Heuristics

A Report on a Course on Knowledge Acquisition

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Preface

During the past year friends and colleagues suggested to me on several occasions to write a short report on a course entitled *Heuristics* which was given under the auspices of the Department of Electrical Engineering (EE 271 and EE 497) in conjunction with the College of Liberal Arts and Sciences (LAS 199) during the Fall and Spring Semesters of 1968/1969 by Professor Herbert Brün of the School of Music and myself, and during the Fall Semester of 1969 by myself.

When on short notice I was advised that such a brief report was desirable for intra-departmental purposes I suggested to Professor Brün that we should draft a joint report. He kindly consented, and the following pages are the results of our effort to have this material organized, written and typed within the alloted 72 hours. This time limit made this report much longer than one would have wished it to be. However, we found ourselves unable to compress the information further without jeopardizing the accuracy of the description of our intentions, efforts and results.

In spite of all its obvious shortcomings I hope that this report may still be of some use to those friends and colleagues who were the first to suggest that such a report should be written.

H.V.F.

1 Background

In its report to the President and the Congress of the United States of March 1970: *To Improve Learning*[1] the Committee on Education and Labor defines in Chapter IV six points of action that will:

i Deal with root problems, such as the advancement of the knowledge of how human beings learn and the application of these findings to instruction in schools and colleges.

ii Support sustained research, development, and application projects.

iii Apply technology to the most critical problems in education.

iv Encourage alternative approaches to the solution of any given educational problem.

v Concentrate resources on action programs of high visibility.

vi Create conditions which encourage scholars and specialists from various fields to work together.

The Committee goes on to say:

> "The Commission proposes a course of action to meet these requirements. Top priority should go to the expansion and improvement of educational research and development and to the application of research findings to important practical problems in education. Finally, the results must be packaged for effective use by the schools and colleges."

In its report to the President of the United States of July 4, 1970: *Toward Balanced Growth: Quantity with Quality*[2] the White House National Goals Research Staff identifies in the summary of Chapter 4, "Education," the following problems and needs:

> "In the past, the public has equated going to school with education. The role of the school was to transmit information and instill traditional values. The society of today is one changing so rapidly that skills and information become outmoded, and traditional values are under challenge. ... It may well be that the schools should be devoted to giving them [the students] the cognitive skills for integrating information, and

a framework within which to sort out the diverse values to which they are exposed.

...

The choices with which the schools are confronted involve, on the one hand, teaching problem-solving skills, fostering the development of students as individuals, and conducting problem-oriented research. Or, on the other hand, there is the option of continuing to transmit the old knowledge and values at the primary and secondary levels, and continuing to transmit the traditional knowledge and seeking to develop knowledge for its own sake at the higher levels of education.

...

In the meantime, we need to develop further understanding of the educational process and of who to evaluate it. We must further develop an experimental posture toward innovation in education which will reflect our basic uncertainty as to how to go about the many problems with which the educational system is faced.

...

Take all in all, the educational system, which is the crucial single institution for the development of our citizenry so that they can live happily, shape our system wisely,and contribute to both the direction and rate of its growth, is in a state of sever stress. The educational system is having its own 'growth' problems which, if not solved, will have a profound impact on the growth of the Nation as a whole."

Long before the identification of these problems and needs found their way into National policy statements they had been registered by the academic community in general and by friends and members of the Biological Computer Laboratory of the Department of Electrical Engineering in particular. In the course of their research activity this group had addressed itself to the establishment of the causes of these deficiencies, and action to overcome these were initiated long ago.

As stated in point (i) of the House Committee's report, the central problem in today's education is, of course, our lack of knowledge of how knowledge is acquired, or more specifically, our ignorance of epistemology, neurophysiology and psychology of cognitive processes. In anticipation of the urgency to solve these problems this group initiated several years ago a series of inter-disciplinary research program in cognition (e.g., "Theory and Application of Computational Principles in Cognitive Systems" (1966); "Analysis and Synthesis of Cognitive Processes and Systems" (1968); "Cognitive Memory: A Computer Oriented Epistemological Approach to Information Storage and Retrieval" (1967); etc.) which during these years have harvested a considerable body of knowledge[3,4].[5]

2 Proposal

It was perhaps more than sheer coincidence that in spring of 1968 a group of undergraduate students from various departments approached us and expressed their desires to have a course on "Heuristic" installed in which the present state of the art of how to perceive problem and how to discover its solution could be learned.

Since Heuristics is a name given loosely to the teaching and learning of the faculties of how to perceive and discover, that is to the development of cognitive processes, the proposal by the students was taken as a welcome opportunity to carry the activities and results of the research laboratory into the classroom.

A course outline for a new course "Heuristics" (EE 271 and 497) was written (see Appendix I), was submitted and duly approved for the fall semester 1968. The purpose of the course was threefold:

(i) to let the students become immersed into the most advanced methodology of coping with semantics and logic of problem identification and solution, with heuristic procedures known and unknown today, and with various models of mentation.

(ii) to conduct the course by applying as much as is known today of knowledge acquisition processes (i.e., not only to teach heuristics but also to *use* heuristics in teaching it).

(iii) to use the classroom as an extension of the research laboratory in which we could broaden our understanding of cognitive processes and obtain more data and insights which, in turn, could be immediately tested as to their effectiveness in the classroom situation.

3 Proceedings

The course met for the first time on September 17, 1968, in a classroom of the EE building. This room as well as a larger room, 138 Administration, proved too small for

the number of students interested in the course. Permission was sought and granted to hold further meetings at the Center for Advanced Studies, and there, for the fall semester, the course proceeded.

The sessions during this semester were dedicated to an introduction into the concepts related to various meanings of the term "Heuristics." The methods of this introduction, however, alternated between explicitly informative presentations of terminology, lecture-discussions on the themes of epistemology and specified reading assignments on the one hand, and, on the other hand, more or less guided or improvised exercises in heuristic attitudes toward class problems, assignments that were to lead the students to the discovers of heuristic techniques, and attempts at having the students understand that they were learning something they needed for their pursuit of individual and social happiness.

In cooperation with the instructors the students were soon able to deal, instructively and constructively, with a variety of questions such as these: Who are the Students? Who are the instructors? What is a problem? *Who* is a problem? Which are the scientific and psychological concepts we already know and thus can learn to use? Where and how could we search for the missing concepts which we need and which we still have to create and render useful? Can one, helped by some answers to the previous questions, setup, or construct, thinking-models on which one might demonstrate the transformation of keenly felt bu tvaguely expressed criticism and discontent into clearly articulated and solution-prone problem definitions?

From here it was but a small step to the subject of human creativity and the application of creative thinking to the tasks of model-conception and problem-solving.

(A more detailed, more descriptive report on the course, providing the context in which the procedures mentioned should be placed for better understanding, is contained in Appendix II. Appendix III gives a brief day by day abstract of every session of the course.)

Although this course was originally conceived as a one-shot affair only, almost all students who participated in this fall semester course insisted that it be continued in the spring semester. We consented and, with some modification caused by an increase in enrollment, repeated and extended this course in Spring 1969. (Appendix II reports on several projects during this second semester.) Again, the overwhelming majority of students persistently petitioned to have this course continued in the fall semester 1969, and we yielded to their request. (Appendix IV gives some statistical data on participating instructors, break-down of students into schools and enrollments.)

4 Distinctive Features and Results

(i) The instructors sharing the course were a physicist, a composer of music, a sociologist, a linguist, and guests from various other disciplines.

(ii) Controversies among the instructors were openly presented and discussed in the presence of the students.

(iii) The students originated from all colleges of the University.

(iv) The students were continuously kept aware of the fact that *they* had initiated and asked for the course.

(v) The instructors agreed on a balance between presentation of acquired knowledge through lecture-discussion on the one hand and special projects for experimental research on the other.

(vi) The instructors also agreed that this balance ought to be the result of their function as catalyst rather than as programmers.

(vii) The structure of the class and of the course, both, were determined by one authority only, namely by the subject matter to be dealt with.

(viii) At any given moment this authority determined the exterior aspects of the course as well as the interior aspects; whether to sit in rows, at table, in circles; whether to continue or drop a subject; whether to form small, large, no groups; whether to invite experts; etc.

(ix) Thesis 1: The study of Heuristics requires that a heuristic attitude pervade the study of Heuristics.

(x) Thesis 2: In a heuristic process one cannot predict that the triviality of a point of departure will carry over to the path the process will take.

(xi) Throughout the three semesters of the course attempts were made, first by the instructors, later also by the students, to actually bring a heuristic attitude to bear on the process of teaching and learning about Heuristics. Some of these attempts started as well prepared and carefully designed assignments; others took their cue from rather trivial occurrences.

(xii) At all times during the course the students were told whether a question addressed to them was to be understood as an invitation to participate in the search for a still unknown answer; or whether they were to try their wits at guessing the answer which the questioner wished to hear.

(xiii) Conventions with regard to language in the course were: Communicative language adjusts thought to language. Creative language adjusts language to thoughts. Improper language exceed the needs of expression of a though but still carries it. Offensive language exceeds the needs of expression of a thought and fails to carry it.

(xiv) To have students listen to the teachers and to have teachers listen to students (which was important in the course on Heuristics) a few conditions have to be satisfied. The person to whom one wishes to listen must be asked to say something, must be rendered capable of saying what he wishes to say, and must be convinced that one is listening. With anyone of these conditions unsatisfied, the wish to listen remains unfulfilled, and the wish to say something whithers away. During the course in Heuristics the results of a number of experimental assignments were studied by both students and instructors. It was shown that the three above mentioned conditions can hardly ever be satisfied under contemporary usual circumstances; that unusual circumstances usually help in satisfying all three conditions simultaneously. It is to be understood that the terms "usual" and "unusual" do not refer to some property of the circumstances but rather to their contemporary relative frequency of appearance.

(xv) Documentations of the efforts that went into the course can be seen in our archives. They include large collections of papers written by students and instructors, reports on special group projects, exhibits for the "anticommunication show," the "Whole University Catalog," a "Self-classifying Student Directory," and numerous notes taken during the course. None of these items represents the goal of the course, though each reflects upon it. All, however, show in unmisunderstandable languages, where we are at present; where unusual educational procedures and concepts succeed and where they fail. It may justifiably cause discomfort if one contemplates the desperate urge, everywhere, to convey messages to those who would rather quibble with the language than listen to the message. As if the languages of discontent, be they improper or not, will ever be anything but offensive to the complacent. To those among us, however, who still can read thoughts, if even through ruins of language, it should give a feeling of comfort that, in this way supplied with the evidence of things as they are, we may become better equipped to continue the search for the ideas and creative thoughts and actions which might produce the evidence for things as they should be.

5 References

Notes

[1]Perkins, C.D.: *To Improve Learning*, A Report to the President and the Congress of the United States by the Commission on Instructional Technology. U.S. Government Printing Office, Washington, D.C. #40–715, 0; 124 pp; (1970).

[2]Garment, L. *Toward Balanced Growth: Quantity with Quality*. Report to the President of the United States by the White House National Goals Research Staff, Washington, D.C., 20,500; 226pp; (1970).

[3]Von Foerster, H., *et al*. *Accomplishment Summary 69/70* B.C.L. Report # 70.2, Biological Computer Laboratory, University of Illinois, Urbana; 337 pp. (1970).

[4]Von Foerster, H., R.T. Chien *et al*. *Cognitive Memory*, Interim Report Phase II; Coordinated Science Laboratory, University of Illinois, Urbana; 185 pp; (1970).

[5]These summary reports of last year's activity on two representative projects alone list over 70 articles, books, reports, and these on the topic of cognition which were published by members of these projects.

Appendix I: Tentative Course Outline

I. Introduction of Concepts Anthropomorphic, linguistic, logical and mathematical interpretations of what constitutes a problem and of the processes that carry a problem into its solution. Solubility, insolubility and paradoxes.

II. Logic of Inferences Deductive, inductive and adductive modalities of inference. Effective procedures. Algorithms. Limits of logical inferences.

III. Heuristics Methodology of search procedures in the absence of effective algorithms. Partitions, search trees, Monte Carlo methods. Paraphrases and metaphors. Meaning and inferability. Levels of meaning and of search procedures.

IV. Cognitive Processes The logical structure of the observer-environment relation. The logical structure of dialog. Concepts and symbols as effective algorithms.

V. Heuristics of Groups Problem solving in large groups. Identification — and lack of identification — of problems in the social context. Individual and society. Social norms as algorithms. Values. Problem solving in small groups. Exercises with participants.

VI. Heuristics of Learning Acquisition of concepts as search procedure for effective algorithms. Equilibria of systems as solutions of problems (perturbations). Habituation, adaptation, conditioning and learning considered as different levels of equilibrial states of coupled systems.

Note: Students may arrange the hourly division of topics to suit individual research interests.

Prerequisite: Consent of instructor

Texts: Morrison, James C., *Meaning and Truth in Wittgenstein's Tractatus*; Wittgenstein, Ludwig, *Tractatus Logico-Philosophicus*

Appendix II: Structure and Context

The course in Heuristics began under conditions that deserve to be called auspicious: A group of students, spokesmen for many others, had suggested that such a course be offered. They also named the instructors they would like to see in charge of the course. Thanks to the Department of Electrical Engineering and the readiness of the invited instructors to accept the challenge, the course could be announced. Seventy students appeared at the initial meeting. The problem was: If the class is to meet twice weekly for at least 1 1/2 hours, which days and hours would be found convenient for most of the 70 students? It took more than half an hour and numerous hints by the instructor until the students suddenly discovered that they were not to solve a problem of convenience but simply to answer the question whether their course was to be given or not. Five minutes later 57 students agreed on a schedule. Whereupon they were given the first assignment:

> Write a paper entitled "Right or Wrong: My Desires." On no more than two typewritten pages state anything of which you wish to say: 'While it is not the case, I desire it to be the case.' List the statements in such an order that the fulfillment of desires earlier in the list may imply the fulfillment of desires later in the list, but not vice versa. You may or may not deal with the reasonability, desirability, or possibility of any fulfillment. Assume that we wish to use the word 'desire' when for a variety of reasons we do not wish to use the word 'reasonable demand.' You have four weeks to write the paper.

It should be mentioned that the delighted students proposed to deliver the paper in a couple of days; that during the next three weeks innumerable questions with regard to the assignment had to be answered by the instructors; that only after six weeks all 57 papers had been turned in.

Then each student received the unsigned copy of another student's paper with the assignment to write a letter of comments to the anonymous author. Only the instructors were in possession of a number code by which the author and the commentator could later be identified. With the comments in hand, several groups of different sizes could be formed. In every group each member was the author of a paper commented on by another member of that group, but he also was the commentator of a paper authored by another member of that group.

The assignment given to the groups was to answer the question: 'Can you, by using the information implied by

the written material, come to an agreement on the priority among the desires which would be representative for your particular group?'

A study of this assignment, the papers, the comments, and the continuous discussions accompanying every phase of the procedure, as it progressed from individuals to groups, gives rise to the following observations:

Not one of the students (age 19 up to 30) had ever before in his life been asked the question in what kind of a world he would like to live, without the pressure of having to respond with a 'reasonable' demand.

In other words: All of them had been educated and had learned how to adjust their desires according to current standards of reasonability and practicability. While it now pleases their ideologically conditioned intellect that they once were able to accomplish such a self-disciplinary feat, this pleasure is dampened by the nagging memory of having renounced some dear and cherished part of themselves under some uninvited pressure. Just because this memory is so busy with nagging, it has no time to bring back the renounced desire. This leads to inarticulate discontent which, in turn, becomes one of the motives for either lethargic passiveness or emotional and physical violence.

The heuristic quality of the assignment lies in the fact which the students were so slow in believing: The question asked of them was asked in good faith, namely with the explicitly stated understanding, that no one, but the student questioned, would know his answer to the question, and that it was not to measure up to some answers in possession of the questioner. Non-heuristic procedures apply the competence of the *questioning* system, heuristic procedures apply the competence of the *questioned* system, to the tasks of defining and eventually solving a problem. It is the privilege of man to accept or to reject competent problem–solutions. He cannot, however, simply call an answer incompetent, just because he wishes to reject it.

Once the students had found that their competence with regard to their desires was presupposed and not to be doubted, they were ready to pay rapt attention to the introduction and explanation of concepts like 'Hypothesis,' 'Theory,' 'Model,' etc., having understood that these concepts could proved them with tools which they might choose to use. For it became obvious: if i live in a world, or society, or system, in which my desires appear to be 'unreasonable' demands, then I should like to conceive of a model for a world, or society, or system, in which my desire would be considered a 'reasonable' demand. Having constructed such a model, I shall be able to study it, see the conditions implied by a fulfillment of my desire, and, finally, be in a position to answer the next question: Is the fulfillment of my desire — beyond being desired — also desirable? Is the system which my desire has created the one in which all my other desires are fulfilled too, and in which I wish to live? Do I have to correct, to modify, the statement of my desire under control of a desire with higher priority on my list? Do I have to rewrite my list? — And so on.

It is to be pointed out that all students had high on their lists a desire that in one form or another showed great concern for the general happiness and contented ness of all mankind. Subsequent discussions demonstrated the ambiguity of this apparently collective agreement. Some thought that only content people will leave them alone. Some thought that one can live together only with content people. Others simply assumed that any discontent is a terrible threat to even the most desirable system. And there were some who held that the discontent always strive for power and that, therefore, the people in power are always disconted[ed] people. Finally most everybody thought he would feel better in the knowledge that all his neighbors were happy too.

Thus it turned out that, when it came to tentative model-proposals, all of them were concerned with social structures rather than with egocentric sub- or super-man images. If a model deems a desire to be a 'reasonable' demand, then, of course, it implies a criticism of all systems, including the one we live in, where that desire is considered to b 'unreasonable'. The implied criticism covers a wide range. Some of the models could be shown to be replicas of the system we live in, thus demonstrating how our system may be capable of, but unwilling to, call a desire a 'reasonable' demand. At the other extreme, the class found itself investigating a few models so vastly different from any image of our system that here even our language, abetted by and fitting to our system, proved to be insufficiently clear and unburdened to satisfactorily describe the ramifications of the model. This led to remarkably fruitful explorations into the realm of linguistics and languages, arriving, finally, at the reevaluation of the concepts of communication and information, as well as that point, where the question arose, whether we master our language or whether our language masters us.

These and related matters were dealt with during the second semester. The class had grown to nearly 70 students, and was to reach an enrollment of more than 150 participants for the third semester. Larger groups could be formed, more ambitious projects were undertaken by the students. On page 11 of "The Whole University Catalog" one can find the paper 'anticommunication: an attempt, not a refusal." This paper is based almost entirely on notes taken during the second semester of the course

in heuristics, and thus reflects a fair amount of the subjects discussed there. The title of the paper was also the title of an exhibition showing student works constructed during the course.

The assignment that generate dthe exhibits went as follows:

> Think of an idea, a thought, that you would like us to share and to contemplate with you, but which, due to difficulties with our language, you fair to articulate properly and we fail to understand properly. Assume that the problem is our language, in that it seems either not to contain the words and the flexibility of meanings you need, or not to produce the informative impact on the listener or reader that you consider necessary for your message to come across. Construct a model which we can see or hear or both. Let that model articulate the message in a language created especially for the purpose, leaving your thought or idea intact, and leaving us with only one alternative: either to understand nothing or to understand properly. We may have to learn the language which you made your model speak.

The response to this assignment was overwhelming in quantity and very impressive in quality. Some of the exhibits could be called works of art, all of them were remarkable studies in the art of composition. The course in Heuristics had attracted students from a great variety of colleges. And now our students of Music and the Arts discovered how engineers and natural scientists become highly imaginative creative artists, while engineers, scientists and psychologists began to understand that artists and musicians, as soon as they compose, become as efficiently involved in the construction of problem solving models as any [scientist?] could wish. Nothing could have raised the mutual respect among the students more than this highly problematical exercise, nothing argued with greater positive strength for the interdisciplinary structure of the course in Heuristics.

Session Abstracts by John White
Heuristics — Fall Semester — 1968–1969

Entries should be interpreted as fragmentary accounts of and quotes from class sessions. The reader's imagination is appealed to for their completion. Names indicate persons responsible for major parts of the show.

Sept. 17 John White. Scheduling Game: a little problem to find out what time to meet for future sessions. Unsolvable problem because of the constraints — to find a unanimously agreed-upon time.

Assignment: Write a paper on the topic *Right or Wrong, My Desires*.

Sept. 19 White. Arm Game: a moderator related two fragmentary episodes. The classes had to generate the story in which the episodes made sense. Class asked ques ions to which the moderator responded: yes, no, irrelevant.

Assignment: Read book — *Polya, How To Solve It*.

Sept. 24 Von Foerster. Lecture on terms Canonical and Logic. Many students did not want a lecture. Discussed heuristics, Zenon, and other Greeks. It was pointed out that there is a difference between an object and its internal representation. Three aspects of things: 1) Verbal or written representation of a thing; 2). the thing; 3). the mental concept of things and abstractions.

Sept. 26 Discussion of the Arm Game. Discussion of what a MODEL is. Everyone seemed to have own idea. Analogue tossed out very quickly. A triangle was drawn on blackboard. Class couldn't agree whether it was a model of anything.

Assignment: read paper — *From Stimulus to Symbol* by Von Foerster.

Oct. 1 Brün. "Behind a word is a meaning. You must listen to the others." Discussion of three questions:

1). What does it *not* mean if you say "I stipulate?"

2). How do you decide whether a statement addressed to you implies an invitation to comment, implies a question, or whether it implies that you have a question to which the statement is to be the answer?

3). Assume a disagreement with a man who, however, successfully argues his case. How

do you decide whether the fact of a man being right implies that you are wrong, or whether it implies that the existent system of concepts, values, and circumstances, in which alone he is right, is wrong?

Tentative definition for algorithm — a method of getting from problem to solution.

Oct. 3 Von Foerster. Discuss what class has done in previous sessions. Discuss the problem of heuristics — how to transform problems so they are resolved. Discussion of 3-valued logic system (as related to Arm Game). "One must know the domain of a solution." Handout and discuss short paper — *Signs and Symbols*.

Oct. 8 White. A fragmentary polotical situation was read. The class was asked: "What were the problems in this situation?" Nothing could be agreed upon — what was fact, what was fiction, what was hypothesis?

Von Foerster discusses article "From Stimulus to Symbol." Discuss solipsism. We have to distinguish between what takes place, what I perceive takes place, and what I describe takes place.

Assignment: Write on…"A crisis is now confronting American University students. No means exists for students to transform their concerns for America's problems into immediate positive action."

Oct. 10 Von Foerster. For use in problem solving situations, introduces the cybernetic concept of GOAL. Gives physiological example of read blood cell number adaptation to different attitudes. Goals can change in time if there is a meta-goal behind them. What does GOAL have to do with a problem? White: "A problem can only exist when a situation is not the way you would like it to be."

If you say you'll live with a problem, have you solved the problem?

Oct. 15 Von Foerster. Discuss existence. The acceptance or denial of the ways in which things exist must be considered. Descriptive models (e.g., explain orbit of Mars by epicycles by earthlings — explain orbit of earth by epicycles by martians). A hypothesis contains an explanation of what is going on. Relativity. The investigator must consider his effect on the things being investigated. Observers need not use transitive relationships. Theories. Brün — "When you ask a man if a picture is obscene and he says "yes", you learn something about the observer; you don't learn, however, anything about the picture."

Oct. 17 Von Foerster. Weak undecidability — undecidability amongst like models (e.g., geo-centric vs. marso-centric).

Egocentric models. Strong undecidability — undecidability amongst models with unlike structure (e.g., planet-centric vs. helio-centric). Tycho Brahe, Keppler, Newton. Cause and Effect. When we have a set of descriptions we call it a descriptive model. By applying the Principle of Relativity we get a hypothesis — a set of descriptive models. When we have cause and effect we get a theory. The principle of relativity is a heuristic principle. For, it generates hypotheses which in time may generate theories.

Oct. 22 Brün. Some possible negative responses to an uttered opinion.

1). not consistent with what I think is the case.
2). not consistent with what I want to be the case.
3). I know that already.
4). I never heard of it. (I do not know that.)
5). I don't understand his language.
6). I don't understand what he means.
7). He does not communicate.
8). It does not communicate.
9). He is trying to convince me.
10). He does not convince me.
11). I don't want to know his opinion.

"If a collection of restrictive rules is applied to a set of elements in process of becoming ordered, and if differently cascaded restrictions fail to bring about different orders in the set, then contradiction becomes a generator."

Oct. 24 Relevant —

1). Significantly changes the problem.
2). Changes the problem in the direction toward the set of possible solutions.

If we were to consider "all possible relevant" things, then the problem would become so large that: (1) there would be an infinity or a continuum of solutions; (2) there would be no solution which accounted for all the "relevant" things. Define relevance according to the problem you want to solve. If "relevant" fact changes the problem beyond what you want to solve, it is "irrelevant."

Oct. 29 Brün. Report on Desire Papers. In a word or short sentence, give the main desire in each paper.

Assignment: Each student is to write a replay to some other student's Desire Paper.

Oct. 31 Discussion of Problem Group Formation.

Paul Weston. Computer simulated conversations. At present only feeds back information gathered earlier in the conversation. E.g.,

human ... My boyfriend made me come here.
computer ... Your boyfriend made you come here?
human ... He says I'm depressed much of the time.
computer ... I am sorry to hear you are depressed.

Nov. 5 Arguments for life on other planets.

1). Non-uniqueness of life on earth.
2). Homogeneity of universe.
3). Probability equals 1.
4). Probability equals 0.
5). Want life.
6). Maybe we are unique in manifestation of process but there might be lots of others we could call life.
7). No life — because GOD wouldn't make it.
8). Intelligence but not life.

Nov. 7 Formation of class Problem Sub-Groups.

1). Relevance
2). Creativity
3). University
4). To know people
5). Evaluation (Engineers)
6). Thought to action

Each group is to come to some agreement on topic so that it can be formally presented to entire class.

The Creativity Sub-Group will be followed in detail. Came up with criteria by which an object or act can be judged creative or not.

1. Must have been intentional.
2. Must be original to social group within which it is created.
3. Must be an addition to the knowledge available to society.
4. Must perform a function accepted by the society.

Nov. 12 Von Foerster. Discuss interpretational levels using the "life on other planets" discussion for an example.

1. Dogmatic (want life, God wouldn't make it)
2. Probabilistic (calculate a number)
3. Semantic (other manifestations of life)
4. Hypothetical (homogeneity of universe)

Nov. 14 Problem Group Meeting
Creativity group — discuss random word and sentence generation by computer.
Group has two extra meetings in Illini Union.

Nov. 19 Von Foerster. Discuss paper by Ronald Fisher, "Biological Models of Creativity." discuss Daedalus Symposium on Universities.

1. Rights of Students and Faculty
2. Accreditation
3. Old–New Morale

Discuss work of K.J.W. Craick, 1952, *Nature of Explanation*. Assignment for Schiller: read Kuhn, *Structure of Scientific Revolutions*.

Nov. 21 Problem Group Meeting
Creativity group — create "random" dialog by having people around table compose story. Each person adds the next line. Try to identify creative elements.

Nov. 26 Schiller. Obstacles to knowledge in the Social Sciences. Crisis produces change. Progress occurs in quantum jumps. Has to be a sense of malfunction in system to cause progress. In social systems it is very difficult to create a sense of malfunction. Ways of denying the existence of crisis in the social sciences:

1. Just deny
2. Say its exaggerated
3. Attribute cause to person who calls attention to crisis

Dec. 3 John Lilly. Discusses his research on dolphin intelligence. At present, dolphin's learn to communicate with man (i.e., use man's language). In the future, man must learn to communicate in "dolphaneese." Brain larger than man's. Can repeat a string of non-sense syllables three times as long as man can.

Dec. 5 Set up Desire Paper Groups.

1. Talk to each other.

2. Obtain the main desire from each paper.
3. What desires are compatible in group.
4. Are some desire unacceptable to anyone.
5. Does a desire exist which is representative of entire group.

Meeting of Problem Groups. Creativity group — discuss creativity in physical and biological sciences. What is common factor to creativity in arts? Discuss creativity in birds — the opening of milk bottles learned by birds in England.

Brün.

1. The difficulty of positive eloquence (i.e., agreeing).
2. The denial of the charm of bottomless pits.
3. The embarrassment of agreement.
4. Prosecution with all the best intentions.
5. Problem solving. Whose?
6. The helplessness of better knowledge.
7. Enlightenment by analysis and by synthesis.
8. First hand, living, present people.
9. Entertainment value of demonstrated boredom.

Dec. 10 Brün. Gives talk on the self-appointed moron. "The self-appointed moron is he who recoils in terrorized modesty and complains of lacking communication whenever a thought he never had is proposed in word or script; who then cries … 'it's wrong, it's bad, it's nonsense' … which, in translation, means that, to him it is neither usage nor his own. … They all have agreed, by convention, to ignore the possibility of happiness being a desirable premise rather than only a desirable consequence."

Dec. 12 Problem Group Meeting. Creativity group — arrange for final report to class. Divide up presentation.

Dec. 17 Report of Desire Paper Groups. Major desires within groups.

1. Power, love
2. Communicate, understand.
3. Security, freedom, fulfillment. First two may produce a paradox.
4. Necessary and sufficient conditions discussed. Could not find a common desire.

Assignment for Schiller: read *The Critique of Pure Tolerance* by Herbert Marcuse.

Dec. 19 Problem Group Reports. Creativity, Relevance, University, Thought to Action. Evaluation (engineers).

Jan. 2 Schiller. Paradigms. Repressive tolerance. The revolutionary character. Control Data Corporation vs. IBM. FCC commissioner — the media business is out of reach.

The Paradigm = P.

1. After P established, struggles are forgotten.
2. Scientific world view a new closed system.
3. Incremental changes.

Crisis crucial for large change
Marcuse — Repressive tolerance.
Fromm — the revolutionary character.

Jan. 7 John Wetzel. Used class to demonstrate basic features of a digital computer. A moronically slow student-simulated computer that could add and subtract using "registers."

Jan. 9 Ronald Ruesch. Illustrates with movies the evolution of a Form. Use of feedback in architectural design. Computer-aided structural planning. Go from Eolithic to Neolithic design.

Jan. 14 Final meeting during finals. Continuation of Problem group reports. Continuation of Desire paper reports. Class summarization by Von Foerster: "We faced fundamental issues of epistemology — what is … reality, existence, creativity, meaning."

Appendix III: Statistics

Heuristics; EE 291, EE 497 Fall Semester, 1968
Place: Center for Advanced Studies
Time: Tuesday, Thursday; 7:00–8:30 p.m.
Instructors:

(i) Heinz Von Foerster (in charge of Course)
Professor of EE and Biophys.

(ii) Herbert Brün
Assist. Prof. of Music

(iii) Humberto Maturana (Guest Lecturer)
Prof. Biology, Univ. of Chile

(iv) Herbert Schiller (Guest Lecturer)
Res. Prof. economics

(v) John Wetzel (Guest Lecturer)
Assoc. Prof. Math.

(vi) Ron Ruesch (Guest Lecturer)
Assist. Prof. Comp. Sci.

(vii) John Lilly, Fellow (Guest Lecturer)
Cent. Adv. Study & Beh. Sci.
Palo Alto, Calif.

(viii) John White
Grad. Student

Students. (Per Finals.)

	LAS	ENG	FAA	JNL	
Fr.	1				1
So.	2		1		3
Jr.	1				1
Sr.	8	1		1	10
	12	1	1	1	15
Grad.					21
Aud.					13
Tot.					49

Heuristics: EE 271, EE 497, Engl 199. Spring Semester 1969
Place: McKinley Foundation
Time: Monday, Thursday: 7:00–8:30 p.m.
Instructors:

(i) Heinz Von Foerster (in charge of Course)
Professor of EE and Biophys.

(ii) Herbert Brün
Assist. Prof. of Music

(iii) Humberto Maturana (Guest Lecturer)
Prof. Biology, Univ. of Chile

(iv) John White
Grad. Student

Students (Per Finals)

	LAS	ENG	FAA	COM	JNL	
Fr.	1					1
So.	5	1				6
Jr.	5	1				6
Sr.	11	5	4	2	1	23
	22	7	4	2	1	36
Grad.						21
Aud.						8
Tot.						65

Heuristics: EE 271, EE 497, Engl 199. Fall Semester 1969
Place: Wesley Foundation
Time: Monday, Thursday: 7:30–9:00 p.m.
Instructors:

(i) Heinz Von Foerster (in charge of Course)
Professor of EE and Biophys.

(ii) Robert Cancro (Guest Lecturer)
Cent. Adv. Studies
Univ. of Illinois

(iii) Tom Bull
Grad. Assist.

Students:

	LAS	ENG	FAA	EDU	COM	AGR	JNL	
Fr.	17	4	3		4	1		29
So.	21	1	1		2			25
Jr.	29	2	4	6	4		1	48
Sr.	22	5	2	6	4		3	42
	89	12	10	12	14	3	4	144
Grad.								12
Tot.								156

(Auditing Students included in categories.)