A COMPARISON OF THREE METHODS OF MATCHING STUDENTS IN LEARNING CELLS

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ABSTRACT

A COMPARISON OF THREE METHODS OF MATCHING STUDENTS IN LEARNING CELLS

By

Larry Paul Donahue

The primary purpose of this study was to compare three methods of matching partners in a learning cell. The three methods were to pair students whose cognitive style maps were highly similar, to let students pair themselves and to pair students randomly. It was intended that the achievement of students in the three conditions be compared and that ratings of the learning cell experience by students in the three kinds of learning cells be compared.

Secondary purposes of the study included exploring the influence upon achievement and ratings of the learning cell experience of matching partners who were of the same or different sex and of matching partners who were relatively the same or different in terms of chronological age.

The three basic research questions were:

1. Do student pairs who are matched by cognitive style similarity attain higher achievement and

rate the learning cell experience more favorably than those who are randomly matched or those who self select?

2. Do student pairs who are similar in chronological age differ in achievement and the rating of the learning cell experience from students who have larger age differences?

3. Do student pairs of the same sex differ in achievement and the rating of the learning cell experience from students of different sexes?

Students in the introductory psychology course at Oakland Community College comprised the population of the study. The sample consisted of those students in four sections of the course taught either by Dr. Mueller or by Dr. Svagr during fall semester of 1974. A cognitive style similarity group, a self select group and a random group were formed in each of the four sections. Fifty-two of the original sixty-one learning cells participated in the study to its conclusion.

Each instructor had one day section that met twice per week and one evening section that met once a week. During the first meeting of each day section there was a lecture for the first forty minutes followed by a thirty-five minute learning cell session. The second meeting began with a twenty-five minute class discussion and review. Next there was a thirty minute learning cell session and then there was a twenty minute

period to respond to a weekly achievement instrument. Each evening section had the same format as two consecutive daily meetings combined. The study lasted four weeks.

There was no required pattern of events that a learning cell had to adopt. Three examples of learning cell patterns were presented during the first learning cell meeting, and the subjects were free to choose one of them or to define a new pattern.

Each week each instructor distributed a study guide for the following week's work. It included items that were representative of the key points in a chapter. The study guides were used throughout the term and they became the core of the learning cell sessions.

The dependent variables of the study were (1) weekly achievement, (2) achievement on a final examination and (3) rating of the learning cell experience. The weekly achievement dependent variable was analyzed via ANCOVA at the .05 alpha level with the midterm as the covariable. The final achievement and the learning cell rating dependent variables were analyzed via ANOVA at the .05 alpha level.

The main conclusions of the study follow.

1. The use of cognitive style similarity based upon cognitive style mapping as a criterion for matching students in learning cells was no better than the use of

self selection or randomization in terms of achievement and rating of the learning cell experience.

2. The closeness of the chronological ages of cell mates did not affect achievement or rating of the learning cell experience by the subjects.

3. The sameness or difference of the sex of cell mates did not affect achievement or rating of the learning cell experience by the subjects.

4. No combination of the three independent variables in the study (Matching Method, Age Difference, Sex Factor) affected achievement or the rating of the learning cell experience by the subjects.

Four implications for the potential user of learning cells resulting from this study are listed below.

1. The findings support the idea that none of the different ways of matching people influenced achievement or learning cell ratings. This implies that if one were going to use learning cells he could randomly assign partners or let them self select without regard to their ages or sex. The use of cognitive style similarity to match people would not be recommended because the random or self select methods require much less time and effort.

2. Both instructors reported that the subjects responded very favorably to having study guides

available. Perhaps other learning cell participants would also benefit from getting study guides from their instructors.

3. Certain learning cells contained incompatible partners but the design of the study required that the partners remain together during the study. It is suggested that partners ought to be permitted to change periodically if desired.

4. It may be desirable to use the learning cell as an alternative rather than requiring every student to participate.

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Larry Paul Donahue

A DISSERTATION

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DEDICATION

This thesis is dedicated

to my parents who

encouraged me to dream.

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CHAPTER I

BACKGROUND

Rising costs coupled with reduced income due to shrinking enrollments and proportionally lower financial support have thrust many institutions of higher education into an economic dilemma. This has caused several universities and colleges to reduce or eliminate selected programs, and there have been instances of certain institutions being forced to close their doors due to insolvency. One outcome of this trend of fiscal difficulties has been a decreased teacher/student ratio. The college teacher is therefore challenged to provide effective instruction at the same time that class size increases without corresponding gains in resources.

A promising alternative to the large lecture classes was introduced at McGill University by Kingsbury in 1966. This innovation called the learning cell or learning dyad consists of two people working together to master cooperatively a given learning task. Since no additional costs need be incurred to implement the learning cell method in a class except perhaps for resource or supervisory people

and given the financial problems that plague higher education, the further development and refinement of the learning cell may be desirable.

Recent work done at the Institute for Educational Sciences at Oakland Community College under the direction of Hill and Nunney has produced a most powerful way of identifying individual learner characteristics. Batteries of tests and inventories are administered to a learner and the results are then analyzed to describe the various ways that thatlearner might use to seek meaning. The unique method one uses to seek meaning from one's environment is known as educational cognitive style. The process of determining a learner's cognitive style is called mapping and the resultant profile is referred to as a cognitive style map.

Problem Statement

Although the learning cell has been shown to be a viable instructional alternative, there is no formalized procedure to match potential learning cell mates. The criteria for the determination of partners seem to be subjective ones.

Purpose Of The Study

The primary purpose of this study was to test three methods of matching partners in a learning cell. The three methods were to pair students whose cognitive style maps

are highly similar, to let students pair themselves and to pair students randomly.

Specifically, this study was intended to do these two things:

1. Compare achievement of students in the three conditions.
2. Compare ratings of the learning cell experience made by students in the three kinds of learning cells.

This study also explored the influence upon achievement and ratings of the learning cell experience of matching partners who were of the same or different sex and of matching partners who were relatively the same or different in terms of chronological age.

Assumptions

There are seven assumptions that were made regarding this study.

1. The students who were the subjects in the study were representative of all the students who take the introductory psychology course at Oakland Community College.
2. The responses of the subjects to the various instruments used in the study were normal.
3. The instruments used to measure cognitive style were valid. Thousands of subjects have

responded to the instruments and the resulting empirical data have been used in an ongoing revision process.

4. The instruments used to measure achievement which were instructor produced were valid because of the content expertise of the instructors.
5. The instrument used for the learning cell experience rating was valid.
6. There was independence of groups.
7. The groups were equivalent. Analysis of Covariance was used to assure group equivalence in terms of achievement.

Delimitations Of The Study

Although a study of this kind could have been conducted with several age groups and in various educational settings, this study occurred at Oakland Community College with subjects in an introductory psychology course. To have conducted the study elsewhere would have required the collection of considerable data about cognitive style which were readily available at Oakland Community College. Generalization of the findings of the study to settings different from that of the study or to content areas other than psychology should be done with caution. A final delimitation is that no treatment representing regular instruction, a control group, was in the study.

Research Questions

The three questions below represent the primary emphasis of this study.

1. Do student pairs who are matched by cognitive style similarity attain higher achievement and rate the learning cell experience more favorably than those who are randomly matched or those who self select?

2. Do student pairs who are similar in chronological age differ in achievement and the rating of the learning cell experience from students who have larger age differences?

3. Do student pairs of the same sex differ in achievement and the rating of the learning cell experience from students of different sexes?

Research Hypotheses

The following hypotheses were derived from the research questions. Achievement was measured in two ways. The first was the existing instructors' evaluation of how well a student could either apply the course material to his own environment in essay form or demonstrate mastery of the content by responding to a multiple choice test. The second achievement measure was a final examination. Those items on the final that tested content that was covered prior to the beginning of the study were not used to calculate the achievement scores for the study. A ten

item Likert type instrument was used to assess student rating of the learning cell experience.

H_1: The mean score for the four weekly measures of achievement of students who are matched by cognitive style similarity will exceed the mean sources of the randomly paired students and the self selected students.

H_2: The mean score for the four weekly measures of achievement of students whose age difference is narrow will differ from the mean score of students whose age difference is wide.

H_3: The mean score for the four weekly measures of achievement of students whose sex factor is the same will differ from the mean score of students whose sex factor is different.

H_4: There will be a matching method by age difference interaction for the dependent variable, weekly achievement.

H_5: There will be a matching method by sex factor interaction for the dependent variable, weekly achievement.

H_6: The mean score for the final examination of students who are matched by cognitive style similarity will exceed the mean scores of the randomly paired students and the self selected students.

H_7: The mean score for the final examination of students whose age difference is narrow will differ from the mean score of students whose age difference is wide.

H_8: The mean score for the final examination of students whose sex factor is the same will differ from the mean score of students whose sex factor is different.

H_9: There will be a matching method by age difference interaction for the dependent variable, achievement on the final examination.

H_{10}: There will be a matching method by sex factor interaction for the dependent variable, achievement on the final examination.

H_{11}: The mean rating of the learning cell experience by students who are matched by cognitive style similarity will exceed the mean ratings by students who are randomly paired and by students who are self selected.

H_{12}: The mean rating of the learning cell experience by students whose age difference is narrow will differ from the mean rating by students whose age difference is wide.

H_{13}: The mean rating of the learning cell experience by students whose sex factor is the same will differ from the mean rating by students whose sex factor is different.

H_{14}: There will be a matching method by age difference interaction for the dependent variable, rating of the learning cell experience.

H_{15}: There will be a matching method by sex factor interaction for the dependent variable, rating of the learning cell experience.

Definitions of Important Terms

The listing of key terms and their meanings is provided to communicate to the reader the use of those terms in the restricted context of this study.

1. Student: A subject in the study who must be enrolled in one of four sections of introductory psychology taught by Dr. Mueller or Dr. Svagr at Oakland Community College during fall semester of 1974.
2. Instructor: Dr. Mueller or Dr. Svagr.

3. Learning Cell: Two students working together to master cooperatively a given learning task.
4. Cell Mates: The two students who comprise a learning cell.
5. Cognitive Style: Educational Cognitive Style. The unique method one uses to seek meaning from one's environment.
6. Orientation: The relative strength of a given element within one's cognitive style. Orientation is expressed as one of three conditions.
   a. Major: A given element appears in the 50th-99th percentile range of a distribution for that element.
   b. Minor: A given element appears in the 26th-49th percentile range of a distribution for that element.
   c. Negligible: A given element appears at or below the 25th percentile in a distribution for that element.
7. Matching Method: The technique used to determine cell mates. The three methods in this study are:
   a. Cognitive Style Similarity: Learning cell whose cell mates' cognitive styles are at least 86% alike.
   b. Random: Learning cell whose cell mates were paired by chance.

c. Self Select: Learning cell whose cell mates mutually agreed to work together without instructor intervention other than directions to choose partners.

8. Age Difference: The closeness of the chronological ages of cell mates expressed in one of two conditions.
   a. Narrow: Learning cell in which the chronological age difference of the cell mates is in the lower half of the distribution of the chronological age differences of the cell mates of all the learning cells of the study.
   b. Wide: Learning cell in which the chronological age difference of the cell mates is in the upper half of the distribution of the chronological age differences of the cell mates of all the learning cells of the study.
9. Sex Factor: The sex composition of a learning cell. The two groups are:
   a. Same: Both cell mates are female or both are male.
   b. Different: One cell mate is female and one is male.

Overview of Other Chapters in the Study

Chapter II provides a review of the literature related to learning cells and cognitive style similarity.

Chapter III explains the methods and procedures used in the study while Chapter IV is a presentation of the analysis of the data. Chapter V, the final chapter, includes a summary of the study, conclusions and recommendations for further research.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of the literature presented in this chapter is structured by six questions that were used to analyze the research studies and other scholarly works. The questions are:

1. What is the learning cell?
2. What is the theoretical support for the learning cell?
3. What advantages does the learning cell offer?
4. How have researchers matched students in learning cells?
5. How have researchers determined cognitive style similarity?
6. What is the support for using cognitive style similarity as a criterion for matching students in a learning cell?

The first four questions deal directly with the learning cell and the last two questions draw upon studies from the educational sciences that involved educational cognitive style similarity as a matching variable. This review is organized to present each of the six questions and the

responses to those questions that are derived from the literature. Implications for this study resulting from the literature review will then be cited.

What Is The Learning Cell?

The process of defining the learning cell will occur at two levels. The first will deal with the characteristics that are common to all learning cells with particular attention given to how learning cells and tutorial systems differ. The second level assumes the first and will proceed to list six factors that may be useful in describing the variations of the learning cell.

Goldschmid (1971) regards the learning cell as two people working together in the classroom, the same definition used by Schermerhorn (1972). A more precise statement is offered by Alexander, Gur, Gur and Patterson (1973): "A learning cell is a dyadic unit in which partners mutually teach and learn from each other [p. 1]." The partners in a learning cell are both students and it is assumed that both have yet to master the given learning task. Teachers and tutors are thus excluded from a learning cell. Any tutorial arrangement provides for the vertical flow of information from the tutor down to the tutee. The tutor may be a teacher, a student who has previously mastered the learning task (Hapkiewicz, 1972; Sheppard and MacDermot, 1970), or a student who has not necessarily mastered the learning task but who has been

trained to be the tutor (Rosenbaum, 1973). A tutorial mode cannot be a learning cell because the learning cell requires that both learners be novices.

Nearly all of the learning cells that have been reported were initiated by a teacher or a researcher. However, Alexander, Gur, Gur and Patterson (1973) conducted one study to investigate students who had decided to work in learning cells independent of any suggestion by a third party. This study is mentioned to confirm that two person learning systems that qualify as learning cells do occur outside the formal classroom or laboratory. Thus a basic way that learning cells may differ is the source of the idea to initiate the learning cell.

The scarcity of literature about informal learning cells might be partially explained by the fact that those learning cells function outside the formal structure of an educational institution and are ignored by most researchers. It is suggested that informal learning cells are probably quite common and further research like that by Alexander, Gur, Gur and Patterson could be useful to those who want to try the learning cell idea in a learning system.

Cell mates in a student-initiated learning cell define the interaction pattern of the learning cell for themselves. Students in a teacher- or researcher-initiated learning cell might define the pattern or the

pattern might be imposed by the teacher or researcher. This suggests another way that learning cells can differ which is who defines the interaction pattern of the learning cell. The majority of studies about learning cells that were not student-initiated showed the teacher or researcher deciding the pattern (Dick, 1965; Goldschmid, 1970; Hartley and Hogarth, 1971; Kingsbury, 1968; Myers, Travers and Sanford, 1965; Schermerhorn, 1972). Amaria, Biran and Leith (1969) let the students define the pattern. One of the studies by Alexander, Gur, Gur and Patterson (1973) treated the source of pattern as a variable.

Another factor that can be used to distinguish between different learning cells concerns advanced preparation by the cell mates. In some cases the cell mates were urged to read and study a given assignment before the next learning cell session. This was true in the studies reported by Goldschmid (1970) and Schermerhorn (1972). The subjects who participated in experiments done by Alexander, Gur, Gur and Patterson (1973), Amaria, Biran and Leith (1969), Amaria and Leith (1969), Hartley and Hogarth (1971), Kingsbury (1968) and Myers, Travers and Sanford (1965) worked on the learning task only while in the learning cell setting. The research into student-initiated learning cells by Alexander, Gur, Gur and Patterson (1973) showed that most cells chose to prepare in advance but that a few did all of the studying together.

Goldschmid (1970) who required his students to prepare in advance offered them two ways that the preparation might occur. In one option both partners were to be held responsible for the same assignment and in the other option each student would have a different assignment. Learning cells in which partners prepare in advance can thus be broken into two smaller groups using the variable, assignment congruity.

Two other factors that might be used to describe differences between learning cells both deal with the use of written study questions. The first issue is whether the learning cell session ought to center around study questions that have been written before the session begins or whether the format should be more conversational with questions arising spontaneously. Specific questions written in advance appeared in the work of Goldschmid (1970), Hartley and Hogarth (1971), Kingsbury (1968), Myers, Travers and Sanford (1965) and Schermerhorn (1972).

The final factor that relates to written study questions is the origin of the questions. They could be authored by the students or they could be externally generated. Stone (1974) has suggested that more effective learning in a learning cell might result if the instructor were to write the questions and provide them for the students. Externally generated questions were used by Hartley and Hogarth (1971), by Kingsbury (1968) and by Myers,

Travers and Sanford (1965). Goldschmid (1970) and Schermerhorn (1972) defined the learning cell partners as the source of the written questions.

The writer has defined the learning cell as two people working together to master cooperatively a given learning task. It was assumed that neither person should have prior mastery of the task and so tutorials were excluded. Six factors were identified that could be used to describe how learning cells may differ. Expressed as questions the six factors are:

1. Who initiated the learning cell?
2. Who defined the interaction pattern?
3. Was advance preparation done by the cell mates?
4. If advance preparation was done, were the assignments of the cell mates congruent?
5. Were written study questions used to guide the session?
6. If written study questions were used, who wrote them?

What Is The Theoretical Support For The Learning Cell?

An effort will be made to build a theoretical base for the learning cell by identifying selected factors that are believed to facilitate learning and linking each factor to the learning cell. The purpose is to

provide a theoretical perspective for the reader as he approaches this study.

Four principles were presented by Moore and Anderson (1969) for the design of clarifying learning environments, those that enable the learner to see more clearly what is happening in the instructional environment and what he is doing in that environment. The productive principle which is the third one offered by Moore and Anderson will be deleted from this discussion because it concerns criteria for content selection based upon the logical structure of the content. The learning cell is an instructional arrangement that treats decisions about content selection as givens.

The perspectives principle states that increasing the number of perspectives that a learner can take will improve learning. The popular notion that a good way to learn something is to teach it (Bruner, 1965; Bugelski, 1964; Gagne and Roher, 1969; Johnson, 1972; Schermerhorn, 1973) seems to demonstrate this principle. The responsibility for teaching tends to add other dimensions to one's approach to a learning task. The dynamics of the learning cell typically cause the participants to alternate between the learner and the teacher roles. This opportunity to be both learner and teacher should provide a wider range of perspectives than could be experienced if only the learner role were available.

The second or autotelic principle says that learning is enhanced if the environment affords protection for the learner. The consequences of the learner's interaction with the environment should minimize physical risk as well as psychological and social risk. It is in the latter area that the learning cell has shown evidence of the autotelic principle. Torrance (1969) found that young children were more likely to try a difficult task if they were in pairs than if they were alone or before an entire class. Later studies also by Torrance (1970, 1971) showed that higher levels of creativity were attained on creative tests by both members of a dyad than by students working alone and that students in dyads had stronger feelings of stimulation, enjoyment and originality. The dyad would appear to be a useful means of helping students to feel less anxious about attempting a task perceived to be difficult by those students and of building a more supportive environment.

The personalization principle stresses the importance of an environment that is responsive and reflexive. It is responsive if it encourages the learner to generate questions and if it then gives relevant responses to that learner. The learning cell does encourage questioning behavior from the students. Concerning the responses in a learning cell Stone (1974) says, "Feedback is relevant, timely, frequent, and likely to be presented on a cognitive level more closely related to that of the student [p. 19]."

A reflexive environment facilitates the learner's gaining a better understanding of himself as a learner. The learning cell is a social unit that is often characterized by alternating questions and responses. In such a setting one might think about how his partner approached a problem and how this compared with his own method. This could lead to an open discussion of study habits and styles of learning. Such events are not guaranteed in a learning cell but the learning cell does seem to make them more probable than certain other methods of instruction. The learning cell provides another readily available learner who is working toward mastery of the same learning task. Using such a person as a basis of comparison could be a step in the process of self assessment.

Reflexive behavior might also result from playing the teacher role in the learning cell. As previously noted, preparing as a teacher and preparing as a student can be quite different. The teaching side of the learning cell offers two more referents that the learner might use to assess himself. He could compare his learning style to his own teaching style and he could compare his learning style to his partner's teaching style.

If an instructional environment can engage a learner in active participation, then it is generally agreed that effective learning is more likely than if the learner were more passive. The key to the previous

statement is the distinction between active and passive participation. According to Burton (1967): "Active participation is preferrable to the kind of passive reception usually involved in listening to a lecture or watching a motion picture [p. 105]." Burton appeared to equate active participation with a measure of the learner's verbal behavior or physical movement since a learner attending to a film or a lecture would probably be quiet and immobile. This way of judging participation seems inadequate since they are superficial measures. Reading a book, attending a lecture or watching a film can engage the learner in a very intensive experience.

Rogers (1967) preferred to use the degree of responsible involvement as the critical criterion for judging the merits of participation. One participates more responsibly when he has a larger share of deciding his own course of action. After noting that the typical learning environment places the control and responsibility for information, rewards, participation and organization outside the learner, Argyris (1962) concurred with Rogers by saying that a learning environment should move the learner toward increased self-responsibility and internal commitment which result in a more independent learner. Further support for this interpretation of active participation comes from Mager (1961) who contended that increasing the learner's control of the learning experience would result in greater learner motivation.

Bruner (1968) recommended that an individual who can see his own contributions as beneficial to a group to which he belongs would be reinforced for his behavior and thus more highly motivated. If Bruner's idea can be added to those of Rogers, Argyris and Mager expressed above, then additional support for the learning cell can be suggested. This combination would describe a learning cell in which a learner could benefit from having a major decision making role and also from making significant input toward accomplishing the goals of the group. Such an environment would afford enough autonomy to avoid external control of all decisions and would foster an atmosphere of cooperation. A learning cell does not necessarily duplicate the hypothetical ideal just described because there is no assurance that teacher domination will not be replaced by partner domination or that one will be able to contribute to cell effectiveness. However, the learning cell can provide the opportunity for some degree of responsible participation for each individual and it may enable a student to further a group's cause. In the latter respect the learning cell may be better able to meet this qualification than larger units since the ratio of available time to number of participants is greater in a two person system than in any system with more than two members.

This discussion of theoretical support for the learning cell will end with a consideration of the learning

cell as a message sent by the instructor to the learner. According to Harrison (1973):

> The way man arranges himself in time and space can have sign value for the astute observer. The way man creates, selects, arranges, and presents his artifacts may reveal much about his intentions, feelings, and aspirations. Often, this use of time, space and object is done without an intent to communicate. It is a symptom, a signal, an index. But the aware communicator can use time, space and artifacts in the purposeful creation of signs. He can use these code systems to structure communication situations, to facilitate or inhibit interaction, to maintain and perpetuate effective communication systems [p. IX-2].

The designer of a learning environment is in a particularly important position because his decisions about time, space and artifacts affect and even dictate the behavior of all who enter that environment. Even the very young respond with precision to the nonverbal cues that come from the way that time, space and artifacts present themselves.

Davis (1970) alerted educators to be aware of the nonverbal messages inherent in learning environments when he wrote:

> The point of these final comments is simply to make clear the fact that the selection and design of instructional models is not merely a question of improved learning of course content, that other forms of learning must also be kept in mind. In the final analysis, a student learns only those messages he processes, and one ought never to forget, that the model also communicates a message. As a matter of fact, in many courses, messages about the model seem to be the only messages that some students ever really learn [p. 38].

After comparing the effects of co-operation and competition upon learning, Thompson (1972) agreed with Davis when he advised that there were other considerations beyond pupil performance when evaluating co-operation and competition. One should also assess the "side effects" of using co-operation or competition.

At a time when accountability, based on student performance, is being emphasized the words of Davis and Thompson suggest that the narrow cognitive outcomes view of accountability is rather like the tip of the iceberg. Dewey (1938) addresses this issue when he wrote about collateral learning.

> Perhaps the greatest of all pedagogical fallacies is the notion that a person learns only the particular thing he is studying at the time. Collateral learning in the way of formation of enduring attitudes, of likes and dislikes, may be and often is much more important than the spelling lesson or lesson in geography or history that is learned. For these attitudes are fundamentally what count in the future. The most important attitude that can be formed is that of desire to go on learning [p. 48].

What messages might a teacher be communicating to his students via the learning cell? The following are suggested examples of those messages.

1. You are capable of accepting more responsibility for your own learning.
2. Your ideas are worthwhile.
3. Working together with another person is a valuable experience.

4. You should have practice sharing your ideas with another person.
5. Learning can and should be enjoyable.
6. I would prefer to support rather than direct your learning.
7. Learning addresses more than cognitive knowledge.

It does seem that students who work in learning cells often like the experience. Perhaps one reason that the learning cell is well accepted by students is that some of the messages listed above are being sent and received and the students appreciate those messages.

An attempt has been made to show theoretical support for the learning cell by presenting factors that may improve learning and then relating those factors to the learning cell. It has been suggested that the perspectives principle, the autotelic principle and the personalization principle of Moore and Anderson (1969) may be satisfied by the learning cell and that the learning cell may encourage active participation in the form of responsible behavior by the student. Finally, the learning cell has been described as a nonverbal message that may communicate beyond the mere transmission of course content.

What Advantages Does The Learning Cell Offer?

Central to the evaluation of an innovation is the gathering and interpretation of evidence as that new idea

is applied. A decision to adopt, amend or reject the innovation should stem from such an analysis. The purpose of this section is to present and interpret evaluative information regarding the effects upon the learner of using the learning cell and other two person interaction systems with elements common to the learning cell. Although a prime concern is the effect upon cognitive learning, the influence upon the learner's attitudes and upon the learning environment will also be considered.

Goldschmid (1970) designed four instructional options and let students select the option they preferred. The four options were to participate in a discussion group of six to twelve students, to be in a seminar group of ten to twelve, to work in a learning cell or to pursue an essay option. Although there were no differences between groups on a final examination, the learning cell group did better on an unannounced essay examination. The learning cell group also showed higher rankings on measures of morale throughout the term and they had the highest peer and self evaluations of achievement.

Myers, Travers and Sanford (1965) conducted a study to compare the effectiveness of four learning conditions in learning a rote-memory task. Elementary students were assigned to play the teacher role in a dyad, the pupil role, to be in a dyad where they would reverse roles or to use self-instructional materials alone.

Students in the pupil condition showed superior learning and students in the teacher condition had the least learning. Students in the reverse roles condition, the typical learning cell format, learned about equally and it was reported that these students maintained a higher degree of interest and attention throughout the three days of the task. This reference to morale seems noteworthy since the likelihood for success by a learner is usually enhanced if his attention and interest can be maintained. The investigators suggested that the instructional activity represented by the reverse roles or learning cell condition seemed to be most likely to be useful in the classroom and that it should be developed further.

A study reported by Alexander, Gur, Gur and Patterson (1973) showed that the learning cell was a more effective means of helping students learn to solve mathematical problems dealing with linear motion of physical bodies than was individual study. More enthusiasm was observed in students in the learning cell condition which is in agreement with the findings of Myers, Travers and Sanford. Further evidence for this point is furnished by Torrance (1970) who found that both kindergarten and college students working in pairs showed greater perseverance in a task requiring the creation of original responses than students working alone. Torrance stated, "At the end of the fourth task, Ss in dyads seemed to be

going stronger than ever and to be having fun while those working alone seemed to be fatigued and ready to stop [p. 393]."

Alexander, Gur, Gur and Patterson (1973) reported a further study that investigated spontaneous or naturally occurring learning cells. Thirty-six students were interviewed who were studying together in dyads for some course. Of the twenty-five students for whom data were available, the mean grade in the course for which students had studied in a dyad was higher than the previous grade point average and the grade point average for the other courses that term. Generalizations must be somewhat limited since data for eleven of the thirty-six students could not be obtained.

Sheppard and MacDermot (1970) compared an experimental group who participated in dyadic interaction to a control group in an introductory psychology class. The experimental group scored significantly higher on a hundred-question final objective examination and on a five-question essay examination. The experimental group also rated the course more favorably in terms of being well organized, stimulating and enjoyable. The internal validity of this study is questioned because the experimental subjects were told in advance that the hundred-question final examination would not count in determining their course grades while the subjects in the control group learned that fifty

per cent of their grades depended on the test. The subjects in the experimental group went into the final examination already knowing what their grades were for the course. The investigators pointed out that these conditions should have favored control group performance. An alternative explanation is that the experimental group was relaxed while the control group had high test anxiety and that the results reflect this difference.

In a similar study Hapkiewicz (1972) found that students who participated in dyadic interviews demonstrated higher achievement on in-class tests in an educational psychology course and they rated the course more positively than students in a control group. No differences on the final examination were detected between groups.

Comparing the effectiveness of paired versus individual work on programmed instruction materials was the topic of two studies reviewed. Amaria, Biran and Leith (1969) found that children in the dyadic situation demonstrated superior learning to children working alone for both heterogeneous and homogeneous pairs. They suggested that the social relationship in dyads may lead students to focus specifically on the development of the teaching steps and that this attention results in a higher degree of success in the learning task.

A similar point was made by Gartner, Kohler and Riessman (1970) who made a comprehensive review of the

literature related to tutorial programs. They found that it was the tutor who benefited more in a tutorial setting and this was attributed to the insight into the teaching-learning process gained by the tutor and more specifically an understanding of how the tutor himself learned. Thelen (1969) who also reviewed tutorial programs noted that a major benefit of tutorials was that the tutors learned how to learn.

College students worked alone or in pairs in a programmed math course in an experiment by Dick (1965). No differences were found between the groups on daily tests, the mid-term, the final examination, a transfer test or on course ratings. The final examination was re-administered a year later and the students who had worked in pairs did significantly better than those who had worked alone. Dick indicated that the social interaction may have accounted for the superior results. The pairs took longer to finish each of the twenty-eight units which may have increased each learner's actual interaction with the course content. Verbal interaction acting as a reinforcer of learning was also identified as a potential factor to explain the retention differences.

The studies that have been reported suggest that dyadic interaction systems can be effective instructional modes to facilitate cognitive learning. It was noted that students in dyads often displayed attending behavior longer

and that they were better able to understand the structure of the learning task. Alexander, Gur, Gur and Patterson (1973) reported that students in learning cells covered more material and also went into more depth with the material. Student interaction with academic content and subsequent cognitive performance relative to that content are important concerns, but it is contended that a discussion of these concerns is necessary but not sufficient as one evaluates the learning cell.

In assessing the influence of tutorial programs Thelen (1969) stated that dyadic systems can be a means of causing a more positive environment of concern for others rather than one of competitiveness. An article in Nation's Schools (1968) that described a buddy system for learning said this about students in the program: "They don't feel that they are on their own. They share their goals [p. 113]." Alexander, Gur, Gur and Patterson (1973) and Goldschmid (1971) agreed that feelings of alienation in large classes can be reduced with the learning cell. Students reported feeling better about going to class and about taking tests. An important feature of peer-mediated instruction is that the social value of working together is encouraged according to Rosenbaum (1973). Frazier (1970) wrote that pair learning teaches students to live and work together as they seek a common goal, to better understand oneself, to respect the

uniqueness of each person and to care about another's well-being. Frazier concluded by saying, "After all, building bonds between people in twos forms the base of most of the truly satisfactory human relations--in the family, in friendship and in the business world [p. 100]."

A review of the literature about dyadic learning systems with a special emphasis on the learning cell has shown certain benefits that this kind of instruction may offer. They include improved cognitive learning, active participation, a more personalized learning environment, feedback that is frequent and timely, more confidence within the learner and a keener insight into self and others. It appears that the learning cell is an instructional medium with sufficient potential to merit further development and refinement.

How Have Researchers Matched Students In Learning Cells?

An investigation of the influence that the method of matching students may have upon the learning cell is a primary emphasis of this study. It is therefore of interest to note the methods used in previous studies to match learning cell partners and the rationale for using those methods. Opinions about matching have been offered by people who have observed but not necessarily researched learning cells and those opinions will also be examined.

The random pairing of students was the most common method appearing in the literature. Random pairing was used in one of the studies by Alexander, Gur, Gur and Patterson (1973), in the study by Dick (1965), in the study by Myers, Travers and Sanford (1965) and in the studies by Torrance (1969, 1970, 1971). Although no reason for the use of random assignment was offered in any of these studies, the researchers were concerned with independent variables other than method of matching students and therefore they probably used random assignment to exclude method of matching as a variable.

Amaria, Biran and Leith (1969) used IQ scores and Hartley and Hogarth (1971) used prior grades to match students into homogeneous and heterogeneous pairs. There had been an indication from previous research on co-operative learning that mixed ability grouping might be beneficial to learning. These two studies were conducted to test that idea. The variables, introversion/extroversion and high anxiety/low anxiety, were added to the variable, homogeneity/heterogeneity, in a study by Amaria and Leith (1969). The two personality factors were selected because they were thought to influence performance in a co-operative learning situation.

One study by Alexander, Gur, Gur and Patterson (1973) which was not completed paired students according to sex, academic competency and previous experience in

the subject area. These three characteristics were chosen because all of the information would be readily available to an instructor wishing to use learning cells.

The matching methods used by Goldschmid (1970) and Schermerhorn (1972) could not be determined. In summary, there were six studies that used random pairing and there were four that used a method other than random pairing.

Westmeyer (1965) studied the learning pairs that existed in chemistry laboratories. He stated, "Studies have shown that groups tend to be more compatible if they are set up as a result of the students' choices rather than the arbitrary judgment of the teacher [p. 355]." The studies that Westmeyer used as a basis for his position are not cited in his article nor did he test his idea in a research study.

Frazier (1970) recommended that the following factors be considered in pairing: sex, ability, disposition, background experiences, maturity, skills. Frazier did not advise how to translate the consideration of these factors into decisions about pairing. Mauer (1968) described pair learning where the pairs were homogeneous but he failed to list the criteria used to determine homogeneity. Neither of these two people offered a rationale to support his matching method nor did either conduct any research to test the methods.

The learning cell is an instructional mode that has only recently been employed at the direction of the teacher and examined by the researcher. Most research about learning cells has treated the learning cell as an independent variable. Students working in learning cells were compared to students working alone on the same task. Not much attention has been given to independent variables that might influence the learning cell. It is suggested that advances in the use of the learning cell will depend upon research that is directed toward such variables that are within the learning cell itself.

How Have Researchers Determined Cognitive Style Similarity?

What is the Support for Using Cognitive Style Similarity as a Criterion for Matching Students in a Learning Cell?

The central concern of this study is a comparison of three methods of matching students in learning cells with particular attention given to the use of cognitive style similarity as a matching variable. Seven studies have been reviewed that treated cognitive style similarity as an independent variable and that used achievement and/or an attitude or effectiveness ratings as dependent variables. Other variables were also considered by the researchers but this review will focus directly on the variables mentioned above because only they are germane to this study. The reader is advised

that none of the studies deal directly with matching one student with another and that this limits somewhat their applicability to this study.

Wasser (1969) mapped the teacher and ten students in each of three sixth grade classrooms. The map of each student was compared to his teacher's map and the number of cognitive style elements they shared was noted. Each of the ten students in a class was ranked according to the number of elements that that student shared with his teacher. It was found that the teacher tended to give higher letter grades in math, language, health, social studies, science, reading and spelling to the students who were in the upper half of the distribution, those most like the teacher, than to the students who were less similar.

DeLoach (1969) investigated whether correlation on a high to low similarity continuum of the cognitive style of an administrator and an instructor would act as a significant variable in the evaluation of the instructor by the administrator. Five instructional division chairmen and two instructors from each of the same five divisions in a community college were the subjects. DeLoach compared all of the instructor cognitive style maps to each administrator map and then put each instructor into a high or low similarity group relative to each administrator. The mean of the evaluation scores

assigned by the administrators to the instructors in the low similarity groups was significantly lower than the mean of the evaluation scores of the highly similar groups.

Thirty-two students and two teachers in a drafting course at a community college were the subjects in a study by Fragale (1969). The total number of cognitive style elements for a given student was calculated as well as the number of elements that the student shared with his teacher. The number of shared elements was divided by the total elements of the student and the quotient was converted to a percentage. Those students whose percentages exceeded fifty were the high match group and the others were the low match group. Fragale described two conditions of agreement and two conditions of disagreement regarding the relationship between degree of match and final grades in the course. The match and grade factors were in agreement if a student were in the high match group and got a high grade in the course or if a student were in the low match group and got a low grade. The two disagreement conditions were either high match-low grade or low match-high grade. One teacher had 66% of his students in an agreement situation and the other had 84% in an agreement situation. Fragale concluded that the matching of the cognitive styles of teachers and students did affect the education processes.

Schroeder (1969) studied the cognitive styles of one hundred eighteen high school English students and their teacher to determine if students similar to the teacher in terms of cognitive style would rate the teacher higher on effectiveness and get higher grades than less similar students. A 70% criterion was used to distinguish similar and disjunct student groups. The particular method used to determine the percentages was not clear. Schroeder found that the similar group did rate the teacher as more effective and did receive higher grades to a significant degree.

Fifty students and two instructors in a math course at a community college were studied by Blanzy (1970) to see if the similarity of student and teacher cognitive style were related to the achievement of performance goals or to the evaluation of the teacher by a student. The number of profiles for each subject was determined by multiplying together the number of elements in each of the three sets of a cognitive style map. The number of profiles that a student shared with a teacher was divided by the total number of profiles in that student's map. The resulting decimal numbers were ranked and divided into an upper half and a lower half to make two groups. Blanzy found no difference between the groups in terms of performance goals finished or the evaluation of the teacher by the students.

A study of two hundred fifty-five students and thirteen instructors in a nursing course was conducted by Lange (1972) to determine if the matching of a student's cognitive style map and preferred teaching style to the instructor's cognitive style and teaching style would affect the grades of the students or their perceptions of their instructor. This study differs from the others in that teaching style was added to cognitive style as a matching criterion. Each element of an instructor's cognitive and teaching style was assigned a value of two. If a student matched an element exactly, then the student also was assigned a two for that element. If the instructor had a major and the student a minor or if the instructor had a minor and the student a major,* then one was assigned to the student for that element. After all of the points had been tabulated for a student in this manner, the number was divided by the total points of the teacher and the quotient converted to a percentage. To be in the matched group a student had to have at least an 80% match with the instructor. Lange found no overall difference in final grades between the matched group and the non-matched group but the matched group did perceive their instructor more positively.

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*A description of major and minor orientations appears in the Definitions of Important Terms section of the first chapter.

Oen (1974a) compared the cognitive styles of four hundred eight technical institute students to their teachers' cognitive styles using a system similar to Lange's. Oen (1974b) used the number of common elements shared by a teacher and a student to rank the students and then used the median to divide the students into a match group and a mismatched group. The findings of this research showed that the matched students were more likely to get higher grades than the mismatched students.

A review of the seven studies just cited shows that no two researchers used precisely the same method to determine cognitive style similarity. There seem to be three questions that describe the important methodological variables regarding how cognitive style similarity was established in these studies. Is the number of cognitive style elements common to both people used directly to define two conditions of cognitive style similarity or is the number used as the numerator of a ratio? If a ratio is used to compute a decimal or percentage that represents the degree of match, is the denominator of the ratio the total number of cognitive style elements of the student or the teacher's total number? Is the median used to distinguish between two conditions of similarity or is a predetermined percentage used? Since the answers to these questions vary across the studies, the actual meaning of cognitive style similarity is also a variable.

An analysis of the various results of the studies and a synthesis of the findings into singular conclusions cannot be done because technically each of the seven researchers had a different definition of terms.

There seems to be value in noting the general direction of the findings of the studies because to treat the studies as seven unrelated entities is to negate some of the potential of the research. Each of the researchers has in a sense engaged in a pioneering venture. The methods and definitions have fluctuated because of the probing nature of the research. It is probable that the chief contribution of these studies has been to lay the foundation for further work rather than to test ideas conclusively.

Of the six studies that addressed the relationship between teacher-student cognitive style similarity and academic achievement or grades, four supported the idea that a student tends to have more success when his cognitive style is relatively similar to his teacher's cognitive style than if it is less similar. Two studies did not support the idea.

In three of the four studies that considered whether the rating of the teacher by the students was higher among students whose cognitive styles are relatively similar to that of the teacher or in the case of DeLoach's study for administrator's ratings of teachers,

it was found that the ratings were higher when cognitive style similarity was higher.

It appears that no research has been done that involves the use of cognitive style similarity as an independent variable to match people in a dyadic condition. In an effort to build upon the knowledge generated by others, seven studies involving cognitive style similarity were investigated and reported in this review even though they did not deal with learning pairs. These studies are interpreted as being suggestive of the potential value that may lie in the further exploration of how cognitive style consonance or dissonance between people may influence the purposeful relationships of those people. It is further suggested that the general findings of the studies reported earlier support the notion that cognitive style similarity should at least be entertained as a criterion to match partners in a learning cell.

Implications for this Study

The review of the literature was organized to address six questions. The responses to those questions influence the study from the initial statement of hypotheses and definitions to the statement of procedures. Listed below are seven important implications provided by the literature review.

1. The experimental treatments should conform to the learning cell definition.

2. The procedures of the study should state specifically the parameters of the learning cells in terms of the six variables that describe differences between learning cells.

3. Each learning cell should have a degree of autonomy to encourage responsible participation.

4. The theoretical and practical support for the learning cell reinforce the assumption that the learning cell is superior to regular instruction so this study will not use a control group.

5. An effort will be made to go beyond the learning cell literature to identify variables that may influence the learning cell since most research has treated the learning cell as an independent variable. Age difference is offered as a researchable variable because of the nature of the community college population. Students may differ by as much as two generations, and a community college instructor might profit from knowing whether the age difference between cell mates should be considered in forming pairs. Sex is a variable which was ignored in the studies reviewed. Any instructor who uses learning cells must decide to stratify by sex or to ignore sex as a variable. There is no evidence from the learning cell literature to support either position and so decisions about sex are arbitrary. The use of sex as a variable in this study seems justified because there is a

need for research evidence upon which to base decisions about the attention given to sex when matching students.

6. The procedures of the study should include a precise account of how cognitive style similarity is determined.

7. There is justification for the use of cognitive style similarity as a matching variable.

CHAPTER III

METHODS AND PROCEDURES

This chapter has three major sections. The first is Design Over Time which explains the relationship between the experimental treatments and the instrumentation. It also includes: (1) a description of the subjects of the study, (2) the procedures followed to assign those subjects to the experimental treatment groups, (3) the nature of the experimental treatment and (4) a discussion of the instruments used in the study. The second section of the chapter is Design Over Variables. It includes the variable matrix of the study. The final section, Hypotheses, lists the research and statistical hypotheses that were tested and the data analysis process for each hypothesis.

Design Over Time

Two designs were used in this study. The first which is shown below accommodated one dependent variable for achievement, performance on weekly measures of achievement.

Key:

R - A form of random assignment

O_1 - Mid-term

X_1 - Self Select group

X_2 - Cognitive Style Similarity group

X_3 - Random group

O_2 - Weekly achievement measures

--- Intact classes used

Class 1	R O_1 X_1 O_2
	R O_1 X_2 O_2
	R O_1 X_3 O_2
	- - - - - - -
Class 2	R O_1 X_1 O_2
	R O_1 X_2 O_2
	R O_1 X_3 O_2
	- - - - - - -
Class 3	R O_1 X_1 O_2
	R O_1 X_2 O_2
	R O_1 X_3 O_2
	- - - - - - -
Class 4	R O_1 X_1 O_2
	R O_1 X_2 O_2
	R O_1 X_3 O_2
	- - - - - - -

The original plan was to use this design for both dependent variables of achievement, weekly achievement and final achievement. The mid-term examination was proposed as a covariable for both of these dependent variables. Table 1 contains data relevant to the decision to use the covariable with each achievement measure. Since the covariable had a relatively high, positive correlation with weekly achievement (R = .58) and since it accounted for 33.55% of the variance of weekly achievement, it was decided to use the mid-term as a covariable with the variable, weekly achievement. ANCOVA was used to analyze those hypotheses related to weekly achievement.

The relationship between the covariable and the final was relatively weak (R = .27). Since only 7.23%

of the variance of the final could be accounted for by the covariable, it was decided not to use the mid-term as a covariable with the variable, final achievement. ANOVA was used to analyze those hypotheses related to final achievement.

TABLE 1.--Relationship of Covariable to Achievement Measures.

Measures	Variance	Variance with covariable var. deleted	Variance accounted for by covariable	Correlation with covariable	Decision
Weekly	68.49	46.67	33.55%	.58	Use covariable
Final	15.09	14.36	7.23%	.27	Do not use covariable

In the design already presented subjects were not randomly assigned to each class as indicated by the broken lines between classes, but rather intact classes were used. To control for the threat to internal validity due to the selection factor a form of random assignment was used to put the subjects into the three groups, Self Select, Cognitive Style Similarity and Random which are X_1, X_2 and X_3 respectively in the design. Analysis of Covariance was also used to control for the selection factor with performance on a mid-term examination being the covariable.

The mid-term examination is shown as 0_1 in the design and occurred two weeks prior to the first learning cell sessions. Each X stands for the four weeks of learning cell interaction and the mean of the four weekly achievement measures is represented by 0_2.

One threat to internal validity was the testing factor. The experience of taking one test might have affected the ability of a subject to take a later test. The mid-term examination, the covariable for ANCOVA, could have influenced performance on the following test. This concern for testing appeared to be slight since all subjects responded to the same testing instruments and so if the testing factor did exist it should have applied to everyone. Also, the weekly measures were used during each of the ten weeks before the study and so all subjects were familiar with how to respond to the instruments.

A final concern for internal validity was instrument decay which in this case could refer to a change in the scoring of the essay response used by one instructor due to fatigue or boredom or a change in the difficulty of the multiple choice tests used by the second instructor. Since all three groups appeared in each class, it seems likely that the effects of instrument decay would have been evenly distributed across groups.

It appears that the chief threat to external validity was the reactive effects of experimental

arrangements. Subjects were told that they were going to be participants in a research study and so they could have faked behavior to conform to imagined expectations, but the likelihood of such behavior would seem to have been the same for all groups. The use of regular instructors rather than strangers should have helped make the setting more natural and therefore helped to control this factor.

Another feature of the study that could have diminished the external validity is that all three groups occurred in each class. It was possible that the subjects' knowing that three groups were in the class could have influenced their behavior apart from the actual learning cell experiences. An attempt was made to control for this factor by having all of the pairs formed prior to the study so that subjects were unable to see any differences in how subjects were matched. No distinctions were made between the groups by the instructors because the instructors did not know which pairs were in each group.

Rating of the learning cell experience and achievement on the final examination were the two dependent variables that the second design addressed. This design duplicated the first except that no observations were made prior to the experimental treatments. The only observation for the variable, rating of the learning cell experience, was in the form of an attitude rating form that was

administered after the final learning cell session. The final examination was the observation for the other variable. The concerns for internal and external validity that the first design suggested were the same for this design except that testing and instrument decay were eliminated.

Population and Sample

Students in the introductory psychology course at Oakland Community College comprised the population of this study. The sample consisted of those students in four sections of the course taught either by Dr. Mueller or by Dr. Svagr during fall semester of 1974. It was assumed that students in the four sections were representative of the population. There were one hundred four subjects who participated in the study to its conclusion.

Procedures

During the first week of the term each instructor informed the students in each of the four sections that they would be participating in a study during the last few weeks of the term. A copy of that statement appears in Appendix A.

The following procedure was used to determine who might become the self select pairs. After five weeks of the term had passed, each instructor announced that the class was to form pairs in order to work on some task

related to the course. Each instructor left the room for five minutes and then returned. The names of each pair were recorded and then the pairs performed the task. During the next class meeting each subject responded to a one item instrument which asked whether that subject would want to work with his partner again during a later session or if he would rather not have the same partner. That instrument is presented in Appendix B.

Before the subjects were assigned to the three learning cell groups in each class, the number of possible pairs per class was determined. A triad was formed in one class because there was an odd number of students. The triad did not participate in the study. The number of learning cells in each of the three matching groups for each class was then made. An attempt was made to have each of the matching groups equally represented in each class and for the study as a whole. When the study began, there were twenty-one Self Select cells, twenty Cognitive Style Similarity pairs and twenty Random cells.

After the number of Cognitive Style Similarity pairs in a class had been established, that many subjects were randomly chosen from the class list. One of those selected individuals was randomly chosen and his cognitive style map compared to the cognitive style map of another subject randomly drawn from the remaining pool of subjects. The procedure for comparing the cognitive style maps of individuals is presented in Appendix C.

If the degree of match between the two subjects was 86% or higher, the two became learning cell mates. If not, the subject drawn from the class pool was returned and another randomly drawn until a partner was found for the original subject. This process was repeated until all of the subjects that had been identified to be in the Cognitive Style Similarity group had partners.

Eighty-six percent had been established as a criterion for membership in the Cognitive Style Similarity group during a pilot study in the summer term preceding the study. In the pilot study the cognitive style map of each of the twenty-seven subjects was compared to the cognitive style maps of all of the other subjects. A distribution of the degrees of match was made and it was found that the 86% point cut off the upper third of the distribution.

After fall term had begun but before the study started, one of the four classes in the study was randomly chosen. The procedure that had been used during the pilot study was repeated to make a distribution of the degrees of match for all of the possible pairs of the thirty-one subjects in the class. It was found that neither the means nor the variances of the two samples (the pilot study group and the class randomly selected from the four classes participating in the study) were significantly different at the .05 level. Therefore, 86% was used as

the criterion for determining whether a pair would be in the Cognitive Style Similarity group in all four classes in the study.

Those who were not placed in the Cognitive Style Similarity group formed the other two groups. The Self Select group was made by selecting pairs who had both agreed to work together again from the list that had been compiled earlier in the term. The rest of the subjects were randomly paired and became the Random group.

Treatment

Each instructor had one day section that met twice per week and one evening section that met once a week. During the first meeting of each day section there was a lecture for the first forty minutes followed by a thirty-five minute learning cell session. The second meeting began with a twenty-five minute class discussion and review. Next there was a thirty minute learning cell session and then there was a twenty minute period to take a ten item multiple choice test covering the week's work for Dr. Mueller's students or to write an essay applying the week's content from the course to their own environment for Dr. Svagr's students. Each evening section had the same format as two consecutive daily meetings combined.

There was no required pattern of events that a learning cell had to adopt. Three examples of learning cell patterns were presented during the first learning

cell meeting, and the subjects were free to choose one of them or to define a new pattern. The suggested learning cell patterns appear in Appendix D.

There was a degree of content structure. Each week each instructor distributed a study guide for the following week's work. There were four parts: (1) Can you define these? - (2) Can you explain these? - (3) Can you compare these? - (4) Do you know the significance of these? A few items that were representative of the key points in a chapter were listed under each question. Subjects were encouraged to add their own items to the study guides. The study guides were used throughout the term and they became the core of the learning cell sessions. A sample study guide is included in Appendix E.

Instruments

Most of the instruments used in the study were those already in use by the instructors. The measures of achievement came from weekly tests and a final examination. The pre-treatment measure of achievement came from the mid-term examination.

One instrument was created to measure subjects' reactions to their learning cell experiences. Prior to the pilot study a pool of Likert-type items was generated cooperatively with another researcher also studying the learning cell. Some of the items were revised after

obtaining feedback from selected faculty members at Michigan State University and from the pilot study subjects. Ten items that dealt with general attitudes toward the learning cell were selected for this study. A final item was added that asked each subject to indicate the predominant communication pattern of his learning cell. The instrument for rating of the learning cell experience is presented in Appendix F.

The data for calculating cognitive style similarity came from the instruments used at Oakland Community College to measure cognitive style which had been administered before the study began.

Design Over Variables

One variable matrix was used for all three dependent variables. The three independent variables are presented and all the groups described by these three variables can be visualized. The distribution of the subjects across the cells is shown. The three dependent variables are given along with the covariable, the mid-term. Note that the covariable was used only with the weekly achievement variable.

INDEPENDENT VARIABLES				CO-VARIABLE	DEPENDENT VARIABLES		
MATCHING METHOD	AGE DIFFERENCE	SEX FACTOR	N	MID-TERM	WEEKLY ACHIEVEMENT	FINAL ACHIEVEMENT	LEARNING CELL RATING
Cognitive Style Similarity	Wide	Same	1				
		Different	5				
	Narrow	Same	10				
		Different	3				
Self Select	Wide	Same	5				
		Different	2				
	Narrow	Same	8				
		Different	2				
Random	Wide	Same	5				
		Different	1				
	Narrow	Same	7				
		Different	3				

Figure 1.--Variable Matrix.

Hypotheses

The following research and statistical hypotheses were tested. A brief description of the statistical treatment for each hypothesis is included.

H_1: The mean score for the four weekly measures of achievement of students who are matched by cognitive style similarity (CSS) will exceed the mean scores of the randomly (R) paired students and the self selected (SS) students.

H_1: $\bar{X}_{CSS} > \bar{X}_R$ & $\bar{X}_{SS}$ $\qquad$ H_0: $\bar{X}_{CSS} \not> \bar{X}_R$ & $\bar{X}_{SS}$

Analysis of H_1 involves the use of ANCOVA with the mid-term the covariable to determine whether the three matching groups differed on the weekly achievement measure. If ANCOVA were significant, then a post hoc analysis would be employed to investigate the null hypothesis.

H_2: The mean score for the four weekly measures of achievement of students whose age difference is narrow (N) will differ from the mean score of students whose age difference is wide (W).

H_2: $\bar{X}_N \neq \bar{X}_W$ $\qquad$ H_0: $\bar{X}_N = \bar{X}_W$

Analysis of H_2 involves the use of ANCOVA with the mid-term the covariable to determine whether the two age difference groups differed on the weekly achievement measure.

H_3: The mean score for the four weekly measures of achievement of students whose sex factor is the same (S) will differ from the mean score of students whose sex factor is different (D).

H_3: $\bar{X}_S \neq \bar{X}_D$ H_0: $\bar{X}_S = \bar{X}_D$

Analysis of H_3 involves the use of ANCOVA with the mid-term the covariable to determine whether the two sex factor groups differed on the weekly achievement measures.

H_4: There will be a matching method (MM) by age difference (AD) interaction for the dependent variable, weekly achievement.

H_4: MM interacts with AD H_0: MM does interact with AD

Analysis of H_4 involves assessing the potential interactive effects of the two variables, matching method and age difference, regarding the weekly achievement measure.

H_5: There will be a matching method by sex factor (SF) interaction for the dependent variable, weekly achievement.

H_5: MM interacts with SF H_0: MM does not interact with SF

Analysis of H_5 involves assessing the potential interactive effects of the two variables, matching method and sex factor, regarding the weekly achievement measure.

H_6: The mean score for the final examination of students who are matched by cognitive style similarity will exceed the mean scores of the randomly paired students and the self selected students.

H_6: $\bar{X}_{CSS} > \bar{X}_R$ & $\bar{X}_{SS}$ H_0: $\bar{X}_{CSS} \not> \bar{X}_R$ & $\bar{X}_{SS}$

Analysis of H_6 involves the use of ANOVA to determine whether the three matching groups differed on the final achievement measure. If ANOVA were significant, then a post hoc analysis would be employed to investigate the null hypothesis.

H_7: The mean score for the final examination of students whose age difference is narrow will differ from the mean score of students whose age difference is wide.

H_7: $\bar{X}_N \neq \bar{X}_W$ H_0: $\bar{X}_N = \bar{X}_W$

Analysis of H_7 involves the use of ANOVA to determine whether the two age difference groups differed on the final achievement measure.

H_8: The mean score for the final examination of students whose sex factor is the same will differ from the mean score of students whose sex factor is different.

H_8: $\bar{X}_S \neq \bar{X}_D$ H_0: $\bar{X}_S = \bar{X}_D$

Analysis of H_8 involves the use of ANOVA to determine whether the two sex factor groups differed on the final achievement measure.

H_9: There will be a matching method by age difference interaction for the dependent variable, achievement on the final examination.

H_9: MM interacts with AD H_0: MM does not interact with AD

Analysis of H_9 involves assessing the potential interactive effects of the two variables, matching method and age difference, regarding the final achievement measure.

H_{10}: There will be a matching method by sex factor interaction for the dependent variable, achievement on the final examination.

H_{10}: MM interacts with SF H_0: MM does not interact with SF

Analysis of H_{10} involves assessing the potential interactive effects of the two variables, matching method and sex factor, regarding the final achievement measure.

H_{11}: The mean rating of the learning cell experience by students who are matched by cognitive style similarity will exceed the mean ratings by students who are randomly paired and by students who are self selected.

H_{11}: $\bar{X}_{CSS} > \bar{X}_R$ & $\bar{X}_{SS}$ H_0: $\bar{X}_{CSS} \not> \bar{X}_R$ & $\bar{X}_{SS}$

Analysis of H_{11} involves the use of ANOVA to determine whether the three matching groups differed on the rating measure. If ANOVA were significant, then a post hoc analysis would be employed to investigate the null hypothesis.

H_{12}: The mean rating of the learning cell experience by students whose age difference is narrow will differ from the mean rating by students whose age difference is wide.

H_{12}: $\bar{X}_N \neq \bar{X}_W$ H_0: $\bar{X}_N = \bar{X}_W$

Analysis of H_{12} involves the use of ANOVA to determine whether the two age difference groups differed on the rating measure.

H_{13}: The mean rating of the learning cell experience by students whose sex factor is the same will differ from the mean rating by students whose sex factor is different.

H_{13}: $X_S \neq X_D$ H_0: $X_S = X_D$

Analysis of H_{13} involves the use of ANOVA to determine whether the two sex factor groups differed on the rating measure.

H_{14}: There will be a matching method by age difference interaction for the dependent variable, rating of the learning cell experience.

H_{14}: MM interacts with AD H_0: MM does not interact with AD

Analysis of H_{14} involves assessing the potential interactive effects of the two variables, matching method and age difference, regarding the rating measure.

H_{15}: There will be a matching method by sex factor interaction for the dependent variable, rating of the learning cell experience.

H_{15}: MM interacts with SF H_0: MM does not interact with SF

Analysis of H_{15} involves assessing the potential interactive effects of the two variables, matching method and sex factor, regarding the rating measure.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this chapter is to present an analysis of the data collected in this study. A total of fifteen hypotheses were tested, all of which are presented in the order they appeared in Chapter III. Data relevant to each hypothesis are presented following the hypothesis.

This chapter is divided into five sections. The first includes hypotheses and data related to weekly achievement. Section two contains hypotheses and data related to achievement on the final examination. The data and hypotheses regarding the students' evaluation of the learning cell experience are presented in the third section. Section four is an interpretation of the data analysis and the final section is a summary of the chapter.

Hypotheses and Data Related to Weekly Achievement

H_1: The mean score for the four weekly measures of achievement of students who are matched by cognitive style similarity will exceed the mean scores of the randomly paired students and the self selected students.

Data relevant to this hypothesis are presented in Table 2. The test of main effects for the independent variable, matching method, produced an F-ratio of .1100 (P = .8961). Since P was not .05 or less, the null hypothesis stating that the mean for the cognitive style similarity group did not exceed the means of the other two matching groups could not be rejected.

H_2: The mean score for the four weekly measures of achievement of students whose age difference is narrow will differ from the mean score of students whose age difference is wide.

Data relevant to this hypothesis are presented in Table 2. The test of main effects for the independent variable, age difference, produced an F-ratio of .4500 (P = .5063). Since P was not .05 or less, the null hypothesis stating that the means of the two age difference groups are equal could not be rejected.

H_3: The mean score for the four weekly measures of achievement of students whose sex factor is the same will differ from the mean score of students whose sex factor is different.

Data relevant to this hypothesis are presented in Table 2. The test of main effects for the independent variable, sex factor, produced an F-ratio of .0089 (P = .9256). Since P was not .05 or less, the null hypothesis stating that the means of the two sex factor groups are equal could not be rejected.

H_4: There will be a matching method by age difference interaction for the dependent variable, weekly achievement.

Data relevant to this hypothesis are presented in Table 2. The test of the interaction of the two independent variables, matching method and age difference, produced an F-ratio of .1209 (P = .8865). Since P was not .05 or less, the null hypothesis stating that there is no interaction between matching method and age difference could not be rejected.

H_5: There will be a matching method by sex factor interaction for the dependent variable, weekly achievement.

Data relevant to this hypothesis are presented in Table 2. The test of the interaction of the two independent variables, matching method and sex factor, produced an F-ratio of .0310 (P = .9695). Since P was not .05 or less, the null hypothesis stating that there is no interaction between matching method and sex factor could not be rejected.

Although no hypotheses regarding the interaction between age difference and sex factor or between matching method, age difference and sex factor were included in this study, data relevant to these interactions are included in Table 2. The test of the interaction of the two independent variables, age difference and sex factor, produced an F-ratio of 3.2251 (P = .0803). The test of the interaction of the three independent variables, matching method,

TABLE 2.--ANCOVA for Weekly Achievement.

Source	MS	DF	F	P	Decision
MM	5.1363	2	.1100	.8961	Do not reject null hypothesis 1
AD	21.0057	1	.4500	.5063	Do not reject null hypothesis 2
SF	.4132	1	.0089	.9256	Do not reject null hypothesis 3
MM x AD	5.6408	2	.1209	.8865	Do not reject null hypothesis 4
MM x SF	1.4480	2	.0310	.9695	Do not reject null hypothesis 5
AD x SF	150.5339	1	3.2251	.0803	--
MM x AD x SF	29.3440	2	.6287	.5387	--
Error	46.6157	39	--	--	--

(MM = Matching Method, AD = Age Difference, SF = Sex Factor)

age difference and sex factor, produced an F-ratio of .6287 (P = .5387). Neither interaction was significant at the .05 level.

Hypotheses and Data Related to Final Achievement

H_6: The mean score for the final examination of students who are matched by cognitive style similarity will exceed the mean scores of the randomly paired students and the self selected students.

Data relevant to this hypotheses are presented in Table 3. The test of main effects for the independent

variable, matching method, produced an F-ratio of .6358 (P = .5348). Since P was not .05 or less, the null hypothesis stating that the mean for the cognitive style similarity group did not exceed the means of the other two matching groups could not be rejected.

H_7: The mean score for the final examination of students whose age difference is narrow will differ from the mean score of students whose age difference is wide.

Data relevant to this hypothesis are presented in Table 3. The test of main effects for the independent variable, age difference, produced an F-ratio of .0189 (P = .8913). Since P was not .05 or less, the null hypothesis stating that the means of the two age difference groups are equal could not be rejected.

H_8: The mean score for the final examination of students whose sex factor is the same will differ from the mean score of students whose sex factor is different.

Data relevant to this hypothesis are presented in Table 3. The test of main effects for the independent variable, sex factor, produced an F-ratio of .0671 (P = .7970). Since P was not .05 or less, the null hypothesis stating that the means of the two sex factor groups are equal could not be rejected.

H_9: There will be a matching method by age difference interaction for the dependent variable, achievement on the final examination.

Data relevant to this hypothesis are presented in Table 3. The test of the interaction of the two independent variables, matching method and age difference, produced an F-ratio of .9247 (P = .4050). Since P was not .05 or less, the null hypothesis stating that there is no interaction between matching method and age difference could not be rejected.

H_{10}: There will be a matching method by sex factor interaction for the dependent variable, achievement on the final examination.

Data relevant to this hypothesis are presented in Table 3. The test of the interaction of the two independent variables, matching method and sex factor, produced an F-ratio of 1.0358 (P = .3643). Since P was not .05 or less, the null hypothesis stating that there is no interaction between matching method and sex factor could not be rejected.

Although no hypothesis regarding the interaction between age difference and sex factor or between matching method, age difference and sex factor were included in this study, data relevant to these interactions are included in Table 3. The test of the interaction of the two independent variables, age difference and sex factor, produced an F-ratio of 1.8687 (P = .1793). The test of the interaction of the three independent variables, matching method, age difference and sex factor, produced an

TABLE 3.--ANOVA for Final Achievement.

Source	MS	DF	F	P	Decision
MM	9.5967	2	.6358	.5348	Do not reject null hypothesis 6
AD	.2857	1	.0189	.8913	Do not reject null hypothesis 7
SF	1.0131	1	.0671	.7970	Do not reject null hypothesis 8
MM x AD	13.9567	2	.9247	.4050	Do not reject null hypothesis 9
MM x SF	15.6345	2	1.0358	.3643	Do not reject null hypothesis 10
AD x SF	28.2067	1	1.8687	.1793	--
MM x AD x SF	10.5534	2	.6992	.5030	--
Error	15.0939	40	--	--	--

F-ratio of .6992 (P = .5030). Neither interaction was significant at the .05 level.

Hypotheses and Data Related to Students' Rating of the Learning Cell Experience

H_{11}: The mean rating of the learning cell experience by students who are matched by cognitive style similarity will exceed the mean ratings by students who are randomly paired and by students who are self selected.

Data relevant to this hypothesis are presented in Table 4. The test of main effects for the independent variable, matching method, produced an F-ratio of .4073 (P = .6682). Since P was not .05 or less, the null

hypothesis stating that the mean rating for the cognitive style similarity group did not exceed the mean ratings of the other two matching groups could not be rejected.

H_{12}: The mean rating of the learning cell experience by students whose age difference is narrow will differ from the mean rating by students whose age difference is wide.

Data relevant to this hypothesis are presented in Table 4. The test of main effects for the independent variable, age difference, produced an F-ratio of 1.8900 (P = .1769). Since P was not .05 or less, the null hypothesis stating that the means of the two age difference groups are equal could not be rejected.

H_{13}: The mean rating of the learning cell experience by students whose sex factor is the same will differ from the mean rating by students whose sex factor is different.

Data relevant to this hypothesis are presented in Table 4. The test of main effects for the independent variable, sex factor, produced an F-ratio of .3105 (P = .5805). Since P was not .05 or less, the null hypothesis stating that the means of the two sex factor groups are equal could not be rejected.

H_{14}: There will be a matching method by age difference interaction for the dependent variable, rating of the learning cell experience.

Data relevant to this hypothesis are presented in Table 4. The test of the interaction of the two independent variables, matching method and age difference, produced an

F-ratio of 1.3724 (P = .2652). Since P was not .05 or less, the null hypothesis stating that there is no interaction between matching method and age difference could not be rejected.

H_{15}: There will be a matching method by sex factor interaction for the dependent variable, rating of the learning cell experience.

Data relevant to this hypothesis are presented in Table 4. The test of the interaction of the two independent variables, matching method and sex factor, produced an F-ratio of .5365 (P = .5890). Since P was not .05 or less, the null hypothesis stating that there is no interaction between matching method and sex factor could not be rejected.

Although no hypotheses regarding the interaction between age difference and sex factor or between matching method, age difference and sex factor were included in this study, data relevant to these interactions are included in Table 4. The test of the interaction of the two independent variables, age difference and sex factor, produced an F-ratio of 3.3632 (P = .0742). The test of the interaction of the three independent variables, matching method, age difference and sex factor, produced an F-ratio of .0810 (P = .9224). Neither interaction was significant at the .05 level.

TABLE 4.--ANOVA for Rating of the Learning Cell Experience.

Source	MS	DF	F	P	Decision
MM	17.6804	2	.4073	.6682	Do not reject null hypothesis 11
AD	82.0310	1	1.8900	.1769	Do not reject null hypothesis 12
SF	13.4770	1	.3105	.5805	Do not reject null hypothesis 13
MM x AD	59.5676	2	1.3724	.2652	Do not reject null hypothesis 14
MM x SF	23.2850	2	.5365	.5890	Do not reject null hypothesis 15
AD x SF	145.9766	1	3.3632	.0742	--
MM x AD x SF	3.5164	2	.0810	.9224	--
Error	43.4037	40	--	--	--

Interpretation of the Data Analysis

The result of analyzing the data was that none of the null hypotheses was rejected. The obvious interpretation is that the relationship between the independent variable(s) and the dependent variable in a given null hypothesis is supported by the data and that the relationship described in the alternate hypothesis does not exist under the conditions of this study. The purpose of this discussion is to present some factors that may help to account for the failure to reject any null hypotheses.

Although there were one hundred four subjects who finished the study, the total N was actually fifty-two. The unit of analysis was the learning cell so the scores for each pair were combined into a mean for each cell. This had the effect of cutting the N in half. In addition nine of the original sixty-one learning cells did not complete the study because at least one of the people in a cell dropped the course or never took the final examination. The relatively small N of the study meant that greater differences between the various groups would have to exist to reach statistical significance than would be needed if the N were larger. The inadequacy of the small N appeared strongly in the analysis of the three-way interaction. The interaction produced two cells with an N of one, two cells with an N of two and two cells with an N of three.

When the study was being planned, it was thought that the four weeks of learning cell experience would be considerable. Actually the total class time devoted to the learning cell in those four weeks was four hours and twenty minutes. It is suggested that perhaps this amount of time spread over four weeks was insufficient to enable learning cell partners to really establish productive relationships. It is assumed that being in a learning cell during class time was a novel experience for the subjects. More time may have been needed to learn how

to function effectively in a learning cell. This point might apply particularly to the subjects in the two evening sections who met once a week. They had only four class meetings that involved learning cells.

This study required that subjects who were paired at the beginning would have to keep the same partners throughout the study. It is certain that incompatible pairs were formed. Such pairs may have viewed the learning cell with contempt instead of looking forward to each session. The requirement that partners remain together was deemed necessary because of the design of the study but it may have been made at the expense of lowering the quality of the learning cell experience for several subjects.

There was no required pattern of communication that the learning cells in the study were required to follow. Three examples of learning cell patterns were given and each pair was free to choose one of the three or to invent a new communication pattern. The decision to provide the options was made because it was thought that the flexibility would make it more likely that the subjects would willingly participate in learning cells. There is the possibility that the different communication patterns confounded the results by acting as uncontrolled independent variables. The different patterns could have

interacted with the independent variables to cause effects that were not investigated.

Another factor presented here that relates to the results of the study is very fundamental. The independent variables for the study (Matching Method, Age Difference, Sex Factor) were all abstract concepts until definitions for each were stated. The findings of this study relate specifically to the relationships between the independent variables as they are operationally defined and the dependent variables. This point is made to suggest that there might be other operational definitions of the abstract concepts that when substituted for the independent variables in the study would have statistically significant relationships with the dependent variables.

There were three conditions for Matching Method: Cognitive Style Similarity, Self Select, Random. The cognitive style maps of two subjects had to be 86% alike to be considered similar. Raising the criterion level might create an operational definition for Cognitive Style Similarity that would change the results of the study. The formation of the Self Select group was delayed until the Cognitive Style Similarity group had been made. The Random group was not formed until the other two had been formed. The operational definitions of the three matching groups were interdependent. Having the matching groups formed independently could affect the findings.

The mean of the distribution of the age differences of the fifty-two learning cells was used to split all the learning cells into two groups, Wide and Narrow. It is possible that real differences did exist between those learning cells whose age differences were very wide and those whose age differences were very narrow but those differences could have been neutralized by the learning cells whose age differences were nearer the mean. The mean may not have adequately discriminated the two age difference groups.

The last factor presented here that could have influenced the results of the study concerns the reliability and validity of the achievement measures. The reliability and validity of the weekly tests and of the final examination are unknown. It is possible that the outcomes of the study across all the variables were affected by these two unknown test characteristics.

Summary

This chapter contained an analysis of the data for the study. Five research hypotheses were presented for each of the three dependent variables, weekly achievement, final achievement and rating of the learning cell experience. Each hypothesis was followed by a brief summary of the data related to that hypothesis. A table containing the data for the set of hypotheses for each dependent variable was provided.

None of the fifteen null hypotheses could be rejected. In addition, two additional interactions for each dependent variable were investigated. There were none of these six interactions which proved to be significant at the .05 level.

Six factors that might have influenced the results were proposed. They included: (1) the relatively small N of the study, (2) the amount of time partners spent working together, (3) the requirement that partners could not change, (4) the possibility that the communication patterns acted as confounding variables, (5) the operational definitions of the independent variables, and (6) the unknown reliability and validity of the achievement measures.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

This final chapter contains four sections. The first section reviews the purpose of the study and the procedures used to realize the purpose. Section two includes the major conclusions of the study. The third section suggests some implications resulting from the study for those who plan to use learning cells. A statement of recommendations for further research is presented in the final section.

Summary

The primary purpose of this study was to compare three methods of matching partners in a learning cell. The three methods were to pair students whose cognitive style maps were highly similar, to let students pair themselves and to pair students randomly. It was intended that the achievement of students in the three conditions be compared and that ratings of the learning cell experience by students in the three kinds of learning cells be compared.

Secondary purposes of the study included exploring the influence upon achievement and ratings of the learning cell experience of matching partners who were of the same or different sex and of matching partners who were relatively the same or different in terms of chronological age.

Students in each of four sections of the introductory psychology course at Oakland Community College were placed into one of three kinds of learning cells: Cognitive Style Similarity, Self Select or Random. Each learning cell met for sixty-five of the one hundred fifty minutes of class time per week for four consecutive weeks at the end of the term. Three examples of interaction patterns for learning cells were given to all the learning cells. A cell could choose one of the three or invent a new pattern. A weekly study guide was provided for each cell to help facilitate interaction with the content.

A mid-term examination, the covariable for weekly achievement, was administered two weeks prior to the study. The subjects took achievement tests each of the four weeks of the study and they took a final examination. A ten item instrument that involved the students' evaluation of the learning cell experience was administered after the final learning cell session. The data that were collected using these instruments were analyzed by ANOVA and ANCOVA with the computer program, Multivariance...Univariate and

Multivariate Analysis of Variance, Covariance and Regression; a fortran IV program (Version 4, June, 1968), on the Michigan State University CDC 6500.

Conclusions

Based on the analysis of data collected four major conclusions of the study are listed below.

Conclusion 1.

The use of cognitive style similarity based upon cognitive style mapping as a criterion for matching students in learning cells was no better than the use of self selection or randomization in terms of achievement and rating of the learning cell experience. This conclusion is based on the failure to reject: (1) the first null hypothesis regarding matching method and weekly achievement, (2) the sixth null hypothesis regarding matching method and final achievement and (3) the eleventh null hypothesis regarding matching method and rating of the learning cell experience.

Conclusion 2.

The closeness of the chronological ages of cell mates did not affect achievement or the rating of the learning cell experience by the subjects. This conclusion is based on the failure to reject: (1) the second null hypothesis regarding age difference and weekly achievement,

(2) the seventh null hypothesis regarding age difference and final achievement and (3) the twelvth null hypothesis regarding age difference and rating of the learning cell experience.

Conclusion 3.

The sameness or difference of the sex of cell mates did not affect achievement or the rating of the learning cell experience by the subjects. This conclusion is based on the failure to reject: (1) the third null hypothesis regarding sex factor and weekly achievement, (2) the eighth null hypothesis regarding sex factor and final achievement and (3) the thirteenth null hypothesis regarding sex factor and rating of the learning cell experience.

Conclusion 4.

No combination of the three independent variables in the study (Matching Method, Age Difference, Sex Factor) affected achievement or the rating of the learning cell experience by the subjects. This conclusion is based on the failure to reject: (1) the fourth null hypothesis regarding the matching method by age difference interaction for weekly achievement, (2) the fifth null hypothesis regarding the matching method by sex factor interaction for weekly achievement, (3) the ninth null hypothesis regarding the matching method by age difference interaction for final achievement, (4) the tenth null

hypothesis regarding the matching method by sex factor interaction for final achievement, (5) the fourteenth null hypothesis regarding the matching method by age difference interaction for rating of the learning cell experience and (6) the fifteenth null hypothesis regarding the matching method by sex factor interaction for rating of the learning cell experience.

Implications

No new idea can qualify for acceptance within a given body of knowledge as the result of a single study. Such acceptance takes a long time and follows numerous replications of the research. Nevertheless, tentative suggestions can be made based on a single study. The purpose of this section is to present four such tentative suggestions resulting from the study that the potential user of the learning cell might consider.

1. In the delimitations of the study it was noted that no control group representing regular instruction appeared in the study. The main intent was to compare the effect of various matching variables on achievement and rating of the learning cell experience. The findings of the study should not be construed to mean that the learning cell itself is not an effective instructional mode. Rather, the findings support the idea that none of the different ways of matching people influenced achievement or rating of the learning cell experience.

This implies that if one were going to use learning cells he could randomly assign partners or let them self select without regard to their ages or sex. The use of cognitive style similarity to match people would not be recommended because the random or self select methods require much less time and effort.

2. Both instructors reported that the subjects responded very favorably to having the study guides available. The subjects said that they could use their time more effectively and that they knew what the instructor thought to be important. Perhaps other learning cell participants would also benefit from getting study guides from their instructors.

3. As mentioned in Chapter IV, certain learning cells contained incompatible partners but the design of the study required that the partners remain together during the study. It is suggested that partners ought to periodically be permitted to change if desired.

4. A final implication is that it may be desirable to use the learning cell as an alternative rather than requiring every student to participate. Some of the subjects resisted being in a learning cell. Some complained that they could get the content on their own and that a partner only slowed them. The learning cell, like most every instructional mode, seems to be effective with some students but not with others. The instructor who

plans to use learning cells might try to be sensitive to those students who do not seem to want to work with a partner and not force such students into learning cells.

Recommendations

Many endeavors that strive to find answers to questions often result in the generation of new questions. This study has raised a number of questions which suggest further directions for research dealing with the learning cell. The following four recommendations are the result of such questions.

Recommendation 1.

Further research should be done with modifications to the independent variables of this study. The N should be increased so that the design would require the independent operational definitions of the three matching groups. Consideration should be given to making the criteria for establishing cognitive style similarity and the age difference groups more discriminating. The potential interaction of communication patterns and the other variables should be investigated. It is possible that a learning cell's communication pattern (method of working together) may interact with the matching method, and/or age difference and/or sex factor associated with that learning cell to affect the cell's level of achievement and rating of the learning cell experience.

Recommendation 2.

Further research should be done to identify the characteristics of those learners who appear to benefit most from participating in a learning cell. Both instructors in the study agreed that certain subjects benefited greatly from being in a learning cell while others did not. If descriptive data regarding such things as personality, academic ability and personal preference were available about those students for whom the learning cell was beneficial and about those for whom the learning cell was not beneficial, one might use the learning cell more selectively on a prescriptive basis.

Recommendation 3.

Further research should be done to identify and describe "successful" learning cells. It would be desirable to generate a profile of such learning cells including elements such as the communication patterns and the frequency and length of sessions. The profile could serve as a model for the users of learning cells.

Recommendation 4.

The learning cell in this study appeared as a required experience replacing part of the regular class lecture. Further research should compare the effect of varying the context within which the learning cell occurs. The learning cell could appear as the only

instructional mode available, as a supplement to regular instruction or as a totally extracurriculuar, voluntary option. If it were a supplement to regular instruction, it could be the only option (as in this study) or one of several options.

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APPENDICES

APPENDIX A

During the last few weeks of the semester this class will be participating in a study conducted within the Department of Psychology at Oakland Community College. The study is intended to examine an instructional innovation known as the Learning Cell. A Learning Cell is made-up of two students who work together to master cooperatively some learning task. The members of this class will be divided into pairs and part of the class time will be devoted to Learning Cell activities. Your cooperation in this study will be greatly appreciated.

APPENDIX B

Name

Two statements are given below. Decide which statement you agree with and place a check (✓) in the space preceding that statement.

___If our class were to work in pairs again, I would be willing to work with my last partner again.

___If our class were to work in pairs again, I would prefer not to work with my last partner again.

APPENDIX C

DETERMINATION OF COGNITIVE STYLE

SIMILARITY: AN EXAMPLE

1. Display all of the cognitive style elements of the potential pair. Show a major as a 2 and a minor as a 1.

	T(AL)	T(AQ)	T(VL)	T(VQ)	Q(A)	Q(V)	I	A	F	M	D	R	L	(K)
Student A	2	2	1	1	1	2	2	1	-	2	1	2	2	-
Student B	2	2	2	1	1	-	2	1	1	2	1	1	2	2

2. Assign three points to each element present in a map but give nine points for an L.

   a. Student A has twelve elements but one of the elements is an L worth nine points.

   $$\text{Points}_A = 11(3) + 9 = 33 + 9 = 42$$

   b. Student B has thirteen elements but one is an L worth nine points.

   $$\text{Points}_B = 12(3) + 9 = 36 + 9 = 45$$

3. Give the pair three points for each element for which there is a direct match. Give nine points for an L match.

   Students A and B have a direct match for the following elements: T(AL), T(AQ), T(VQ), Q(A), I, A, M, D, L.

   $$\text{Points}_{\text{Direct}} = 8(3) + 9 = 24 + 9 = 33$$

4. Give the pair two points for each element for which there is a non-direct match.

   Students A and B have a non-direct match for the following elements: T(VL), R.

   $$\text{Points}_{\text{Non-Direct}} = 2(2) = 4$$

5. The sum of the direct and non-direct match points becomes the numerator of a cognitive style similarity ratio.

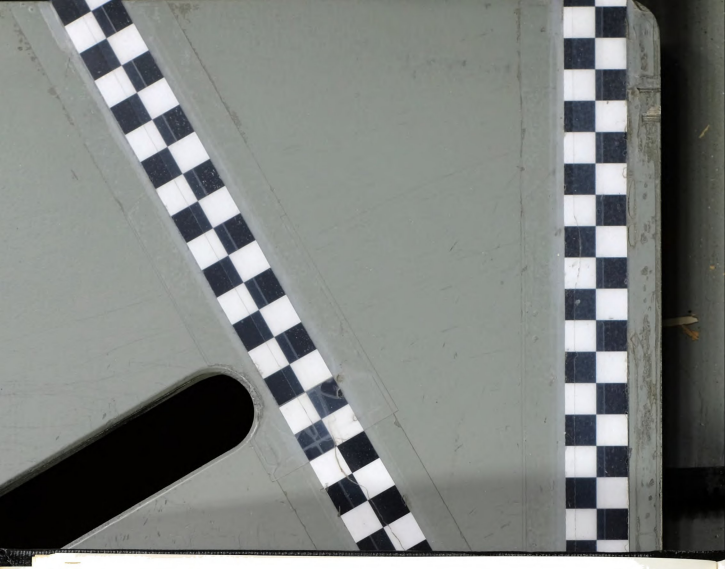
   The denominator of the ratio is the larger number of points from step 2.

   Numerator = 33 + 4 = 37

   Denominator = 45

6. Make the ratio, perform the indicated division and convert the answer to a percentage.

   $$\frac{37}{45} = .8\underline{2} = 82\%$$



APPENDIX D

SUGGESTED LEARNING CELL PATTERNS

It is important that each learning cell establish a pattern or method of working together. Four options are explained below. Each cell should agree upon one of these options before starting a session.

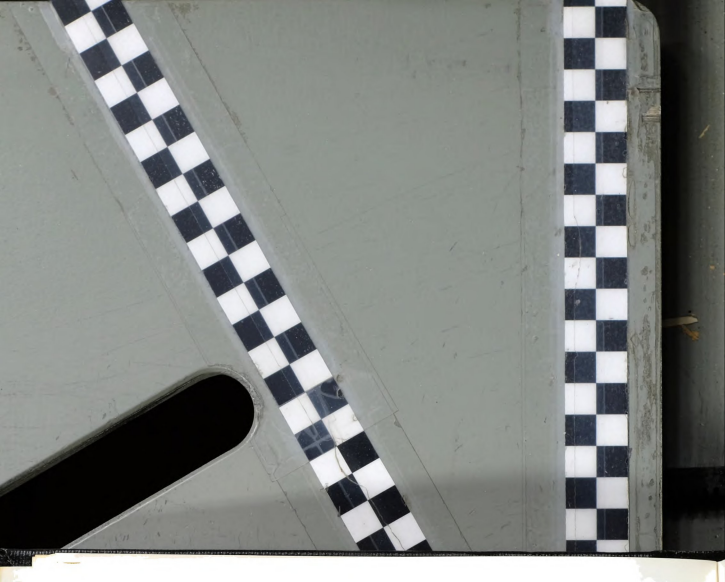
OPTIONS:

1. One student asks his/her partner a question. The partner responds and the questioner gives feedback. Then the partners change roles and proceed as before. This process is continued until both partners feel they have mastered the content.

2. During the first few minutes of the learning cell session, the partners divide the assigned content in half. For the first half of the remaining time one person explains the major points of his/her assigned content and interacts with the partner for clarification. Partners reverse their roles for the remaining time.

3. Partners agree upon content that needs clarification or review. They hold a discussion without either partner being assigned a particular role.

4. Partners may invent a new pattern or adapt one of the above.



APPENDIX E

STUDY GUIDE FOR CHAPTER 14

I. CAN YOU DEFINE THESE?

1. Four requirements of a formal psychological test

   a. objectivity
   b. standardization
   c. reliability
   d. validity

2. Mental Age

3. Chronological Age

4. Intelligence

II. CAN YOU EXPLAIN THESE?

1. The method used to compute a child's I.Q.

2. Importance of heredity

3. Importance of environment

4. Group test

5. Individual test

III. CAN YOU COMPARE THESE?

1. Aptitude tests and achievement tests

2. Stanford-Binet test and Wechsler test

3. Objective and projective tests

4. Group test and individual test

IV. DO YOU KNOW THE SIGNIFICANCE OF THESE?

1. Environment on I.Q.
2. MMPI test
3. Heredity on IQ
4. Of the relationship of environment and heredity
5. General factor in intelligence

APPENDIX F

LEARNING CELL RATING FORM

Name: _____

Please be frank and honest in responding to each of the following items. The information you provide will be the most important factor in determining the future use of learning cells. Please respond to every item. Your responses will be kept confidential.

KEY:

SA = you strongly agree
A = you agree
U = you are uncertain
D = you disagree
SD = you strongly disagree

1. I felt more comfortable raising questions in my learning cell than in front of the whole class.	___ SA	___ A	___ U	___ D	___ SD
2. Learning cells should be used in more courses.	___ SA	___ A	___ U	___ D	___ SD
3. In general the learning cell was a worthwhile experience for me.	___ SA	___ A	___ U	___ D	___ SD
4. The learning cell did not improve my understanding of the content of the course.	___ SA	___ A	___ U	___ D	___ SD
5. Being in a learning cell caused me to prepare for class more thoroughly.	___ SA	___ A	___ U	___ D	___ SD
6. Learning was more enjoyable because of the learning cell.	___ SA	___ A	___ U	___ D	___ SD
7. My learning cell met outside of regular class time at least once.	___ SA	___ A	___ U	___ D	___ SD

8. The learning cell sessions took too much of the class time each week.	SA	A	U	D	SD
9. The learning cell activity should have started earlier in the term.	SA	A	U	D	SD
10. I would avoid enrolling in a section of a course if the instructor planned to use learning cells.	SA	A	U	D	SD

11. After reading the four learning cell patterns given below, indicate the one that most nearly explains how your learning cell operated.

___ One student asks his/her partner a question. The partner responds and the questioner gives feedback. Then the partners change roles and proceed as before. This process is continued until both partners feel they have mastered the content.

___ During the first few minutes of the learning cell session, the partners divide the assigned content in half. For the first half of the remaining time one person explains the major points of his/her assigned content and interacts with the partner for clarification. Partners reverse their roles for the remaining time.

___ Partners agree upon content that needs clarification or review. They hold a discussion without either partner being assigned a particular role.

___ Other (please explain).

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