen in Table XVII. This table presents the mean values of items 1-14 for the best representative curriculum segments in the three curriculum development models.

When a particular effect has been found significant in MANOVA (as is reported in Table XVI), there is still the question of how the groups representing the levels of that effect differ in terms of the criterion variables used. In this investigation it seemed appropriate to use the more refined technique of discriminant analysis to determine the nature of, and the linear dimensions along which the stable differences occurred[153]. In using this technique new variables called discriminant functions, or canonical variates, are derived as weighted sums of the original variables such that these derived variables maximally separate the groups. Thus, the group means on the canonical variables differ more than would the group means in any other combination of the original variables. Study of the way the original variables are weighted to form the canonical variates thereby helps to interpret the between model difference that was detected using the MANOVA.

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[153] Maurice M. Tatsuoka, Discriminant Analysis: The Study of Group Differences, Champain, Illinois, Institute for Personality and Ability Testing, 1970, p. i-iv, 1-57.

TABLE XVII

THE MEAN VALUES FOR ITEMS 1-14 FOR THE BEST REPRESENTATIVE SEGMENT WITHIN EACH MODEL

ITEM		MODEL 1 LINEAR-EXPERT SEGMENT 1	MODEL 2 CIRCULAR-CONSENSUS SEGMENT 1	MODEL 3 DIALOGICAL SEGMENT 2
1	CONTEMPORARY	3.4000	2.4000	3.0000
2	FUNDAMENTAL	3.0667	2.9333	3.2000
3	INQUIRY	3.6667	2.5333	3.4667
4	BREADTH & DEPTH	2.6666	2.6667	2.8667
5	SEQUENCE	3.4667	2.6667	3.1333
6	APPROPRIATENESS	2.7333	2.1333	3.3333
7	STUDENT'S INTEREST	3.0667	1.9333	3.2000
8	OBJECTIVES	3.0000	2.6000	2.9333
9	UTILITY	2.3333	2.4000	3.0667
10	STUDENT'S NEEDS	2.2000	2.3333	2.4000
11	NATURE OF MAN	1.6000	2.0667	2.3333
12	HUMAN DEVELOPMENT	2.3333	2.2667	2.7333
13	SOCIAL & CULTURAL	2.2000	2.2000	2.9333
14	SOCIAL & CULTURAL NORMS	2.3333	2.5333	3.0000

Number of responses = 45

The discriminant analysis resulted in two canonical variates with over two thirds (68.28%) of between-group variance attributed to a single linear combination of the item measurements, and, under one third (31.72%) explained by a second combination. Bartlett's chi square test for significance of successive canonical variates indicated that both of these linear combinations are significant with a p less than 0.0001 for the two combinations together, and 0.0242 for the second combination, which is over and above the first combination. Tables XVIII, and XX, report the discriminant function coefficients for the best representative curriculum segments in the three models in order of their standardized values.

Table XVIII reports the first discriminant function which accounts for 68.28% of between-group variance. The standardized coefficients indicate that the greatest amount of variance occurs between items 3 (inquiry), with a positive value of 0.9292, and 10 (student's needs), with a negative value of -0.8641. It should be noted that inquiry is emphasized in Macdonald's Linear-Expert model; whereas student's needs are stressed in his Dialogical model.

The standardized coefficients in Table XVIII also indicate that considerable variance exists between item 1 (contemporary knowledge), with a positive value of 0.6743, and

TABLE XVIII

FIRST DISCRIMINANT FUNCTION COEFFICIENTS OF THE BEST REPRESENTATIVE SEGMENTS IN THE MODELS IN ORDER OF STANDARDIZED VALUES

ITEM	VARIABLES	RAW COEFFICIENTS	STANDARDIZED
3	INQUIRY	1.469195	0.9292
1	CONTEMPORARY KNOWLEDGE	0.870582	0.6743
9	UTILITY	0.510892	0.4009
13	SOCIAL & CULTURAL	0.555943	0.3999
7	STUDENT'S INTEREST	0.426573	0.3853
5	SEQUENCE	0.256783	0.1807
14	SOCIAL & CULTURAL NORMS	0.174240	0.1291
4	BREADTH & DEPTH	0.049141	0.0404
6	APPROPRIATENESS	-0.019599	-0.0166
12	HUMAN DEVELOPMENT	-0.258331	-0.2001
2	FUNDAMENTAL	-0.317310	-0.2603
11	NATURE OF MAN	-0.379173	-0.2858
8	OBJECTIVES	-0.501795	-0.3988
10	STUDENT'S NEEDS	-1.000456	-0.8641

Number of responses = 45

Function accounts for 68.28% of between group variance, $p < 0.0001$

item 10 (student's needs). Contemporary knowledge and inquiry are emphasized in the Linear-Expert model; whereas the student's needs are stressed in the Dialogical model.

The values given to items 9, 13, 7, and 8 in the first discriminant function are also worthy of note as they too, account for some of the difference among the three models. Items 9 (utility), and 13 (social and cultural), are emphasized in Macdonald's Circular-Consensus model, whilst item 7 (student's interests), is stressed in the Dialogical model, and item 8 (objectives), is a common concern in all three of his development models.

The results reported in Table XVIII for the first discriminant function indicate where the variance occurs among Macdonald's models. Additional information regarding these differences may be found in Table XIX which presents the mean values for items 1-14 of the best representative curriculum segments for each model, and illustrates where the differences occur. This information was obtained by multiplying the standardized coefficients for each item in the models by the original corresponding mean value. For example, in Model One the standardized coefficient for item 14 in the first canonical variate is 0.1291, and its corresponding mean value is 2.3333 (see Table XVII), which when multiplied produces 0.3012 as found in Table XIX. This procedure of

TABLE XIX

THE MEAN VALUES FOR ITEMS 1-14 IN THE BEST REPRESENTATIVE SEGMENT FOR EACH MODEL IN THE FIRST DISCRIMINANT FUNCTION (CALCULATED)

ITEM		MODEL 1 LINEAR-EXPERT	MODEL 2 CIRCULAR-CONSENSUS	MODEL 3 DIALOGICAL
1	CONTEMPORARY KNOWLEDGE	2.2926	1.6183	2.0229
2	FUNDAMENTAL	-0.7983	-0.7635	-0.8329
3	INQUIRY	3.4071	2.3539	3.2212
4	BREADTH & DEPTH	0.1077	0.1077	0.1158
5	SEQUENCE	0.6264	0.4818	0.5662
6	APPROPRIATENESS	-0.0454	-0.0354	-0.0553
7	STUDENT'S INTERESTS	1.1816	0.7449	1.2329
8	OBJECTIVES	-1.1964	-1.0368	-1.1698
9	UTILITY	0.9354	0.9621	1.2293
10	STUDENT'S NEEDS	-1.9010	-2.0162	-2.0738
11	NATURE OF MAN	-0.4573	-0.5906	-0.6668
12	HUMAN DEVELOPMENT	-0.4668	-0.4535	-0.5469
13	SOCIAL & CULTURAL	0.8798	0.8797	1.1730
14	SOCIAL & CULTURAL NORMS	0.3012	0.3270	0.3873
MODEL MEANS 1st. CANONICAL VARIATE		= 4.8666	= 2.5794	= 4.6031

Number of responses = 45

calculating the mean values from the standardized coefficients was repeated for items 1-14 in each one of the three models and resulted in the information to be found in Table XIX.

Table XX reports the coefficients of the second discriminant function for the best representative curriculum segments in Macdonald's models in order of their standardized values. This function accounts for under one third (31.77%) of the variance and it was shown to be statistically significant with a $p<0.0242$.

The data in Table XX indicate that variance occurs between the positive values given to item 10 (student's needs), and item 8 (objectives), when compared with the negative values of items 13 (social and cultural), and 14 (social and cultural norms). The difference between these items is responsible for much of the variance among the models in this second discriminant function. It should also be noted that item 10 (student's needs), is emphasized by Macdonald's Dialogical model; whereas items 13 (social and cultural), and 14 (social and cultural norms), are stressed in his Circular-Consensus model. Item 8 (objectives), is of common concern in all three models.

Other items of significance in Table XX are items 7 (student's interests), 9 (utility), 6 (appropriateness), and 11 (nature of man). All of these items contribute to the variance among the models, although to a somewhat lesser

TABLE XX

SECOND DISCRIMINANT FUNCTION COEFFICIENTS OF THE BEST REPRESENTATIVE SEGMENT IN THE MODELS IN ORDER OF STANDARDIZED VALUES (CALCULATED)

ITEM		VARIABLE	RAW COEFFICIENT	STANDARDIZED
	10	STUDENT'S NEEDS	0.910574	0.7865
	8	OBJECTIVES	0.811008	0.6446
	7	STUDENT'S INTEREST	0.362947	0.3278
	1	CONTEMPORARY KNOWLEDGE	0.366777	0.2841
	5	SEQUENCE	0.365416	0.2572
	12	HUMAN DEVELOPMENT	-0.075145	-0.0582
	4	BREADTH & DEPTH	-0.098220	-0.0808
	3	INQUIRY	-0.374626	-0.2369
	2	FUNDAMENTAL	-0.295907	-0.2428
	9	UTILITY	-0.454845	-0.3570
	6	APPROPRIATENESS	-0.547555	-0.4628
	11	NATURE OF MAN	-0.637782	-0.4808
	13	SOCIAL & CULTURAL	-0.791551	-0.5694
	14	SOCIAL & CULTURAL NORMS	-0.830315	-0.6153

Number of responses = 45

Function accounts for 31.72% of between group variance, $p < 0.0242$

extent than those mentioned previously. Item 9 (utility), is emphasized by the Circular-Consensus model; whereas items 6 (appropriateness), 11 (nature of man), and 7 (student's interests), are stressed in Macdonald's Dialogical model.

Additional information regarding the differences that occur among the items representative of the three curriculum development models is to be found in Table XXI. This table presents the mean values for items 1-14 in the second discriminant function. It is worthy of note that the mean values of the previously mentioned items of the three models are disparate as would be expected from the findings of the second discriminant function.

A discussion of the findings reported in this chapter will be presented in Chapter Five in which the researcher makes reference to the theoretical and historical background information which was introduced in the first two chapters of this thesis.

TABLE XXI

THE MEAN VALUES FOR ITEMS 1-14 IN THE BEST REPRESENTATIVE SEGMENT FOR EACH MODEL IN THE SECOND DISCRIMINANT FUNCTION (CALCULATED)

ITEM		MODEL 1 LINEAR-EXPERT	MODEL 2 CIRCULAR-CONSENSUS	MODEL 3 DIALOGICAL
1	CONTEMPORARY KNOWLEDGE	0.9659	0.6818	0.8523
2	FUNDAMENTAL	-0.7445	-0.7122	-0.7769
3	INQUIRY	-0.8686	-0.6001	-0.8212
4	BREADTH & DEPTH	-0.2154	-0.2154	-0.2316
5	SEQUENCE	0.8916	0.6858	0.8058
6	APPROPRIATENESS	-1.2649	-0.9872	-1.5426
7	STUDENT'S INTEREST	1.0052	0.6337	0.7211
8	OBJECTIVES	1.9338	1.6759	1.8908
9	UTILITY	-0.8329	-0.8568	-1.0948
10	STUDENT'S NEEDS	1.7303	1.8357	1.8876
11	NATURE OF MAN	-0.7693	-0.9936	-1.1218
12	HUMAN DEVELOPMENT	-0.1358	-0.1319	-0.1590
13	SOCIAL & CULTURAL	-1.2527	-1.2527	-1.6702
14	SOCIAL & CULTURAL NORMS	-1.4357	-1.5587	-1.8459
MODEL MEANS 2nd. CANONICAL VARIATE		= -0.9930	= -1.7963	= -3.1064

Number of responses = 45

CHAPTER V

DISCUSSION OF RESULTS

This study was based on Macdonald's description of model typology and used junior high school physical-science curricula in an attempt to answer the question: Do the different value positions suggested by Macdonald to be inherent in each of his curriculum development models result in different content and content organization?

Initially, it was necessary to determine whether the personal backgrounds of the respondents had any effect on their evaluations of the curricula representative of the development models. From the results obtained for frequency of response, and the analysis of variance for evaluation, it was concluded that no significant differences exist which can be attributed to the different personal backgrounds of the respondents.

The multivariate analysis of variance for the curricula representative of Macdonald's three development models reflected significant differences among the models. From these results it could be concluded that the null hypothesis of no significant difference was not upheld. However, as there were two curricula representing each one of the three development models further analyses which involved the segment factor were deemed necessary.

The multivariate analysis of variance for the curriculum segments that were representative of Macdonald's three development models indicated that significant differences occurred among the segments. From these results it was considered prudent to undertake a more specific analysis to determine the significance of the segments within each level of the factor model.

The multivariate analysis of variance for the two curriculum segments representative of each of the three models indicated that significant differences existed among the segments in Models One and Two, but not in Model Three. These results were not unexpected as the difficulty of matching curricula had been noted in the review of the literature and in the categorization of curricula in this study.

It was concluded that, since the results obtained had involved averaging across curriculum segments that were significantly different, better and more precise information could possibly be obtained from using the segment considered to be the best representative of each model. This segment for each model was then determined by examining the data available from the categorization process. A multivariate analysis of variance was then undertaken for model factor using those curriculum segments best representative of Macdonald's three models.

Macdonald's curriculum development Model One is known as the Linear-Expert model and is discipline oriented. This model attempts to control the developmental procedures in the selection and organization of the discipline's content for a curriculum. Such an approach stresses content concerned with the fundamental, investigative procedures, organization, and contemporary knowledge of the discipline.

The discipline-oriented conceptions for curriculum development made by Phenix[154], and King and Brownell[155], contend that the knowledge of the disciplines is the only content suitable for a curriculum. This necessitates that the development of a curriculum is controlled by discipline scholars. Several studies illustrated the practical application of such values and perspectives with Thompson's study[156] providing an ideal example of discipline-oriented curriculum development. An overall concern of the models, conceptions, and the study is that the integrity of the discipline in curriculum development can only be maintained when the procedures are controlled by the discipline. Control over curriculum development by the disciplines supports Macdonald's Linear-Expert model.

Model Two is known as the Circular-Consensus model which places emphasis on the developmental procedures being governed by consensus and the selection of content that meets

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154 Philip H. Phenix, Op.Cit. p. 189-196.

155 King and Brownell, Op.Cit. p. 1-221.

156 B.E. Thompson, Op.Cit. p. 1-338.

the needs of society. Such content is readily associated with the social, cultural, and utilitarian aspects of knowledge.

The conceptions of curriculum development made by Schwab[157], and Walker[158], give support to Macdonald's model and therefore add to its credibility. Several studies used practices in line with these conceptions with the study by Craig[159] providing a practical example which lent support to the Circular-Consensus model.

The third curriculum development model is known as the Dialogical model. This model places its emphasis on humanistic concerns that the curriculum meet the needs of the students. Such a curriculum stresses content that is appropriate for human development, the nature of man, and the student's needs and interests.

Conceptions for curriculum development made by Sergiovanni and Starratt[160], and Weinstein and Fantini[161], substantiate the credibility of this model. Both Bingham[162] and Robertson[163] involved a large number of students in their studies in an attempt to match the cultural knowledge with the needs and interests of the students. In this respect, they gave support to Macdonald's Dialogical model.

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157 Joseph J. Schwab, Op.Cit. p. 501-522.
158 Decker F. Walker, Op.Cit. p. 51-65.
159 Gerald S. Craig, Op.Cit. p. 65-70.
160 T. Sergiovanni and R. Starratt, Op.Cit. p. 237-264.
161 G. Weinstein and M. Fantini, Op.Cit. p. 3-223.
162 N. Eldred Bingham, Op.Cit. p. 226-236.
163 Martin L. Robertson, Op.Cit. p. 65-70.

The analysis of variance undertaken to determine whether differences in content existed among the curricula associated with the three models proved positive when the curriculum segments best representative of the three models were involved. These results indicated that the null hypothesis of no significant difference in the content of the three models was not upheld.

The univariate analyses of variance obtained from this MANOVA suggested that differences did exist between specific items among the three curriculum development models. Thus, whilst it was possible to conclude that the different value positions suggested by Macdonald to be inherent in his development models do result in different content, the results suggested further investigation. Such an investigation was deemed necessary in order to understand the nature of the differences. In this respect, it was decided to invoke the more refined technique of discriminant analysis to determine where the specific differences occurred among the models.

The multiple discriminant analysis performed on the collected data yielded two discriminant functions which were statistically significant with a p less than 0.0001 and 0.0242 respectively.

The largest positive standardized coefficients in the first discriminant function were for inquiry and contemporary knowledge. These were followed with lower values for utility, social and cultural, and student's interests. At the other end of the scale with the highest negative standardized coefficients were the criteria for student's needs and for objectives.

These results indicate that inquiry, contemporary knowledge, student's needs, and objectives, were responsible for much of the differentiation among the three models. It should also be noted that since Model One places emphasis on inquiry and contemporary knowledge; Model Two on utility, social and cultural; Model Three on student's needs and interests; these results suggest the different values inherent in the models were responsible for differentiation in content among the models.

The largest positive standardized coefficients in the second discriminant function were selection criteria for the student's needs, and objectives, followed by the criterion for student's interests with a lesser value. At the other end of the scale with the highest negative standardized coefficient were selection criteria for social and cultural norms, and, social and cultural. These values were followed by those for the nature of man, appropriateness, and utility, at lower levels. Moreover, since Model Two emphasizes social and cultural norms, social and cultural, and utility; Model Three the student's needs and interests, appropriateness, and the nature of man, these results indicate that the different emphases of Macdonald's models were responsible for the differentiation in content among the models.

According to Tatsuoka[164] it is possible to provide a visual corroboration of the differences portrayed by the two discriminant functions. Two axes, Y_1 and Y_2, are used to represent the first and second discriminant analyses along which the significant differences among the three models are found. Plots for criteria, criteria groupings, or model centroids (means), illustrate the differences among the models in the discriminant space. Thus, the means of Models 1, 2, and 3 found in Tables XIX and XXI for the first and second discriminant analyses are plotted as in Figure 2.

The centroids of the three models in Figure 2 show that the first discriminant function separates Models One and Three from Model Two. The figure shows that Model One, the Linear-Expert, and Model Three, the Dialogical, have a magnitude almost twice as great as that given to Model Two, the Circular-Consensus.

The second discriminant function separates the three models equally well ranking them from high to low in the order of Model Three, the Dialogical, Model Two, Circular-Consensus, and Model One, Linear-Expert.

The separation of the three model centroids in the discriminant space corroborates the findings reported in Table XVI, that there are significant differences in the

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[164] Maurice M. Tatsuoka, Op. Cit. p. 46-47.

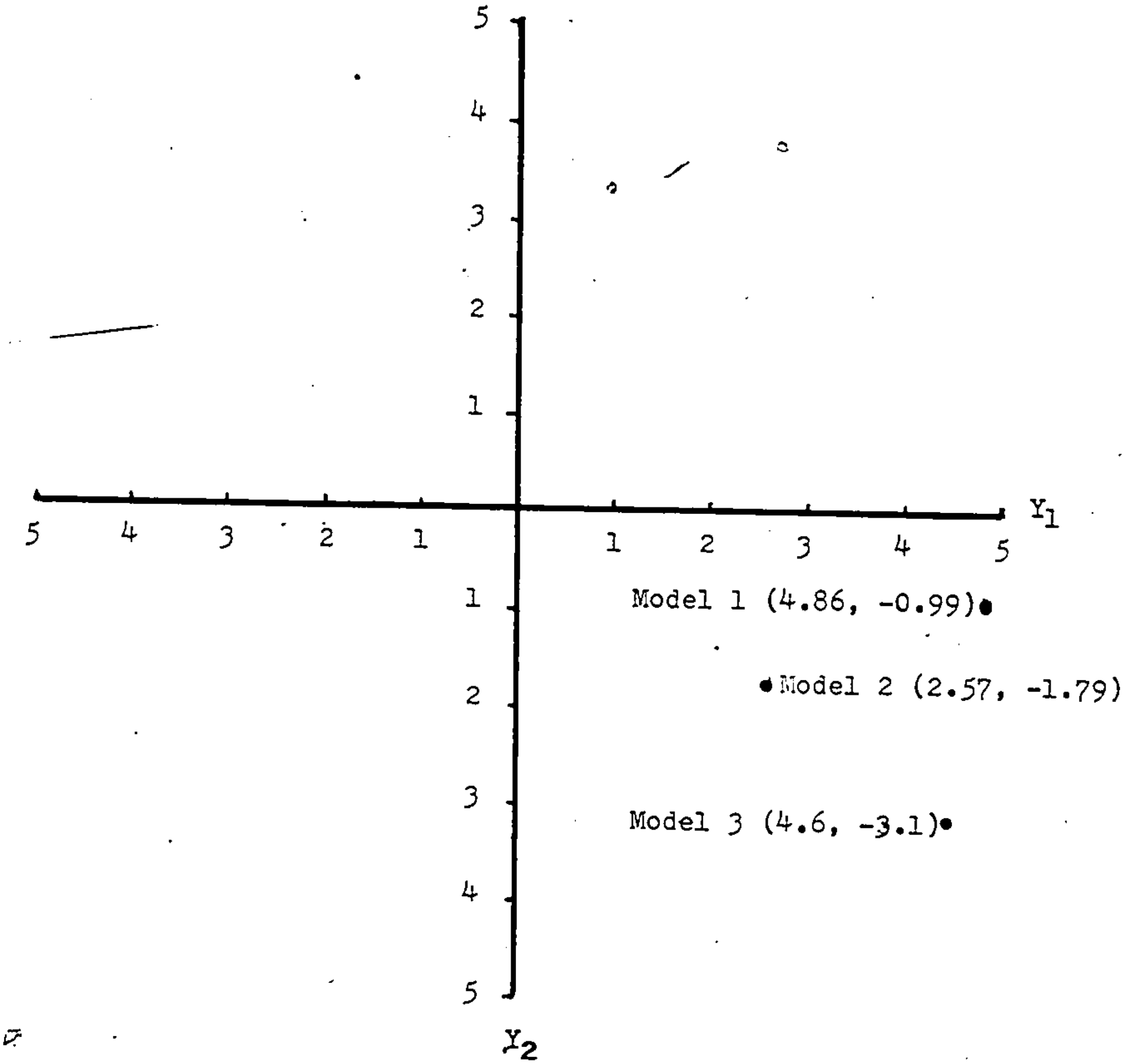

Figure 2 Centroids of the Three Models in the Discriminant Function Space

content of the curricula associated with the three models. These findings support Macdonald's contention that the content produced for a curriculum is dependent upon the model used. It would thus appear that the decisions made during the translation of the aims of the curriculum into content are affected by the values and perspectives held by the developers.

From the different viewpoints offered by various curriculum conceptualists which substantiate each of Macdonald's development models, it could be assumed that the value systems inherent in each model would result in obvious differences in the content of the curricula examined. And, bearing in mind the configuration of the model centroids in Figure 2, the content selection criteria will now be grouped according to the emphasis given to them in each one of Macdonald's models. The centroids for each group of criteria in Models 1, 2, and 3, will be plotted in discriminant space to determine whether any meaningful interpretation can be obtained for the groups of criteria in the two discriminant functions.

Model One is the discipline-oriented model identified by Macdonald as the Linear-Expert. This model gives emphasis to the discipline's content, in particular, to content selection criteria for contemporary knowledge, the fundamental, inquiry, and the organization (sequence) of its content. The centroids for this group were obtained by an addition of the means for these criteria in Tables XIX and XXI. The centroids for these groups in Models One, Two, and Three are presented in Figure 3. The figure shows that the first discriminant function, axis Y_1, separates the discipline-oriented groupings in the three models equally well ranking them from high to low in the order of Linear-Expert (1), Dialogical (3), and Circular-Consensus (2).

The discipline-oriented grouping in the second discriminant analysis, axis Y_2, is hardly separated at all. From the configuration in Figure 3 it can be seen that the Linear-Expert model (1) is rated the highest for content associated with the disciplines which is in agreement with Macdonald's contention for this model. Of the other two models, it is interesting to note that the Dialogical model (3) produces content more closely associated with the disciplines than does the Circular-Consensus model (2). The findings for the Linear-Expert model corroborate the values and perspective inherent in Macdonald's model and the conceptions for curriculum development made by Phenix[165], and King and Brownell[166].

The Linear-Expert model can be clearly identified with discipline-oriented (college preparatory) curricula of the past. Such curricula emphasized contemporary knowledge, the fundamental,

[165] Philip H. Phenix, Op.Cit. p. 189-196.
[166] King and Brownell, Op.Cit. p. 1-221.

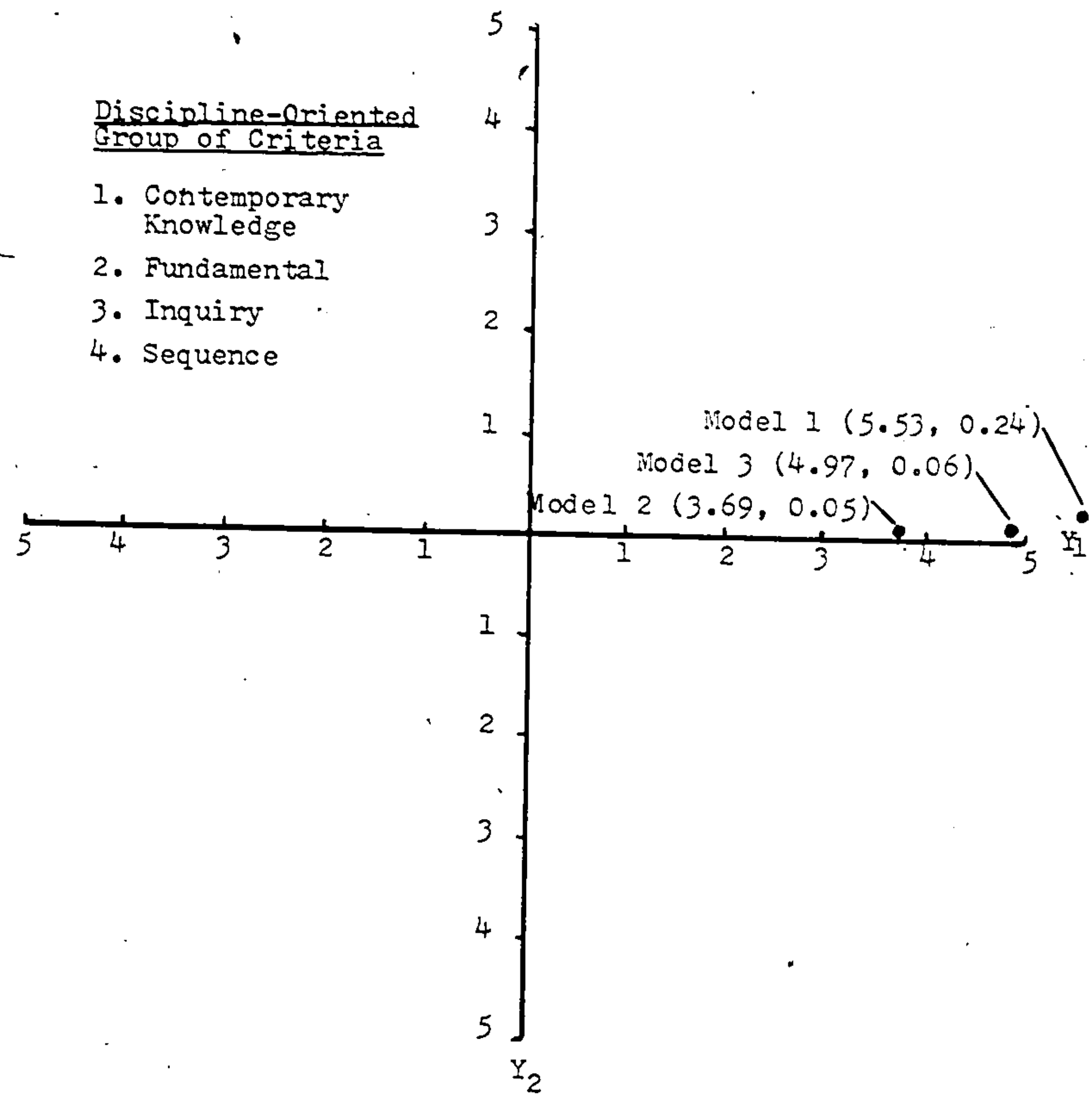

Figure 3 Centroids for the Discipline-Oriented Groups in Models 1, 2 & 3 in the Discriminant Function Space

organization, and inquiry methods common to the particular discipline. The most recent examples of this curricula occurred during the sixties (see pages 40-41) of which the Physical Science Study Committee's (P.S.S.C) Physics Project is a prime example. This kind of curriculum is ideal for students who desire to continue their studies in a particular discipline at the university level. Knowledge of the value commitments inherent in a Linear-Expert type of curriculum should aid an educator who wishes to accommodate academically able students in pursuit of higher learning.

The Circular-Consensus model (2) is associated with content that is arrived at from a consensus and is societal-oriented. Content selection criteria emphasized by this model are social and cultural, social and cultural norms, and utility. Figure 4 presents the three model centroids for this grouping which were obtained by an addition of the means for these criteria found in Tables XIX and XXI. The first discriminant analysis, axis Y_1, shows a distinct separation of the Dialogical model (3) from the Circular-Consensus (2) and Linear-Expert (1) models. The second discriminant analysis, axis Y_2, shows a similar pattern of separation.

Figure 4 illustrates that the societal-oriented selection criteria associated with the Circular-Consensus model (2) were responsible for differentiation of content among the curricula associated with Macdonald's models. From the

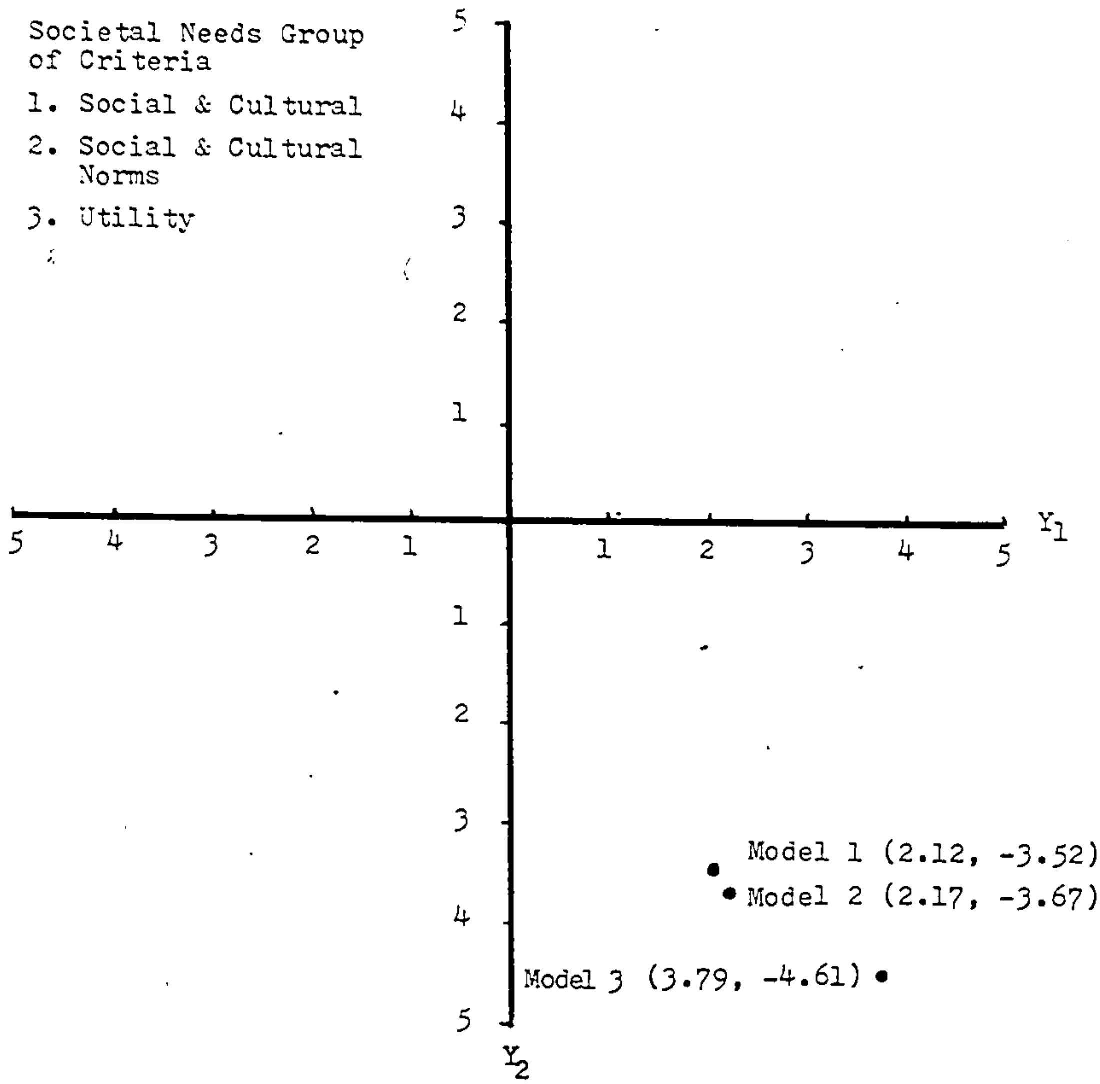

Figure 4 Centroids for the Societal-Oriented Groups in Models 1, 2 & 3 in the Discriminant Function Space

emphasis placed on this grouping it could be anticipated that the Circular-Consensus model would have the highest magnitude in the separation of the models. However, the location of the centroids in the discriminant space shows that the values for societal concerns in the curriculum are greater for the Dialogical model (3) than in the Circular-Consensus model. This is quite possible since the Dialogical model stresses the needs and interests of the students which could easily be associated with their environment.

The Circular-Consensus curriculum development model can easily be identified with the societal-oriented curricula of the past. Knowledge of the values stressed in this model should enable an educator to develop or implement a curriculum suitable for students who are interested in learning the role of science in their society.

Figure 5 presents the centroids for the humanistic criteria groupings present in Models One, Two, and Three. Humanistic concerns are emphasized in the Dialogical model (3). This humanistic grouping includes selection criteria for content representing appropriateness, student's interests, student's needs, the nature of man, and human development.

The first discriminant analysis for this grouping, axis Y_1, shows a distinct separation between the Linear-Expert model (1) and the Dialogical (3) and Circular-Consensus (2) models. However, little separation occurs between the three

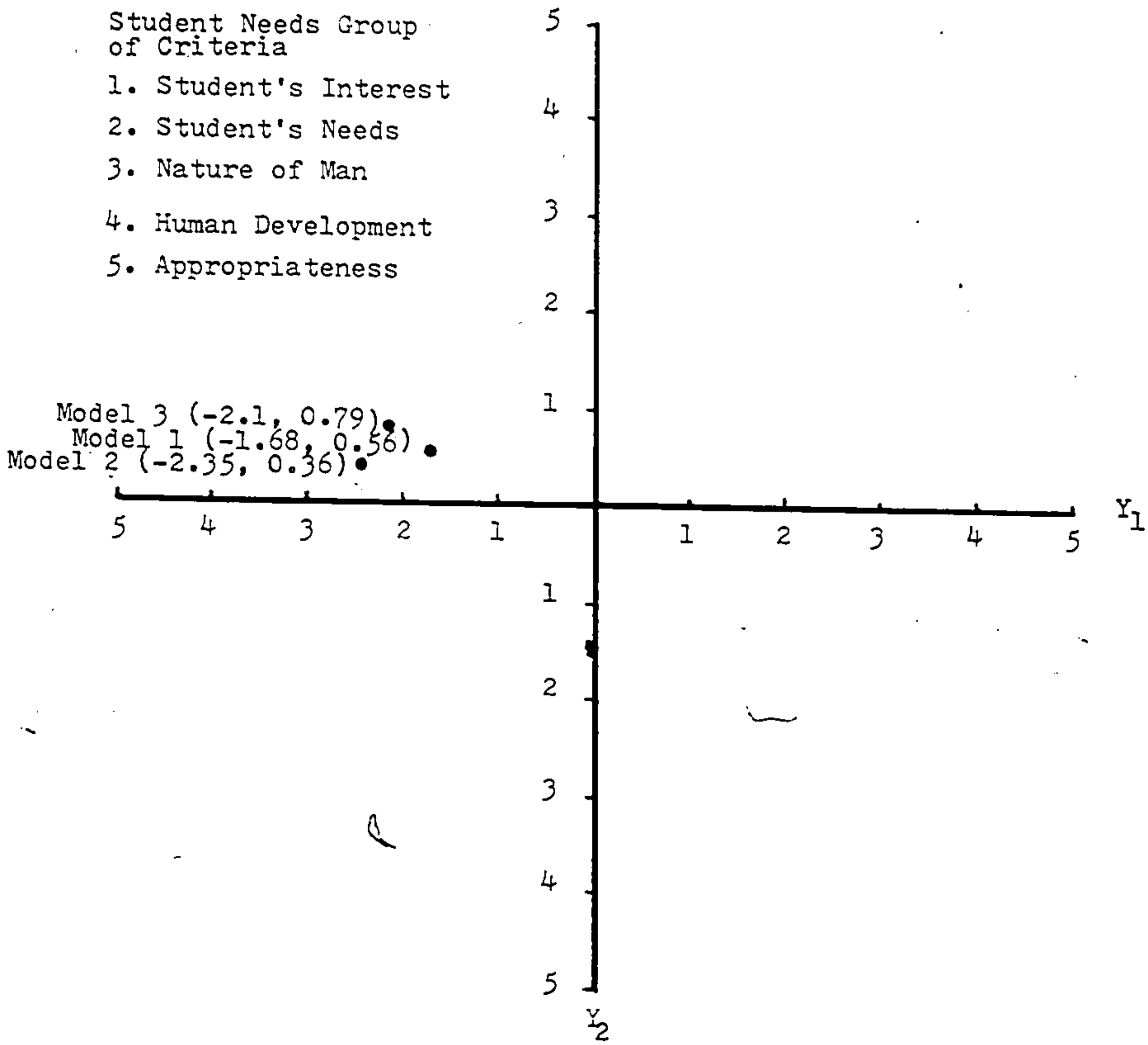

Figure 5 Centroids for the Student's Needs Groups in Models 1, 2 & 3 in the Discriminant Function Space

models with respect to the second discriminant analysis, axis Y_2. Figure 5 indicates that the humanistic selection criteria grouping was responsible for difference in content between the Linear-Expert model (1) and the Dialogical (3) and Circular-Consensus (2) models. The findings illustrated in Figure 5 for the humanistic criteria grouping suggest that this emphasis in the Dialogical model was an influence in selecting content that was significantly different to that resulting from the other two models.

Knowledge of the values stressed in the Dialogical model can be useful to the educator who wishes to develop a curriculum which meets the particular needs of students. In this respect, the model should be ideal for producing a curriculum in sex education as its developmental procedures allow for the matching of cultural knowledge with the specific needs and interests of the students at various levels of maturation.

The two remaining content selection criteria in this study are for objectives and breadth and depth. Both of these criteria are not emphasized by any one model and are therefore considered equally related to all three curriculum development models. The centroids for these two criteria are illustrated in Figure 6. The proximity of the centroids for objectives and breadth and depth indicate that these two criteria had little influence on the difference in content among the three models.

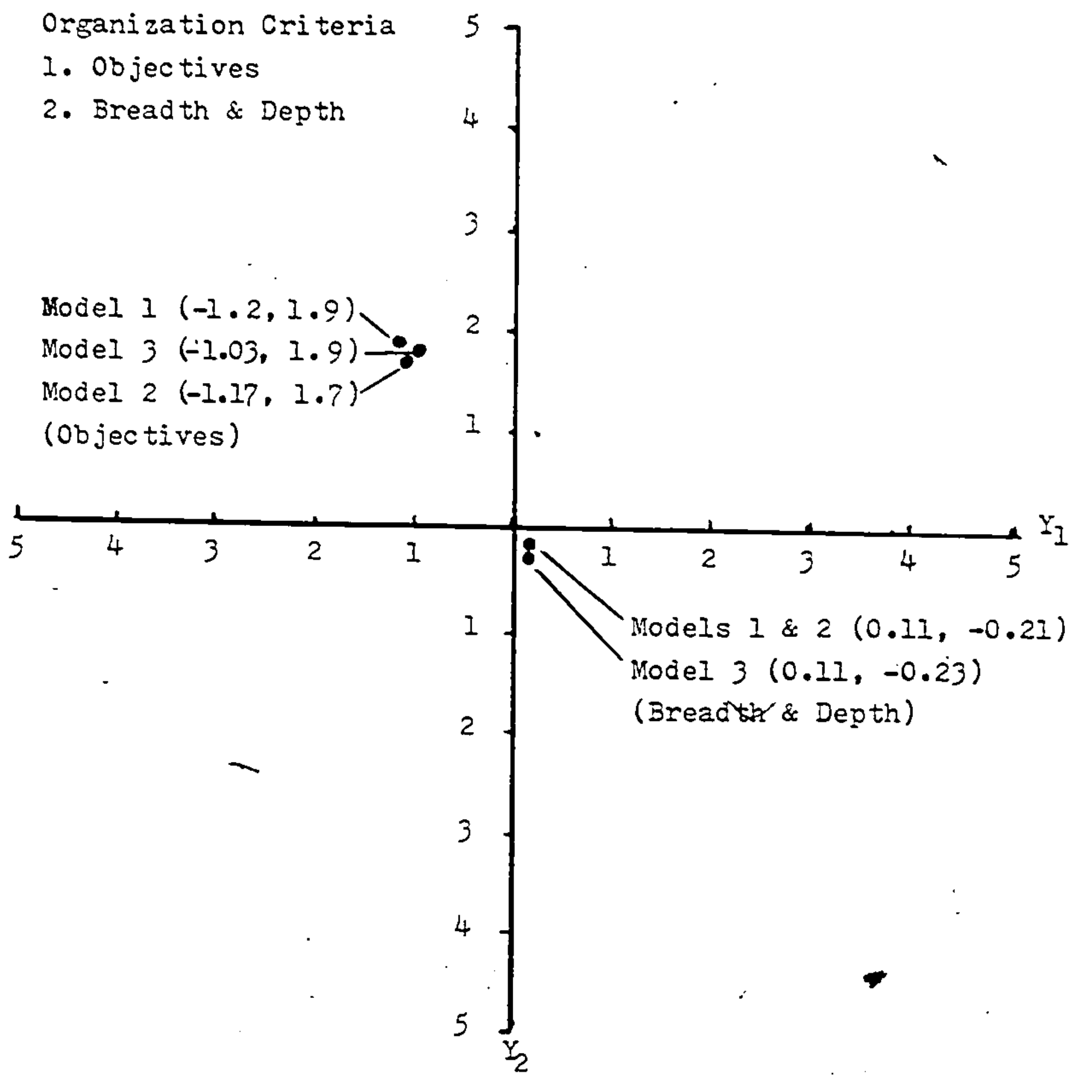

Figure 6 Centroids for Objectives and Breadth & Depth in Models 1, 2 & 3 in the Discriminant Function Space

The results obtained in this study indicated that obvious differences did exist in the content and its organization in the curricula which were representative of Macdonald's models. The discriminant analysis provided information regarding the specific selection criteria that were responsible for differences in content among the models. By grouping specific criteria together to represent the emphasis inherent in each model it was possible to determine to what extent the emphases of the different models were responsible for differentiation in content resulting from the different curriculum development models used.

An awareness of the different value perspectives that these results indicated were present in Macdonald's models, leads to the possibility of the categorization of curriculum development models. Knowledge of such a classification system should prove useful to educators who are required to develop or implement new curricula.

The following section presents the conclusions which can now be made from this investigation.

CONCLUSIONS

This section presents the conçlusions for the study that was undertaken to obtain information regarding the content resulting from the use of different curriculum development models; in particular, those models identified by Macdonald. Such information was necessary to answer the question: Do the different value positions that Macdonald considers to be inherent in each of his models result in different content for junior high school physical-science curricula?

Based on the findings of this study which was limited to physical-science curricula being used in the Provinces of Ontario and Québec, and the evaluation of these curricula by science teachers in the English speaking schools in the Province of Québec, the following conclusions seemed valid:

1. Significant differences do exist in the content and its organization in curricula representative of Macdonald's three curriculum development models.

2. Content associated with contemporary content, inquiry, appropriateness, student's interests, utility, student's needs, social and cultural, and social and cultural norms, was responsible for differentiation among the models.

3. Content representative of specific groups of selection criteria such as discipline-oriented, societal needs, and student needs was also responsible for differentiation in the content among the models.

4. From conclusion 3, there are different value positions in Macdonald's models which result in the selection and organization of different content that depends on the model used.

5. The null hypothesis of no significant difference between the content and its organization in junior high school physical-science curricula was not upheld.

6. Content representative of selection criteria for objectives and breadth and depth was not responsible for any noticeable difference in content among the curricula resulting from the use of Macdonald's models.

The aforementioned conclusions indicated that the specific hypothesis of this study had been answered as have the questions posed on pages 25-26.

From the overall results obtained in this study it was also concluded that Macdonald's models do provide a useful framework upon which to base an investigation into the influence of different curriculum development models on the content selected for a science curriculum. These results provide for a greater understanding of the human interests and value commitments to content that meets the needs of the discipline, society, or the students, and which thereby affect curriculum development.

Knowledge of the value commitments of curriculum developers and the corresponding design aids the potential consumer of their curriculum or those educators who wish to develop a specific type of curriculum to match the needs and interests of particular students. In this respect, a curriculum developed using the Linear-Expert model may be considered the most appropriate for students who wish to pursue further studies in the discipline at the university level. A curriculum developed using the Circular-Consensus model with its emphasis on societal concerns may be suitable for those students who do not desire to pursue post-secondary studies, but who should have some practical knowledge of their environment. Also, for a curriculum of a very personal nature such as special education, the Dialogical model in which the knowledge of the culture is matched with the needs and interests of the students may be the most appropriate to use in its development.

An awareness of the different levels and kind of value perspectives inherent in each one of Macdonald's models leads to the possibility of the categorization of curriculum development models. Knowledge of the model category may prove useful when large school boards attempt to implement a curriculum throughout the schools in its system. As mentioned in Chapter Two, problems have arisen in the past when teachers failed to recognize the values implicitly inherent in a curriculum. As these values are now known for each of Macdonald's models, they could be more readily related to and understood by the teachers required to implement the curriculum. In this manner, a better understanding of the values involved in curriculum development may prevent some of the misunderstandings which usually arise during curriculum implementation.

Macdonald's models, together with the findings of this study, should provide useful information to educators involved in curriculum development or its implementation. These findings also provide potential for curriculum theory and a framework for further inquiry into curriculum development.

Recommendations for Further Study

This investigation into the influence of different curriculum development models on the selection and organization of content for a science curriculum generates a number of questions worthy of similar studies.

1. Do significant differences occur in the content and its organization in chemistry, physics, biology, or other science curricula when related to Macdonald's development models?

2. Do significant differences occur in the content and its organization in non-science curricula when related to Macdonald's models?

3. Would significant differences occur in investigations in the above two questions if undertaken at grade levels other than those in this study?

4. What would be the results if ~~a~~ broader geographic area such as the whole of Canada was used for evaluation purposes?

BIBLIOGRAPHY

Bingham, N. Eldred, "A Study Made in Hillsborough County, Florida, to Determine What Science to Teach in the Junior High School", Science Education, Vol. 47, No. 3, 1963, p. 226-236.

This study used textbooks and scientific journals to construct a list of contemporary content for a science curriculum. It then utilized students and teachers to evaluate the suitability of this content. The results of this evaluation were then subjected to a screening process using content selection criteria concerned with the needs and interests of society, and students, in order to determine the content for the science curriculum. In its use of textbooks and journals, types of persons, and selection criteria, the study was meaningful to the present investigation.

Burnett, R. Will, Teaching Science in the Secondary School, New York, Holt, Rinehart and Winston, 1960, vii-383 p.

The author presents the critical problems in modern science teaching by examining their foundations. The historical development of curricular practices provide support for this study by presenting the cultural influence on change.

Craig, Gerald S., Certain Techniques Used in Developing a Course of Study in Science for the Horace Mann Elementary School, New York, Columbia University, 1927, i-73 IL p.

Craig's study is referred to as a "milestone" in science education since he used many sources and criteria in the development of a science curriculum. His use of laymen to represent the needs of society and a concern that the needs of the student are reflected in the questions they ask set a trend in curriculum development that has since appeared in many studies. This study lends support to the present investigation by its use of many sources, persons, criteria, and in considering the needs of society and human interest.

Eisner, Elliot W., and Vallance, Elizabeth, Eds., Conflicting Conceptions of Curriculum, Berkeley, California, 1974, v-200 p.

These editors consider that there is a need for educators to recognize the conflicting conceptions of the curriculum. They identify the alternate ways of formulating distinctive orientations in the field of curriculum and present five different foundations which reflect basic priorities concerning the form and content of a curriculum.

Gatewood, Claude W., and Obourn, Ellsworth S., "Improving Science Education in the United States", Journal of Research in Science Teaching, Vol. 1, No. 3, 1963, p. 355-399.

This research paper uses an historical approach to outline the influence and problems involved in changing science curricula. Emphasis is placed on science curricula developed after 1950 and the influence of the disciplines on what is now known as the reform movement in science education in the United States.

Hankins, Lela R., A Determination and Selection of Biology Course Content of Significance for a Freshman Level General Education Course, unpublished doctoral thesis for the Oregon State University, Oregon, 1968, xii-161 p.

The content in twenty leading textbooks was analyzed, summarized, and then classified under eleven broad content areas. The current opinions of one hundred fifty research biologists, college and university teaching biologists, science educators, and science historians were then obtained regarding the content found in the textbooks in order to develop a curriculum. The study illustrates the use of many different kinds of persons associated with the discipline, the use of criteria for content selection, and the reliance on content found in textbooks. As such, it provides an example of a study which considers textbooks to be a valuable resource for a curriculum.

Henry, Nelson B., Ed., Rethinking Science Education, Part 1, The Fifty-ninth Yearbook of the N.S.S.E., Chicago, The N.S.S.E., 1960, xiii-344p.

This yearbook represents a comprehensive study of the role of science education in a civilization undergoing constant change. Significant trends in science were interpreted and resulted in emphasis on the content and investigative procedures of science since the practical applications of scientific discoveries are important to the welfare of our civilization. Such information was meaningful to this study since it dealt with constant change, its implications for science education, and the persons who should be involved in curriculum development.

--------, Science Education in American Schools, The Forty-sixth Yearbook of the N.S.S.E., Chicago, University of Chicago Press, 1947, i-306 p.

The problems associated with modern living and the advancement of scientific knowledge were stressed in this yearbook. Emphasis was placed on content selection using criteria based on the personal-social needs of the students; also, on the organization of content conducive to growth skills by using the scientific method. These emphases, along with the utilization aspect of science education, were meaningful to the present study.

Hyman, Ronald T., Ed., Approaches in Curriculum, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1973, 3-225 p.

Hyman conceptualizes curriculum focus as a combination of purpose, selection, and organization of content which is influenced by the critical events of the times. He considers that curriculum workers must be aware of alternatives, and presents a number of different curriculum foci throughout this century to illustrate the variance in curriculum alternatives.

Janke, Delmar L., The Concept Currency of K-12 Science Textbooks Relative to Earth Science Concepts, unpublished doctoral thesis for the University of Wisconsin, Wisconsin, 1969, xii-148 p.

This study determined the degree of agreement between science textbooks and scholars in earth-science relative to the earth-science concepts to be included in a K-12 science curriculum. It found that a majority of the fifty-two earth-science concepts identified by the scientists as being important for inclusion in a K-12 science curriculum are included in textbooks. The study illustrated the use of a combination of textbooks and university professors in the development of a curriculum.

King, Arthur R., and Brownell, John A., The Curriculum and the Disciplines of Knowledge, New York, John Wiley & Sons, 1966, v-221 p.

The various historical systems of knowledge are reviewed prior to presenting the current conditions of knowledge as a pluralism of disciplines. A community of discourse model is proposed for devising a theory of curriculum which affirms the centrality of the disciplines of knowledge and gives primacy to the claim of intellect. This conception of the curriculum gave support to the Linear-Expert model in the present study.

Macdonald, James B., "Curriculum and Human Interest", Curriculum Theorizing: The Reconceptualists, Wm. Pinar, Ed., Berkeley, California, McCutchan Publishing Corp., 1975, p. 283-294.

Fundamental to Macdonald's argument is the assertion that all knowledge is grounded in human interest. He considers that this human interest precedes and channels the activity of curriculum thinking, and has identified three basic orientations which influence curriculum development. Macdonald's three curriculum development models form the framework of this investigation.

Pettit, Donald D., "The Content of Junior High School Science", School Science and Mathematics, Vol. 40, No's. 7 & 8, Oct. 1940, p. 643-654, Nov. 1940, p. 763-776.

These articles report on a number of studies that the author directed on the content in textbooks. The studies investigated the extent of agreement for concepts, commonality of units, and degree of emphasis given to commonly used concepts. He found that although agreement appeared to be present at the unit level, the actual factual content differed considerably. These studies were examples of textbook studies and were useful to the present study by pointing out the difference in the perspectives of actual content.

Phenix, Philip H., "The Architectonics of Knowledge", Education and the Structure of Knowledge, Stanley Elam, Ed., Chicago, Rand McNally & Co., 1964, p. 44-62.

Phenix conceptualizes the architectonics of knowledge as the ordering of knowledge into systematic categories which may be divided and sub-divided into more specialized domains of inquiry. The categorization of knowledge is controlled by a community of specialists who are knowledgeable of, and actively involved in the activities of the discipline. The discipline's organized body of knowledge serves as a valuable resource for curriculum makers. This article supported the conception of curriculum development which believes that it should be controlled by the disciplines.

--------, "The Disciplines as Curriculum Content", Curriculum Crossroads, H. Passow, Ed., New York Teachers College, 1965, p. 189-196.

The author explicates his thesis that all curriculum content should be drawn from the disciplines and that psychological needs, social problems and other materials not based on the disciplines are inappropriate. He views the discipline as a conceptual system in which the cognitive elements are organized into a common framework which reveals patterns and relationships for the simplification of understanding.

Schwab, Joseph J., "The Practical 3: Translation into Curriculum", School Review, Vol. 1, No. 4, August 1973, p. 501-522.

The author explicates a curriculum development model for the translation of scholarly materials into a curriculum. In this model the participants collaborate and employ consensus in their deliberations. Five bodies of experience must be represented in this model, they are: subject matter, learners, the milieu, teachers, and a curriculum specialist. This article lends support to one of the curriculum development models investigated in this study.

Sergiovanni, T., and Starratt, R., Emerging Patterns of Supervision: Human Perspectives, New York, McGraw-Hill, 1971, v-309 p.

The authors' primary goal is the humanizing of education. Initially, they stress supervisory behavior which leads to self-actualization of all school inhabitants. Recent curriculum reforms are examined in order to clarify the focus of a human curriculum with its emphasis on the developmental patterns of human growth. The significance of objectives, learning environment, and evaluation in this type of curriculum are presented along with supportive material. The human curriculum lends support to the Dialogical model in the present study.

Smith, Herbert A., "Educational Research Related to Science Instruction for the Elementary and Junior High School: A Review and Commentary", Journal of Research in Science Teaching, Vol. 1, No. 3, 1963, p. 199-225.

A comprehensive historical study of the educational practices and developments in the elementary and junior high school science program during the past century. The major influences which affected curriculum change are examined and provide insight into the nature of that change. The influences outlined in this report provided meaningful material to the idea of different conceptions of the curriculum and its development. This information was valuable to the present investigation.

Taba, Hilda, Curriculum Development: Theory and Practice, New York, Harcourt, Brace and World Inc., 1962, xiv-526 p.

The most comprehensive text available on curriculum enterprise. This book examines the theory of curriculum development by looking into associated fields of inquiry in order to find support, and thereby strengthen, curriculum thinking.

Thompson, Benjamin E., A List of Currently Credible Biology Concepts Judged by a National Panel to be Important for Inclusion in K-12 Curricula, unpublished doctoral thesis for The University of Wisconsin, 1970, xii-365 p.

This study obtained its content from a panel of university professors who submitted content which they felt should be included in K-12 biology curricula. This content was then rated for suitability by a national panel of biologists, science educators, and biology teachers. One hundred fourteen biology concepts evolved from this study. The utilization of university scientists was considered a successful method of creating a list of credible concepts. This study provided an example of curriculum development controlled by discipline scholars and thereby lent support to the Linear-Expert model in the present study.

Tyler, Ralph, Basic Principles of Curriculum and Instruction, Chicago, Illinois, University of Chicago Press, 1950, 1-83 p.

Tyler's text presents an elaboration of four basic questions that provide the key for curriculum planning at any level of the educational hierarchy. This book is one of the earliest organized approaches to curriculum planning and forms the base upon which other curriculum writers have built.

Underhill, O. E., The Origins and Development of Elementary School Science, Chicago, Illinois, Scott Foresman & Co., 1941, i-347 p.

A comprehensive historical study on the elementary school science program. The various environmental factors that influenced change in the curriculum are illustrated and show that the socio-economic condition was a major factor in change. The study also explains how the curriculum materials reacted to changing conditions and underwent constant change with fluctuations in the beliefs and thinking of the developers.

Walker, Decker F., "A Naturalistic Model For Curriculum Development", School Review, Vol. 80, No. 1, Nov. 1971, p. 51-65.

This article illustrates a model of curriculum development which the author claimed is based on practice. The model consists of the curriculum's platform, its design, and the deliberation associated with its development. It is the interest in consensus which lends support to the Consensus model in this study.

Washton, Nathan S., Teaching Science Creatively in the Secondary School, Philadelphia, Penn., W.B. Saunders Co., 1967, vii-430 p.

The theme, that the only constant in science and science teaching is change, permeates this text. To accommodate this change the author presents the guiding principles and methods for teaching science creatively through inquiry. Chapter five presents an historical viewpoint of the changing science curriculum which provides support for the different curriculum conceptions examined in this study.

Weinstein, G., and Fantini, M., Eds., Toward Humanistic Education, A Curriculum of Affect, New York, Praeger Publishing, 1970, 3-223 p.

These authors consider that education should have a broad human focus and that its objectives should adhere to a personal and interpersonal base dealing with the student's concerns. They present a model for developing a curriculum of affect that will link with cognition, and thereby aid the learner to cope with his own development based on basic-need satisfaction. The explanation and development of the student's needs in Chapter one provides support for the Dialogical model in the present study.

Whipple, Guy Montrose, Ed., A Program for Science Teaching, The Thirty-First Yearbook of the N.S.S.E., Bloomington, Illinois, Public School Pub. Co., 1932, i-370 p.

This yearbook was concerned with the role of science in general education and emphasized the learning of "big ideas" in place of vast amounts of factual information. It stressed the use of personal and social criteria in content selection, also, the type of person who should be involved in curriculum development. These concerns proved to be useful in the present study.

Zais, Robert S., Curriculum Principles and Foundations, New York, Thomas Crowell Co., 1976, xi-516 p.

This book examines the various evolutionary aspects of curriculum foundations and the theory which enhances an understanding of curricular phenomena. It focuses attention on the various dimensions of the curriculum enterprise by analyzing the components, organizational structures, and the process involved in development and implementation. Chapter fourteen, on content and criteria for its selection and organization in curricula, was of concern to the present study.

APPENDIX 1

LETTER TO SUPERINTENDENTS OF INSTRUCTION AND CURRICULUM

3700 McTavish Street,
Montréal,
Québec, H3A 1Y2,

May 28th, 1977.

Dear Sir,

I am presently undertaking a study concerned with junior high school Physical Science curriculum development, and would be most pleased if you would cooperate with me in my endavor.

Initially, it is necessary for me to obtain a wide selection of junior high school Physical Science curricula that are presently used in Canadian schools. Such curriculum materials may be found in the form of a junior high school Physical Science program, a course of study, a manual, or a publisher's textbook, etc. .

To accomplish this task I am contacting major school boards in Ontario and Québec, to obtain information as to the Physical Science curriculum being used in junior high schools (Grades 7-9 in Québec and Grades 8-10 in Ontario).

In the case of textbooks being used, or associated with a Physical Science curriculum, the information required is: the author's name, title of textbook, publisher's name and date of publication. With respect to other curriculum materials, I would appreciate receiving a copy of your junior high school Physical Science curriculum in whichever of the above forms it is expressed.

As I am requested to keep to a timetable in this study I would greatly appreciate hearing from you at your earliest convenience regarding my request.

Thanking you,

Yours sincerely,

W. E. Searles.

APPENDIX 2

SECOND LETTER TO SUPERINTENDENTS OF INSTRUCTION AND CURRICULUM

3700 McTavish Street,
Montréal,
Québec, H3A 1Y2,

June 30th, 1977.

Dear Sir,

This is a follow-up letter to a request that I made to your school board in May but which to-date I have received no reply.

At present I am undertaking a study concerned with junior high school Physical Science curriculum development, and would be most pleased if you would cooperate with me in my endeavor.

Initially, it is necessary for me to obtain a wide selection of junior high school Physical Science curricula that are presently used in Canadian schools. Such curriculum materials may be found in the form of a junior high school Physical Science program, a course of study, a manual, or a publisher's textbook, etc..

To accomplish this task I am contacting major school boards in Ontario and Québec, to obtain information as to the Physical Science curriculum being used in junior high schools (Grades 7-9 in Québec and Grades 8-10 in Ontario).

In case of the textbooks being used, or associated with a Physical Science curriculum, the information required is: the author's name, title of textbook, publisher's name and date of publication.

With respect to other curriculum materials, I would appreciate receiving a copy of your junior high school Physical Science curriculum in whichever of the above forms it is expressed.

As I am requested to keep to a timetable in this study I would greatly appreciate hearing from you at your earliest convenience regarding my request.

Thanking you,

Yours sincerely,

W. E. Searles.

APPENDIX 3

LETTER AND CURRICULUM DEVELOPMENT QUESTIONNAIRE TO CURRICULUM DEVELOPERS

3700 McTavish Street,
Montréal,
Québec, H3A 1Y2,

June 10th, 1977.

Dear Sir,

I am presently undertaking a study concerned with junior high school Physical Science Curriculum Development. Initially, it is necessary for me to determine how the curriculum was developed. To this end I am contacting educators who have developed or have been involved in the development of a junior high school Physical Science curriculum.

As one of the authors of INTERACTION OF MATTER AND ENERGY it would aid me considerably if you would consider the manner in which your text was developed, then complete the enclosed questionnaire. Space has been provided at the end of the questions should you wish to add any comments which you feel may be helpful to me.

The completion of the questionnaire should take only a few minutes of your time and an addressed prepaid envelope is included for your convenience.

Thanking you for your time and cooperation.

Yours sincerely,

W. E. Searles.

APPENDIX 3

JUNIOR HIGH SCHOOL PHYSICAL SCIENCE
CURRICULUM DEVELOPMENT QUESTIONNAIRE

Place a check (✓) against the statement which best describes the basic influence present in the development of the junior high school physical science curriculum in which you were involved.

The junior high school physical science curriculum was:

1. Initiated by an expert or experts of the discipline who normally operate at the university level. _____
2. Developed by an expert or experts who normally operate at the university level and who maintained a controlling influence throughout its development. _____
3. Developed using a group process approach in which teachers were centrally involved and the consensus of the group was a major influence throughout its development. _____
4. Developed by educators who involved students in dialogue before and during its development. _____

The content for the junior high school physical science curriculum was selected:

5. By an expert or experts of the discipline who normally operate at the university level. _____
6. Using a group process in which the participants arrived at a censensus regarding which content was suitable for the curriculum. _____
7. By educators whose major concern was to match the cultural resources - knowledge of physical science- with the needs and interests of the students. _____

The initial and final decisions regarding the validity of the content and its organization in the curriculum was made by:

8. An expert of the discipline area who normally operates at the university level. _____
9. The consensus of the participants engaged in the developmental process. _____
10. Educators actively involving students in curriculum development. _____

APPENDIX 3

The curriculum developmental procedures in which the materials were prepared and tried out, the results fedback, analyzed, rewritten, piloted, and then revised for broad distribution were controlled by:

11. An expert or experts of the discipline area who normally operate/s at the university level. ______
12. The consensus of those persons engaged in the development of the curriculum. ______
13. Educators whose decisions were controlled by the needs and interests of the students. ______

COMMENTS

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NAME OF AUTHOR

NAME OF TEXT

Signature

June, 1977

APPENDIX 4

LETTER TO SCIENCE TEACHERS FOR CATEGORIZATION OF CURRICULA

Dear Colleague,

I am presently undertaking a study concerned with junior high shcool Physical Science Curriculum Development. Specifically, I am interested in substantiating a theory concerned with curriculum development. The importance of such research may be seen in the fact that at present no universally accepted curriculum theories exist to guide educators involved in curriculum development. Therefore, the results of such a substantiation will be a curriculum development theory which will serve as guide and consequently be of considerable value to curriculum developers in the future.

At this level of building a theory one makes use of ideal models such as those developed by James B. Macdonald. Unfortunately, the response to a questionnaire involving ideal models is seldom as clear as one would like. On such occasions the researcher weighs the different responses to a questionnaire very carefully and also searches any written comments for further clues. For example, in No. 1 questionnaire the statements checked (✓) would initially indicate that Macdonald's Circular-Consensus Model was used, but the comments underlined in red ink clearly establish that it was in fact the Linear-Expert Model.

It would aid me considerably in my research endeavor if you would:

1. Study Macdonald's three curriculum development models, then,
2. Making reference to Macdonald's models, study and recognize that No. 1 is in fact Linear-Ecpert.
3. Examine the other completed questionnaire, 2 to 19, categorizing them as belonging to one of Macdonald's three curriculum development models by completing the following:

No. 1 is ____________	No. 11 is ____________
No. 2 is ____________	No. 12 is ____________
No. 3 is ____________	No. 13 is ____________
No. 4 is ____________	No. 14 is ____________
No. 5 is ____________	No. 15 is ____________
No. 6 is ____________	No. 16 is ____________
No. 7 is ____________	No. 17 is ____________
No. 8 is ____________	No. 18 is ____________
No. 9 is ____________	No. 19 is ____________
No.10 is ____________	No. 20 is ____________

PLEASE READ THE FOLLOWING PRIOR TO ANSWERING THE ATTACHED QUESTIONNAIRE.

An outline of three curriculum development models proposed by James B. Macdonald[1] as exemplars or as ideal types.

Linear-Expert Model

A basic interest in control leads to a common linear-expert dominated model. Thus, the procedures employed most advantageously by the national curriculum projects in science and mathematics over the past fifteen years or so fit this model.

In very general terms, the projects are initiated by experts (usually in discipline areas), who begin by preparing materials to be tried out, fed back to the experts, rewritten and piloted, and then revised for broad distribution.

The central features of this procedure are expert domination of the process and the attempt to maximize control by aiming all feedback procedures at gaining the greatest possible amount of student achievement and teacher satisfaction. Thus, the whole process is controlled and monitored with specific goals in mind, and it is the experts who make the initial and final decisions about the validity of the content and process.

This approach, I may add in passing, finds its logical fruition in the behavioral objectives movement.

Circular-Consensus Model

A second model might be likened to what used to be called "grass roots" curriculum development. Essentially what this approach sought to do was engage the local staff of schools in the clarification and specification of aspects of the curriculum (experts are on call).

This approach requires considerable faith in the use of group process and a conviction that unless teachers are centrally involved in the process of curriculum development, texts, documents and materials will be misused or relatively meaningless.

There is some rhetoric of control in this process, but it appears for purposes here that consensus and communication are more important outcomes in this process. Thus, the teachers, staff, and community participate and knowing appears central.

At present the community school curriculum development activities seem to be the direct outcome of this basic interest.

APPENDIX 4

Dialogical Model

The third approach might best be called the dialogical model in the sense that it is out of a dialogical process that the curriculum emerges.

We in the United States do not have a great deal of experience with this model because it actively involves the student in curriculum development. Paulo Freire, on the other hand, has demonstrated this sort of model in literary programs for South American peasants.

In general, this approach would follow from the idea that leaders (staff and other adults) would identify student leaders and with their help try to find major ways of providing a "match" between the cultural resources the adults know about and the needs and interests of students.

General curriculum themes or topics would be prepared by leaders who would engage students in dialogue, and the worth and direction of this material would be validated and verified by each student in his own self-reflection. The closest available illustration of this process would, I suppose, be some of the core curricula, or interdisciplinary activities.

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[1] James B. Macdonald, "Curriculum and Human Interests", in Curriculum Theorizing: THE RECONCEPTUALISTS, Wm. Pinar, Ed., Berkeley, California, McCutchan Publishing Corp., 1975, p.292-293.

APPENDIX 5

CONTENT SELECTION QUESTIONNAIRE

APPENDIX 5

CONTENT SELECTION QUESTIONNAIRE

What evidence exists in the curriculum you have just examined that its content:	VERY WEAK	MODERATELY WEAK	MODERATELY STRONG	VERY STRONG	UNABLE TO JUDGE
1. Is up-to-date knowledge?	1	2	3	4	___
2. Includes knowledge considered essential for an understanding of the discipline?	1	2	3	4	___
3. Can be obtained by students using investigative procedures common to the discipline?	1	2	3	4	___
4. Involves a wide range of topics of which is given adequate treatment for this grade level?	1	2	3	4	___
5. Is organized in a manner consistent with a simple learning hierarchy?	1	2	3	4	___
6. Is suitable for the mental development of the students at this grade level?	1	2	3	4	___
7. Arouses the student's curiosity and moves it toward the ordered structure of the discipline?	1	2	3	4	___
8. Provides for a number of different aims and goals of education?	1	2	3	4	___
9. Includes information that is useful to man in his everyday activities?	1	2	3	4	___
10. Has the approval of the educational authority?	1	2	3	4	___
11. Meets the demands and expectations made on the role the individual is expected to play in our present environment?	1	2	3	4	___
12. Is associated with the universal problems of mankind?	1	2	3	4	___
13. Is relevant for the healthy, physical, and mental growth of the students?	1	2	3	4	___
14. Includes a variety of learning activities associated with the various customs and practices common to our nation?	1	2	3	4	___
15. Includes subject matter suitable for the students living within the community?	1	2	3	4	___

APPENDIX 6

INSTRUMENT PACKAGE

3700 McTavish Street,
Montréal, Québec,
H3A 1Y2,

April 12th, 1978

Dear Colleague,

Thank you for volunteering to participate in my curriculum study.

The purpose of my study is to determine whether and to what extent differences exist from using different models in curriculum development. It is hoped that the study will contribute to a greater understanding of the role played by various curriculum development models.

Anonymity will be ensured throughout the study. Upon completion of the questionnaire, please use the enclosed self-addressed envelope to return the materials to me. Information regarding the findings of this study will be available to you on request.

Your cooperation and time are appreciated.

Sincerely,

W. E. Searles.

APPENDIX 6

GENERAL INFORMATION

Please place a check (✓) in the appropriate space:

Sex: Male ________

Female ________

Degrees or Certificates Held: Teaching Diploma: ______

B. A. ______ B.Sc. ______

B.Comm. ____ B.Ed. ______

M. A. ______ M.Sc. ______

M.Ed. ______ Ph.D. ______

Other ________________
(please specify)

Years of Teaching Experience: 1 - 3 ______

4 - 6 ______

7 - 9 ______

10 - 12 ______

13 - 15 ______

Over-15 ______

Level of High School Science Teaching:

Senior Science Programs ________________________________

Junior Science Programs ________________________________

Both ________________________________

APPENDIX 6

CONTENT SELECTION QUESTIONNAIRE

DIRECTIONS

The attached questionnaire is submitted for your evaluation of a content segment of a junior high school Physical Science curriculum. It is suggested that you:

1. Examine the enclosed content segment of the junior high school Physical Science curriculum.
2. Evaluate the content and organization of the curriculum and answer the 15 questions on the following page.
3. Indicate your evaluation by circling the appropriate number for each question, or, if you are unable to make a judgement place a check (✓) in the space provided.

Example

	VERY WEAK	MODERATELY WEAK	MODERATELY STRONG	VERY STRONG	UNABLE TO JUDGE
What evidence exists in the curriculum you have just examined that its content includes information that is useful to man in his everyday activities?	1	2	3	4	____

Note

1. VERY WEAK denotes a lack of evidence as to the presence of the topic in question.
2. MODERATELY WEAK denotes a small amount of the topic in question is present in the curriculum.
3. MODERATELY STRONG denotes that a fairly large amount of the topic in question is present in the curriculum.
4. VERY STRONG denotes that a very powerful influence (very large amount) of the topic in question is present in the curriculum.

APPENDIX 6

CONTENT SELECTION QUESTIONNAIRE

What evidence exists in the curriculum you have just examined that its content:	VERY WEAK	MODERATELY WEAK	MODERATELY STRONG	VERY STRONG	UNABLE TO JUDGE
1. It up-to-date knowledge?	1	2	3	4	___
2. Includes knowledge considered essential for an understanding of the discipline?	1	2	3	4	___
3. Can be obtained by students using investigative procedures common to the discipline?	1	2	3	4	___
4. Involves a wide range of topics each of which is given adequate treatment for this grade level?	1	2	3	4	___
5. Is organized in a manner consistent with a simple learning hierarchy?	1	2	3	4	___
6. Is suitable for the mental development of the students at this grade level?	1	2	3	4	___
7. Arouses the student's curiosity and moves it toward the ordered structure of the discipline?	1	2	3	4	___
8. Provides for a number of different aims and goals of education?	1	2	3	4	___
9. Includes information that is useful to man in his everyday activities?	1	2	3	4	___
10. Has the approval of the educational authority?	1	2	3	4	___
11. Meets the demands and expectations made on the role the individual is expected to play in our present environment?	1	2	3	4	___
12. Is associated with the universal problems of mankind?	1	2	3	4	___
13. Is relevant for the healthy, physical, and mental growth of the students?	1	2	3	4	___
14. Includes a variety of learning activities associated with the various customs and practices common to our nation?	1	2	3	4	___
15. Includes subject matter suitable for the students living within the community?	1	2	3	4	___

APPENDIX 7

FREQUENCY OF RESPONSE ACCORDING TO PERSONAL DATA - TABLES I - IV

APPENDIX 7

TABLE I

FREQUENCY OF RESPONSE ACCORDING TO SEX OF RESPONDENT

ITEM		MALE (49) 1	2	3	4	FEMALE (41) 1	2	3	4
1	CONTEMPORARY KNOWLEDGE	1	11	27	10	1	7	23	10
2	FUNDAMENTAL	0	7	29	13	1	3	21	16
3	INQUIRY	0	8	17	24	0	9	17	15
4	BREADTH & DEPTH	3	11	28	7	1	12	21	7
5	SEQUENCE	2	12	20	15	0	7	21	13
6	APPROPRIATENESS	5	10	25	9	3	11	21	6
7	STUDENT'S INTERESTS	5	15	17	12	3	9	22	7
8	OBJECTIVES	3	10	30	6	4	10	18	9
9	UTILITY	2	16	23	8	3	14	18	6
10	STUDENT'S NEEDS	6	21	19	3	9	16	15	1
11	NATURE OF MAN	11	21	16	1	16	15	8	2
12	HUMAN DEVELOPMENT	4	19	25	1	5	18	15	3
13	SOCIAL & CULTURAL	5	12	26	6	7	17	13	4
14	SOCIAL & CULTURAL NORMS	3	10	31	5	2	20	16	3

Number of responses = 90

TABLE II

FREQUENCY OF RESPONSE ACCORDING TO THE ACADEMIC BACKGROUND OF RESPONDENTS

		TEACHING CERTIFICATE AND																			
		M.Sc. (29)				M.Ed. (9)				B.Sc. (47)				B.A. (3)				B.Ed. (2)			
ITEM		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	CONTEMPORARY KNOWLEDGE	1	2	20	6	0	3	5	1	1	12	23	11	0	1	1	1	0	0	1	1
2	FUNDAMENTAL	0	3	18	8	0	0	6	3	1	6	23	17	0	1	1	1	0	0	2	0
3	INQUIRY	0	5	11	13	0	2	4	3	0	10	17	20	0	0	1	2	0	0	1	1
4	BREADTH & DEPTH	0	8	16	5	0	4	5	0	4	10	24	9	0	1	2	0	0	0	2	0
5	SEQUENCE	1	4	14	10	0	5	2	2	1	10	23	13	0	0	1	2	0	0	1	1
6	APPROPRIATENESS	2	6	20	1	1	3	4	1	5	12	20	10	0	0	1	2	0	0	1	1
7	STUDENT'S INTERESTS	1	12	10	6	3	1	3	2	4	10	25	8	0	0	1	2	0	1	0	1
8	OBJECTIVES	3	7	17	2	1	2	6	0	3	9	23	12	0	1	2	0	0	1	0	1
9	UTILITY	1	7	18	3	0	3	6	0	4	18	15	10	0	2	1	0	0	0	1	1
10	STUDENT'S NEEDS	5	11	10	3	1	5	3	0	9	19	18	1	0	1	2	0	0	1	1	0
11	NATURE OF MAN	8	9	11	1	3	3	3	0	15	21	9	2	1	2	0	0	0	1	1	0
12	HUMAN DEVELOPMENT	1	11	17	0	0	4	5	0	8	21	15	3	0	1	2	0	0	0	1	1
13	SOCIAL & CULTURAL	3	7	16	3	0	4	4	1	9	16	18	4	0	1	0	2	0	1	1	0
14	SOCIAL & CULTURAL NORMS	2	9	15	3	0	2	7	0	3	17	22	5	0	1	2	0	0	1	1	0

Number of responses = 90

TABLE III

FREQUENCY OF RESPONSE ACCORDING TO YEARS OF TEACHING EXPERIENCE

	1-3 Yrs. (27)				4-6 Yrs. (15)				7-9 Yrs. (13)				10-12 Yrs. (10)				13-15 Yrs. (9)				OVER 15 Yrs. (16)			
ITEM	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	0	4	17	6	1	1	10	3	0	3	6	4	0	2	5	3	0	4	3	2	1	4	9	2
2	1	3	11	12	0	2	10	3	0	1	7	5	0	1	7	2	0	1	5	3	0	2	10	4
3	0	3	13	11	0	2	6	7	0	5	2	6	0	3	2	5	0	0	4	5	0	4	7	5
4	2	7	15	3	2	3	5	5	0	4	7	2	0	3	6	1	0	1	7	1	0	5	9	2
5	1	6	12	8	0	1	7	7	0	4	7	2	1	2	6	1	0	1	3	5	0	5	6	5
6	2	4	14	7	1	2	10	2	1	4	8	0	2	3	3	2	1	1	4	3	1	7	7	1
7	1	4	15	7	2	4	6	3	1	5	4	3	1	5	3	1	0	2	5	2	3	4	6	3
8	0	5	16	6	1	4	6	4	1	2	9	1	2	3	3	2	1	1	7	0	2	5	7	2
9	1	11	10	5	1	3	8	3	0	4	5	4	2	3	3	2	1	3	5	0	0	6	10	0
10	5	9	13	0	2	8	5	0	1	6	5	1	2	3	4	1	1	4	4	0	4	7	3	2
11	8	13	5	1	4	9	2	0	2	4	5	2	3	3	4	0	3	4	2	0	7	3	6	0
12	4	10	11	2	1	5	8	1	1	7	5	0	2	2	5	1	0	4	5	0	1	8	7	0
13	3	10	12	2	1	7	5	2	2	2	9	0	3	0	6	1	1	4	2	2	2	6	5	3
14	1	9	14	3	2	5	5	3	0	3	10	0	1	3	4	2	1	4	4	0	0	6	10	0

Number of responses = 90

TABLE IV

FREQUENCY OF RESPONSE ACCORDING TO GRADE LEVEL OF TEACHING

ITEM		GRADES 10-11 (19)				GRADES 7-9 (15)				GRADES 7-11 (56)			
		1	2	3	4	1	2	3	4	1	2	3	4
1	CONTEMPORARY KNOWLEDGE	0	3	12	4	0	2	10	3	2	13	28	13
2	FUNDAMENTAL	0	1	14	4	0	3	5	7	1	6	31	18
3	INQUIRY	0	3	8	8	0	2	5	8	0	12	21	23
4	BREADTH & DEPTH	0	4	10	5	0	3	10	5	4	16	29	7
5	SEQUENCE	0	2	8	9	0	7	2	6	2	10	31	13
6	APPROPRIATENESS	2	3	11	3	0	2	10	3	6	16	25	9
7	STUDENT'S INTERESTS	2	6	5	6	1	3	7	4	5	15	27	9
8	OBJECTIVES	2	3	9	5	1	1	10	3	4	16	29	7
9	UTILITY	0	7	8	4	0	5	7	3	5	18	26	7
10	STUDENT'S NEEDS	2	9	6	2	2	4	8	1	11	24	20	1
11	NATURE OF MAN	5	4	8	2	4	5	5	1	18	27	11	0
12	HUMAN DEVELOPMENT	0	8	9	2	0	3	10	2	9	26	21	0
13	SOCIAL & CULTURAL	2	5	8	4	2	4	6	3	8	20	25	3
14	SOCIAL & CULTURAL NORMS	1	3	14	1	1	7	6	1	3	20	27	6

Number of responses = 90

APPENDIX 8

EVALUATION OF SELECTION CRITERIA FOR
PERSONAL DATA GROUPINGS - TABLES V - XII

TABLE V

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE ACCORDING TO THE SEX OF THE RESPONDENT

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
SEX					ERROR		
MULTIVARIATE	14	--	0.9823	0.4794	MULTIVARIATE	75	—
UNIVARIATE					UNIVARIATE		
ITEM 1	1	0.1636	0.3144	0.5764	ITEM 1	88	0.5203
2	1	0.4748	1.0628	0.3054	2	88	0.4467
3	1	0.7248	1.2782	0.2613	3	88	0.5670
4	1	0.0248	0.0439	0.8346	4	88	0.5655
5	1	0.6207	1.0096	0.3178	5	88	0.6147
6	1	0.0428	0.0602	0.8068	6	88	0.7111
7	1	0.1100	0.1382	0.7110	7	88	0.7953
8	1	0.0053	0.0079	0.9293	8	88	0.6702
9	1	0.2082	0.3255	0.5698	9	88	0.6395
10	1	0.8283	1.3000	0.2573	10	88	0.6371
11	1	1.2902	1.8429	0.1781	11	88	0.7001
12	1	0.1398	0.2566	0.6138	12	88	0.5450
13	1	2.4605	3.3835	0.0693	13	88	0.7272
14	1	1.8477	3.6315	0.0600	14	88	0.5088

Number of responses = 90

TABLE VI

MEAN VALUE AND STANDARD DEVIATION ACCORDING TO THE SEX OF THE RESPONDENT

ITEM		MALE (49)		FEMALE (41)	
		MEAN	S.D.	MEAN	S.D.
1	CONTEMPORARY KNOWLEDGE	2.9387	0.7190	3.0243	0.7241
2	FUNDAMENTAL	3.1224	0.6335	3.2682	0.7079
3	INQUIRY	3.3265	0.7468	3.1463	0.7602
4	BREADTH & DEPTH	2.7959	0.7632	2.8292	0.7383
5	SEQUENCE	2.9795	0.8536	3.1463	0.6914
6	APPROPRIATENESS	2.7755	0.8723	2.7317	0.8069
7	STUDENT'S INTERESTS	2.7346	0.9525	2.8048	0.8130
8	OBJECTIVES	2.7959	0.7354	2.7805	0.9086
9	UTILITY	2.7551	0.7781	2.6585	0.8249
10	STUDENT'S NEEDS	2.3877	0.7857	2.1951	0.8130
11	NATURE OF MAN	2.1428	0.7905	1.9024	0.8889
12	HUMAN DEVELOPMENT	2.4694	0.6801	2.3902	0.8024
13	SOCIAL & CULTURAL	2.6735	0.8263	2.3415	0.8834
14	SOCIAL & CULTURAL NORMS	2.7755	0.7148	2.4878	0.7114

Number of responses = 90

TABLE VII

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE ACCORDING TO THE ACADEMIC BACKGROUND OF THE RESPONDENT

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
ACADEMIC BACKGROUND					ERROR		
MULTIVARIATE	56	--	0.8639	0.7415	MULTIVARIATE	282	--
UNIVARIATE					UNIVARIATE		
ITEM 1	4	0.3074	0.5841	0.6750	ITEM 1	85	0.5261
2	4	0.0936	0.2018	0.9368	2	85	0.4637
3	4	0.2253	0.3852	0.8187	3	85	0.5849
4	4	0.2334	0.4061	0.8038	4	85	0.5747
5	4	0.7821	1.2886	0.2810	5	85	0.6069
6	4	1.0226	1.4850	0.2140	6	85	0.6886
7	4	0.8864	1.1321	0.3470	7	85	0.7829
8	4	0.6160	0.9263	0.4527	8	85	0.6650
9	4	0.5026	0.7842	0.5386	9	85	0.6409
10	4	0.2312	0.3510	0.8427	10	85	0.6585
11	4	0.4201	0.5833	0.6756	11	85	0.7202
12	4	1.0336	1.9983	0.1021	12	85	0.5172
13	4	0.9715	1.3198	0.2692	13	85	0.7361
14	4	0.0605	0.1108	0.9785	14	85	0.5456

Number of responses = 90

TABLE VIII

MEAN VALUES AND STANDARD DEVIATIONS ACCORDING TO THE ACADEMIC BACKGROUND OF THE RESPONDENTS

	M.Sc.(29)		M.Ed. (9)		B.Sc.(47)		B.A. (3)		B.Ed. (2)	
ITEM	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
1	3.0689	0.6508	2.7777	0.6666	2.9361	0.7634	3.0000	1.0000	3.5000	0.7071
2	3.1724	0.6017	3.3333	0.5000	3.1914	0.7413	3.0000	1.0000	3.0000	0.0000
3	3.2758	0.7510	3.1111	0.7817	3.2127	0.7784	3.6666	0.5773	3.5000	0.7071
4	2.8965	0.6732	2.5555	0.5270	2.8085	0.8505	2.6666	0.5773	3.0000	0.0000
5	3.1379	0.7894	2.6666	0.8660	3.0212	0.7658	3.6666	0.5773	3.5000	0.7071
6	2.6896	0.6602	2.5555	0.8819	2.7446	0.9200	3.6666	0.5773	3.5000	0.7071
7	2.7241	0.8404	2.4444	1.2360	2.7872	0.8323	3.6666	0.5773	3.0000	1.4142
8	2.6206	0.7754	2.5555	0.7264	2.9361	0.8445	2.6666	0.5773	3.0000	0.4142
9	2.7931	0.6750	2.6666	0.5000	2.6595	0.9154	2.3333	0.5773	3.5000	0.7071
10	2.3793	0.9029	2.2222	0.6666	2.2340	0.7860	2.6666	0.5773	2.5000	0.7071
11	2.1724	0.8891	2.0000	0.8660	1.9574	0.8329	1.6666	0.5773	2.5000	0.7071
12	2.5517	0.5723	2.5555	0.5270	2.2765	0.8262	2.6666	0.5773	3.5000	0.7071
13	2.6551	0.8139	2.6666	0.7071	2.3217	0.8950	3.3333	1.1547	2.5000	0.7071
14	2.6551	0.7688	2.7777	0.4409	2.6170	0.7676	2.6666	0.5773	2.5000	0.7071

Number of responses = 90

TABLE IX

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE
FOR YEARS OF TEACHING EXPERIENCE OF THE RESPONDENT

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
YEARS OF EXPERIENCE					ERROR		
MULTIVARIATE	56	--	0.8142	0.8218	MULTIVARIATE	278	--
UNIVARIATE					UNIVARIATE		
ITEM 1	4	0.3322	0.6309	0.6419	ITEM 1	84	0.5265
2	4	0.1688	0.3627	0.8346	2	84	0.4654
3	4	0.2321	0.4007	0.8077	3	84	0.5791
4	4	0.0985	0.1686	0.9539	4	84	0.5844
5	4	0.8619	1.4593	0.2219	5	84	0.5906
6	4	0.8355	1.2011	0.3165	6	84	0.6956
7	4	0.9584	1.2309	0.3040	7	84	0.7786
8	4	0.8739	1.3241	0.2678	8	84	0.6601
9	4	0.4896	0.7639	0.5517	9	84	0.6409
10	4	0.1993	0.2985	0.8782	10	84	0.6678
11	4	0.9876	1.4144	0.2363	11	84	0.6982
12	4	0.1849	0.3280	0.8585	12	84	0.5638
13	4	0.0206	0.0261	0.9987	13	84	0.7900
14	4	0.0686	0.1270	0.9723	14	84	0.5403

Number of responses = 90

TABLE X

MEAN VALUES AND STANDARD DEVIATIONS ACCORDING TO THE YEARS OF TEACHING EXPERIENCE OF THE RESPONDENTS

	1-3 Yrs.(27)		4-6 Yrs.(15)		7-9 Yrs.(13)		10-12Yrs.(10)		13-15Yrs.(9)		Over 15 Yrs.(16)	
ITEM	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
1	3.0741	0.6155	3.0000	0.7559	3.0769	0.7595	3.1000	0.7378	2.7777	0.8333	2.7500	0.7745
2	3.2592	0.8130	3.0667	0.5936	3.3076	0.6304	3.1000	0.5676	3.2222	0.6666	3.1250	0.6191
3	3.2962	0.6688	3.3333	0.7237	3.0769	0.9540	3.2000	0.9189	3.5555	0.5270	3.0625	0.7719
4	2.7037	0.7753	2.8666	1.0601	2.8461	0.6887	2.8000	0.6324	3.0000	0.5000	2.8125	0.6551
5	3.0000	0.8320	3.4000	0.6324	2.8461	0.6887	2.7000	0.8232	3.4444	0.7264	3.0000	0.8164
6	2.9629	0.8540	2.8666	0.7432	2.5384	0.6602	2.5000	1.0801	3.0000	1.0000	2.5000	0.7302
7	3.0370	0.7586	2.6666	0.9759	2.6923	0.9473	2.4000	0.8432	3.0000	0.7071	2.5625	1.0307
8	3.0370	0.6493	2.8667	0.9154	2.7692	0.7250	2.5000	1.0801	2.6667	0.7071	2.5625	0.8920
9	2.7037	0.8234	2.8667	0.8338	3.0000	0.8164	2.5000	1.0801	2.4444	0.7264	2.6250	0.5000
10	2.2962	0.7753	2.2000	0.6761	2.4615	0.7762	2.4000	0.9661	2.3333	0.7071	2.1875	0.9810
11	1.9629	0.8077	1.8667	0.6399	2.5384	0.9674	2.1000	0.8755	1.8889	0.7817	1.9375	0.9287
12	2.4074	0.8439	2.6000	0.7367	2.3076	0.6304	2.5000	0.9718	2.4444	0.5270	2.3750	0.6191
13	2.4814	0.8024	2.5333	0.8338	2.5384	0.7762	2.5000	1.0801	2.5555	1.0138	2.5625	0.9639
14	2.7037	0.7240	2.6000	0.9856	2.7692	.4385	2.7000	0.9486	2.3333	0.7071	2.6250	0.5000

Number of responses = 90

TABLE XI

MULTIVARIATE AND UNIVARIATE ANALYSIS OF VARIANCE
ACCORDING TO THE LEVEL OF TEACHING OF THE RESPONDENT

SOURCE	df.	M.S.	F	P	SOURCE	df.	M.S.
LEVEL OF TEACHING					ERROR		
MULTIVARIATE	28	--	1.1337	0.3080	MULTIVARIATE	148	--
UNIVARIATE					UNIVARIATE		
ITEM 1	2	0.1803	0.3440	0.7099	ITEM 1	87	0.5240
2	2	0.0575	0.1260	0.8818	2	87	0.4560
3	2	0.2494	0.4328	0.6501	3	87	0.5761
4	2	1.0345	1.8859	0.1579	4	87	0.5485
5	2	1.1928	1.9829	0.1439	5	87	0.6015
6	2	0.9887	1.4184	0.2477	6	87	0.6970
7	2	0.2901	0.3630	0.6966	7	87	0.7990
8	2	0.6801	1.0267	0.3625	8	87	0.6624
9	2	0.5521	0.8673	0.4237	9	87	0.6366
10	2	0.8479	1.3363	0.2682	10	87	0.6345
11	2	1.9770	2.9179	0.0594*	11	87	0.6775
12	2	3.8164	8.2049	0.0006*	12	87	0.4651
13	2	0.9422	1.2695	0.2862	13	87	0.7421
14	2	0.4369	0.8309	0.4391	14	87	0.5[illegible]58

Number of responses = 90

TABLE XII

MEAN VALUE AND STANDARD DEVIATION ACCORDING TO THE LEVEL OF TEACHING OF THE RESPONDENT

ITEM		GRADES 10-11(19)		GRADES 7-9 (15)		GRADES 7-11 (56)	
		MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
1	CONTEMPORARY KNOWLEGE	3.0526	0.6213	3.0666	0.5936	2.9285	0.7829
2	FUNDAMENTAL	3.1578	0.5015	3.2666	0.7988	3.1785	0.6904
3	INQUIRY	3.2631	0.7335	3.4000	0.7368	3.1964	0.7727
4	BREADTH & DEPTH	3.0526	0.7050	2.9333	0.5936	2.6964	0.7844
5	SEQUENCE	3.3684	0.6839	2.9333	0.9611	2.9821	0.7505
6	APPROPRIATENESS	2.7894	0.8549	3.0666	0.5936	2.6607	0.8796
7	STUDENT'S INTERESTS	2.7894	1.0316	2.9333	0.8837	2.7142	0.8466
8	OBJECTIVES	2.8947	0.9365	3.0000	0.7559	2.6964	0.7843
9	UTILITY	2.8421	0.7647	2.8666	0.7432	2.6250	0.8215
10	STUDENT'S NEEDS	2.4210	0.8377	2.5333	0.8338	2.1964	0.7727
11	NATURE OF MAN	2.3684	1.0116	2.2000	0.9411	1.8750	0.7150
12	HUMAN DEVELOPMENT	2.6842	0.6710	2.9333	0.5936	2.2142	0.7061
13	SOCIAL & CULTURAL	2.7368	0.9334	2.6666	0.9759	2.4107	0.8040
14	SOCIAL & CULTURAL NORMS	2.7894	0.6306	2.4666	0.7432	2.6428	0.7490

Number of responses = 90

APPENDIX 9

ABSTRACT OF

AN INVESTIGATION INTO THE TYPES OF JUNIOR HIGH SCHOOL SCIENCE CURRICULA PRODUCED THROUGH THE UTILIZATION OF MACDONALD'S THREE CURRICULUM DEVELOPMENT MODELS

APPENDIX 9

ABSTRACT OF

<u>An Investigation into the Types of Junior High School Science Curricula Produced Through the Utilization of Macdonald's Three Curriculum Development Models</u>[1]

The purpose of this study was to determine whether the different value positions claimed by Macdonald to be inherent in his three curriculum development models resulted in different content and its organization. The specific hypothesis was:

The content and its organization in junior high school physical-science curricula will not vary depending on the developers' orientation (as identified by Macdonald in his curriculum development models).

To obtain information regarding the selection and organization of content in a science curriculum a sample of ninety teachers was chosen randomly from the English speaking high schools in the Province of Québec. The measuring instrument used questions based on established criteria for the selection and organization of content for a curriculum.

The data collected were analyzed as follows:

1. A single factor multivariate analysis of variance on four personal data groupings showed that no differences

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[1] W.E. Searles, doctoral thesis presented to the School of Graduate Studies of the University of Ottawa, Ontario, December, 1978.

existed in the respondent's evaluations which could be attributed to their different backgrounds.

2. The multivariate analysis of variance data for model indicated the presence of significant differences in the content associated with the three curriculum development models.

3. A discriminant analysis undertaken to determine how the models differed in terms of the criterion variables used resulted in two canonical variates that were significant.

a) The first discriminant function indicated that considerable variance existed among the models for content associated with selection criteria for; inquiry, contemporary knowledge, utility, social and cultural, student's interests, objectives, and student's needs.

b) The second discriminant function indicated that considerable variance existed among the models for content associated with selection criteria for; student's needs, objectives, student's interests, utility, appropriateness, nature of man, social and cultural, and, social and cultural norms.

The following conclusions were drawn from the results:

1. Significant differences do exist in the content and its organization in curricula representative of Macdonald's three curriculum development models.

2. Content associated with contemporary content, inquiry, appropriateness, student's interests, utility, student's needs, social and cultural, and social and cultural norms, was responsible for differentiation among the models.

3. Content representative of specific groups of selection criteria such as discipline-oriented, societal needs, and student needs was also responsible for differentiation in the content among the models.

4. From conclusion 3, there are different value positions in Macdonald's models which result in the selection and organization of different content that depends on the model used.

5. The null hypothesis of no significant difference between the content and its organization in junior high school physical-science curricula was not upheld.

6. Content representative of selection criteria for objectives and breadth and depth was not responsible for any noticeable difference in content among the curricula resulting from the use of Macdonald's models,

From the results obtained in this investigation it was also concluded that Macdonald's curriculum development models provided a useful framework upon which to base an investigation into the influence of different models on the selection and organization of content for a science curriculum. The findings also supported Macdonald's contention that the different value positions inherent in his three models result in the selection and organization of different content.

Suggestions for further research included:

1. Investigations into the content and its organization for chemistry, physics, and biology, when related to Macdonald's development models.

2. Investigations into the content and its organization for non-science curricula when related to Macdonald's development models.

3. Replicative studies at other grade levels.

4. Replicative studies using a broader geographic area for evaluation purposes.