COMPETENCE DEFINITION AND ASSESSMENT PLAN IN A COMPETENCE-ORIENTED PROGRAM

Jean Le Mee
Allen Rakow
The Cooper Union School of Engineering
New York, New York

Summary

A scheme for the organization and definition of competences in an engineering curriculum is proposed and a set of general evaluative criteria which can be applied to the different areas of the curriculum are worked out. The problem of assessment is considered. Its purpose, modes and procedure, instrument design and graduation requirements are discussed.

1. Introduction

The concept of competence and competence assessment is well established in graduate as well as in some undergraduate programs with their comprehensive and qualifying examinations. Even the concept of a formalized competence-oriented curriculum has already been proposed as far back as 1929 for teachers' training. What is new, however, in the competence programs now being developed, is the broadening scope and the explicitness with which the competencies are defined and assessed.

The SHAPE Program (Synthesis of a Holistic Approach to Professional Education),[1] under development at the Cooper Union, proposes a professional engineering curriculum structured around certain competences broadly defined and interrelated to corresponding psychological functions. These competences are in turn articulated in terms of three levels representing degrees of progressive complexity and maturity. The SHAPE competences address themselves to an overall characterization of the individual rather than to the possession of discreet and narrow skills. They can be applied to the different areas of the subject matter which, in turn, may be used to enhance them. This feature is particularly attractive in a professional curriculum where the subject matter itself is dictated by the professional requirements. This scheme therefore exploits the subject matter in the most rational way for the personal and professional development of the learner. It also emphasizes the development of the competences throughout the whole curriculum. It is around these competences that the curriculum is synthesized.

In a competence-oriented program, it is the student progress toward, and attainment of, competence that is the main purpose. Progress is assessed against stated criteria and standards, not against comparative performance of other students. Effective competence assessment becomes, therefore, the key to a successful program for it allows the educator to say not only what the student will be able to do when he or she graduates but also at what level he or she is doing it along the way. Since it is competence that is assessed, i.e., professional qualities which do not specifically depend on subject matter, it becomes possible to certify what students can do with what they know now and therefore what they must be able to do in the future with what they will then learn.

This paper proposes to consider the organization and the definitions of the competences in the SHAPE program and to examine the assessment plan and procedures to evaluate these competences.

2. Key Features of Approach Taken

Considering the curriculum as a whole, the approach taken has been humanistic and holistic.[1,2] We have strived in the context of the professional engineering education to develop a paradigm for a truly liberal education for professionals by adopting:

. An orientation toward the development of broadly defined competences representing abilities and qualities common to all professional fields.

. An emphasis on the holistic and humanistic basis of knowledge by inter-

weaving the humanities and social sciences with the sciences and the professional subjects.

. An integration of the subject matter with coordinated learning experiences to promote the development of the competences.

3. Organization of the Competences

Drawing upon the experience with competence-oriented programs which have already gone on for several years at some Liberal Arts colleges, and at the American College Testing Program, as well as on the work of educational psychologists [3,4] and other sources,[5,6] we have sought to formulate a fundamental approach to the development of competences. The epistemological structure which we have used derives from the observation that the practice of any profession (i.e. the application of knowledge for social use) always relies on three modes of knowing: the cognitive, the affective and the volitional. For the professional, knowledge is always knowledge of what is, of what is to be done and of how to do it.

The three modes of knowing translate themselves into three fundamental human abilities, namely: the ability to THINK, the ability to CARE, and the ability to WORK. For a professional person, and particularly an engineer, these essential abilities manifest themselves as the ability to:

a. THINK clearly, analytically and imaginatively from fundamental principles.
b. CARE for others, for the public interest, for the work, for oneself, all from a fundamental viewpoint (i.e. universal and objective), to lead and to manage.
c. WORK attentively, reliably, thoroughly and productively from well-thought-out ideas.

The professional engineer must therefore be effective, diligent, innovative, skilled in solving engineering problems in a natural, social and cultural environment, and act with a broad view and a sense of values. Professional satisfaction is the result of a well balanced development of these functions.

The shortcomings of most competence schemes are caused by the ad hoc character and unplanned overlapping of the competence domains[3,4] rendering the assessment process difficult. As developed elsewhere[5,6] we propose to circumvent these problems by intermeshing the modes of knowledge (cognitive, affective, volitional) with the subject-matter orientation (theoretical, applied, skill). This results in a matrix of interrelated psychological functions (Fig.1.) which can itself be used to establish a corresponding matrix of competences (Fig.2). The competences are, in turn, defined in terms of three levels representing degrees of progressive complexity and maturity. Their development is emphasized throughout the whole curriculum. Generally speaking, the cognitive mode provides the direction and the framework of principles, laws, concepts, definitions and generalizations necessary. The affective mode lends the quality, the tone, the attitude which both allow and encourage the student to relate a particular problem or discipline to a wider context of activities, facts and persons. The volitional mode supplies the skill, precision, zest and stamina necessary to execute the project or master the subject material of a course of study. It is around the competences that the curriculum is synthesized by superimposing their matrix over the different areas of the subject matter and noting, in each case, what contribution each area can make to the competence development, and what form of learning experience, in the context of the subject matter, is most conducive to this development.

4. Definition of Competence Levels-Criteria

For purposes of operational definition and assessment, levels of proficiency are distinguished within a given competence. Levels are not absolutes, exactly equivalent from field to field or domain to domain. Unlike credit hours or units they do not measure the "workload" of the student but represent degrees of proficiencies that the student has achieved. They are therefore to be defined relative to clearly stated, operationally testable abilities. For our purpose, and in line with the nature of learning,[7] 3 levels have been devised. Each of these levels corresponds to a stage in the depth and breadth of acquaintance with a subject in the cognitive domain or in the degree of ease or creativity in the affective or volitional domain, for example. Each field and each domain needs its own rationale and set of specifications to define these levels. They represent natural stages in the dynamic rhythm of education and are linked with the dominance of certain domains of qualities, the affective predominating in "first acquaintance," the active in the "precision stage" and the cognitive at the "generalization stage."

Grades can be used. When a student achieves a certain level with more ease, elegance and style than others, this may be taken into consideration.

The criteria and standards for judging the levels of competence of students must be made as explicit as possible and specified in the syllabus. Among these criteria should be found:
- clear statements of the levels constituting acceptable performances in a given area of study
- mode(s) of demonstration to be used by the students
- mode(s) of assessment to be used
- frequency of demonstration required throughout the term

5. Definition of the Competences

It is essential that the competences be defined broadly to avoid the danger of fragmentation of the learning process and the reliance on simplistic behavioral evaluations. They have to be conceived in terms much larger than the educational objectives defined in such instructional methods as the Keller Plan which concentrate on discrete limited steps in competency. Competences may be viewed as "functions" of an integrated nature that the individual performs and which bring into play a coherent set of abilities and skills important in the exercise of the profession. Abilities and skills should indeed be cultivated but they form part of a subset particular to a given learning experience.

As mentioned earlier, our studies have lead us to single out a group of nine interrelated competences as being particularly important for a professional. They are listed below together with the meaning we attribute to them in the context of engineering education.

I. Competence in Fundamental Principles

Implies a working knowledge of the fundamental scientific laws relevant to the practice of engineering (physics, chemistry, life sciences, etc.), of the principles of design including relevant economic and societal principles, of the principles of experimentation. It also implies familiarity with the great religious and philosophical principles (values), a strong desire to examine one's actions in their light, and to act according to reason.

II. Competence in Problem Solving

This most important and complex competence of the engineer can, for our purpose, be seen as comprised of three fundamental abilities:
- Ability in analysis and synthesis
- Ability in innovation
- Ability in relating problems to a wider context.

a. Ability in Analysis and Synthesis

Implies the ability to select appropriate principles and methodologies for the formulation of theories and models in order to arrive at an understanding; to translate situations into mathematical form and establish realistic models or to establish correspondances or links between what is under study and other known facts, theories or views. It also implies the ability to formulate assumptions and to optimize designs.

b. Ability in Innovation - Implies the ability to recognize a need and to act accordingly; to envision and formulate alternative possibilities and solutions presenting new and useful features to satisfy the need. It requires openness to new ideas whether they come from oneself or others, objectivity about their practical value and realism about their implementation. It encourages the use of techniques (e.g. brain-storming,etc...) to stimulate innovation, the cultivation within oneself of the powers of observation, curiosity and imagination, and of the desire for simplicity, beauty and economy.

c. Ability in Relating Problem to a Wider Context - Implies the ability to integrate new learning in its particular domain of knowledge or experience, to see particular domains of knowledge and experience in perspective with other domains in the framework of eternity (values), time (history) and space (geography), to establish unobvious and helpful correspondences and analogies between different fields by:

1. widening and deepening one's interest in human affairs (values, history, geography)
2. developing a sense of nuance and the qualitative (to counter the stress on the quantitative put in by the engineering and scientific training)

3. to understand the relations between the engineering activity and the ecological, economic, social and cultural world in which it takes place.

III. Competence in Methodologies

Implies an ability to think clearly, logically, in analogies, fast; to manipulate concepts rapidly and accurately. It also implies a working knowledge of techniques, models, methods and approaches standard to the relevant fields of studies (e.g. mathematical tools, methods of textual analysis, standard design techniques etc...).

IV. Competence in Values

Implies a recognition and a sense of values, of their ground and relations; a knowledge of ethics and ethical principles of conduct as an individual, a member of a family, group, profession, nation and mankind as a whole.

V. Competence in Human Development and Relations

Implies being open, attentive, considerate, honest, fair, sincere, sensitive, cooperative, helpful, sparing (of other people's time) and having a sense of humor (particularly regarding one's own importance), a sense of one's own and other people's strength and limitations and a desire to develop the former, remove the latter; ease and poise in social relations, and enough tact to reach the objective without alienating people. It therefore implies the ability to lead, i.e. to inspire, encourage and advise others in the execution of a project.

VI. Competence in Discipline

A disciplined intelligence is the hallmark of an educated person. Again, in our particular context and in relation to the other competences three qualities stand out as particularly important, namely

. Reliability
. Thoroughness
. Productivity

a. Reliability - Implies truthfulness, i.e. that one means what one says and says what one means with words and figures, and that one does what one says and says what one does in all activities.

b. Thoroughness - Implies that one does not neglect details and sees to it that the task is completed to the best of one's abilities and consistent with objectives.

c. Productivity - Implies that the work is done right and need not be redone, that the work is done steadily and attentively, realizing that attention is the most effective single quality at a man's disposal and that deadlines are met. It also implies that no time is wasted, one being proficient in the techniques of the profession (use of library, equipment, etc.) and that one knows where and how to find what is needed in terms of information, help, equipment, etc. and finally that one strives for simplicity and economy.

VII. Competence in Information

Implies the ability to find and use information efficiently from published literature, other people, or direct observation; the ability to relate new material to previous learning, to apply what is just learned (make it practical), to keep an open mind and a healthy curiosity. It also implies the ability to draw conclusions from analysis, studies and experiments and present them critically in a manner useful for discussion, decision making or implementation.

VIII. Competence in Action

Effectiveness in action requires planning, organization and confidence. In turn,

a. Ability in planning - Implies the ability to formulate explicit realistic work plans, to establish priorities, to budget time and resources, and to be familiar with planning techniques.

b. Ability in organizing - Implies the ability to initiate plans, originate projects, marshall time and resources and manage people towards the satisfactory completion of the project.

c. Confidence (in one's abilities) - Implies the willingness to take responsibility for key decisions that may rest on only partial information, or under conditions of high risk; the ability to inspire confidence to others, to live with uncertainty and ambiguities.

IX. Competence in Basic Skills

Among the most essential basic skills of use to professionals, abilities in communication, computation and experimentation are essential.

a. Ability in communication - Implies the ability to keep the other in mind, i.e. the ability to listen and the ability to speak audibly and clearly, to the point and appropriately (to time, place and person). It also implies the ability to make use of audio-visual equipment as may be helpful, to read with comprehension and write legibly, grammatically and clearly. To draw graphs, sketches, drawings and use symbolism familiar to the reader.

b. Ability in computation - Implies the ability to perform arithmetic operations fast and accurately (mentally, by slide rules, or by calculator), to construct and exploit graphs, to learn and use standard computer languages, to use computer libraries and services, to use digital and analog computers, to check for errors.

c. Ability in experimentation - Implies the ability to formulate experimental plans according to available knowledge and information, to know laboratory methodologies and techniques (particularly regarding measurements, sources of error, and the use and care of instruments), to use manual skill required in assembling simple test rigs, to exploit results of experiment.

6. Evaluative Criteria for the Competences

The description of the competences just given makes it apparent that they are complex, involving a degree of interdependence. But, by reference to the matrices of figures 1 and 2, it is also apparent that this interdependence falls within a systematic description of the psychological functions.

It need be emphasized that the psychological functions, at the root of each competence, take place throughout mind and therefore engage the whole mind, though different types of activities have, so to speak, a different "center of gravity", some being predominantly cognitive for example, but also involving elements of the affective and the volitional domains. For instance, the power of abstraction demonstrated by "Competence in fundamental principles and concepts" cannot be developed or demonstrated without developing and exhibiting a certain analytical ability, or without the ability to recognize values, or that of handling information; yet, one can speak of the power of abstraction in contradistinction to any of these other abilities or to take a physical example, information, energy and matter are distinct entities, yet, each cannot be handled without the support of the others. They are in fact different aspects of a more fundamental substance.

The operational explication of the competences or, in other words, the setting of educational objectives requires that the assessment process be kept in mind.

The following indicates the requirements a student would have to satisfy in order to demonstrate his degree of competence in each of the main subject areas of the curriculum.

Competence I. Competence in Fundamental Principles and Concepts

Level 1: Identify principles applicable to given situations and formulate them verbally.
Level 2: Give precise formulation of principles, their assumptions and limitations.
Level 3: Demonstrate in specific cases the deeper implications of principles and their relations to other fields of thought and actions; show flexibility, subtlety, resilience of viewpoint, and zest for knowledge and truth.

Competence II. Competence in Problem Solving

Level 1: Demonstrate ability to formulate assumptions and identify implicit and explicit elements so as to be able to apply simple common principles and methodologies in specific situations to obtain a realistic solution.
Level 2: Analyze situations new in configurations but similar to known ones in substance; identify relationships in a given system or situation. Recognize needs and synthesize alternative proposals and problem solving strategies. Carry out a project within a well-defined field, interpret results, critique own and other works in the area. Draw conclusions for further action.
Level 3: Analyze situations new in substance and configuration with strong interdisciplinary elements. Synthesize alternative proposals and problem solving strategies for these cases and carry out their execution. Establish relations to

a wider context. Exhibit critical spirit. Show proof of imagination and innovation.

Competence III. Competence in Methodologies

Level 1: Demonstrate ability to use elementary methods particular to the fields being studied (e.g. textbook problem solution).
Level 2: Demonstrate working knowledge of a repertoire of techniques and methods useful to perform professional routine tasks in the various fields of study.
Level 3: Demonstrate facility in using certain methods in particular fields of interest and in devising new methods of approach and techniques or in applying known methods to new fields.

Competence IV. Competence in Values
Level 1: Demonstrate ability to identify one's own values and their sources and to relate them to personal development by observation of one's own attitude, opinions, feelings, thoughts, beliefs, goals, and individual ethics in a specific professional situation. Codes of ethics.
Level 2: Demonstrate understanding of philosophy, history, religion, arts, literature, science, and technology as reflection of values in the traditions and civilizations of the world. Social ethics principles for professionals in the American society today.
Level 3: Demonstrate understanding of relationship of values, social and scientific and technological development in different societies and demonstrate ability to use it practically when acting professionally. Demonstrate awareness of intercultural differences and of the common elements necessary to life in society.

Competence V. Competence in Human Development and Relations

Level 1: Demonstrate ability to identify and formulate factors as basis for value judgment in specific situations. Identify and analyze behavior of self and others in given situations, show a degree of care, trust and fairness in relation with others, and a zest for truth.
Level 2: Demonstrate ability to form value judgments in situations related to one's own personal development and in areas of public concern. Evaluate self and others' behavior. Demonstrate sense of justice, of nuances and of the qualitative.
Level 3: Demonstrate ability to examine critically the assumptions and factors implicit in a value judgment and evaluate possible consequences. Demonstrate ability to one's own and others' development. Demonstrate leadership and managing abilities. Show subtlety, flexibility, resilience, imagination, and a sense of justice in judgment.

Competence VI: Competence in Discipline

Level 1: Demonstrate consistent positive attention to details, precision and accuracy of observation, neatness of work habits, craftsmanlike attitude to work well done.
Level 2: Demonstrate consistent care for work by exhibiting thoroughness, reliability, productivity.
Level 3: Demonstrate that attitudes toward values are firmly established and based on understanding leading to a sense of nuances, of the qualitative counterbalancing the stress on the quantitative in scientific and technical training. Demonstrate a sense of subtlety, resilience, critical spirit, attention, in specific situations. Demonstrate a sense of simplicity, generality, power, elegance, efficiency in the application of concepts, principles, and methods.

Competence VII: Competence in Information
Level 1: Identify process, assumptions, limitations involved in particular data gathering methods or procedures. Demonstrate ability to compare and relate information accurately, rapidly and critically.
Level 2: Demonstrate ability to select relevant information and use it effectively. Demonstrate knowledge of the principles and methods used for selecting information, their limitations and assumptions.
Level 3: Demonstrate ability to synthesize information in a form suitable for action, to form a sound opinion and articulate it. Demonstrate critical awareness of the nature of the methodologies used and of the validity of results.

Competence VIII: Competence in Action (Initiative, Drive)

Level 1: Show drive and willingness to initiate action, courage, self-confidence, zest for life.
Level 2: Show perseverance and willingness for sustained action, planning and organizational abilities, reliability, thoroughness.
Level 3: Show ability to take risks (entrepreneurship) to capitalize on work, to be original and productive.

Competence IX: Competence in Dexterity, (Basic Skills)

Level 1: Demonstrate skills in learning, communication, computation, and manual abilities in standard assignments. Here the emphasis is on the psychomotor skills

and in the elementary training of attention, in connecting the mind with the senses.

Level 2: Demonstrate ability to use these skills in new situations. Demonstrate clear understanding of the process used; emphasis on breadth and depth of observation.

Level 3: Demonstrate ability to use these skills in actual involvement at professional level. Creative and original use of skills. Art of observing holistically.

7. Application to the Curriculum Stems

These competences are quite general and are, in fact, characteristics belonging to the learner, independently of the subject matter involved. However, their application to a given subject-matter allows for the definition of specific behaviors or responses which may be expected from learners who have mastered a particular area of expertise. The evaluation of these behaviors and responses is part of the assessment process. We have developed such criteria for the three stems (Engineering, science, and the Humanities) of the curriculum.

8. Implementation of the Competences

If students are not provided adequate means of progress, the competence-based curriculum remains for them a set of unrealizable goals.

In the design of the learning experiences, particular attention must be paid to avoid rigidity and fragmentation. One should aim at the broad human capabilities, always bringing together the three modes of learning: cognitive, affective and volitional, which are implicit in any learning activity and which the organization of the competences, according to the scheme proposed here, emphasizes.

The design of the learning experiences is therefore crucial.

What is important to realize is that the student does not necessarily "train" for a particular competence, but that the competence development is infused in the learning experiences. However, he may be assessed separately for the different competences.

9. The Assessment Problem

The process of assessment is a complex one and generally brings more questions than answers. It can be defined as the evaluation of a student's capability in a given area on the basis of a set of previously established criteria. Since the evaluation itself is based on the observation of the behavior, or the product of the behavior, of the student while demonstrating mastery of a given educational objective, it is seen that the conception of the nature and role of the behavioral objectives in a competence-based curriculum is critical.

The evaluation has to be made by assessor(s) based on observations of the sampling of the assessee's (student's) activity in a given task engaging the assessee's particular capability to be assessed. Fig.3 illustrates the relation of these fields. Many legitimate questions arise out of such a process. Like in any technique using sampling, one may ask: How representative is the sample? How accurate, reliable, objective or subjective are the evaluations? Do these words indeed have any specific meaning in such a context? What does the sample really tell us? What is the effect of the evaluation on the performance itself? Who should establish criteria or performance standards? On what basis? What is the effect of specifying criteria on the learning process itself? Does it tend to narrow it as some assert? Or does it facilitate the integration of intellectual capabilities as others would like to think? As a recent conference[8] on these issues pointed out, these and many other operations have to be considered by assessment process designers.

A few things, however, are clear:

1. The process must be kept simple: simple to understand by all involved, simple to use and to administer.

2. If the emphasis is to be on education rather than on narrow training, the assessment must be holistic, addressing itself to an overall characterization of the individual rather than to the possession of discrete and narrow skills.

10. Purpose of Assessment

The purpose of assessment is to demonstrate the attainment of a specific level of proficiency in a stated competence. The purpose of this demonstration is for credentializing, i.e. certifying that the student has reached a specific

level of proficiency in a stated competence as contracted for graduation and for diagnosis to provide information to the student, the faculty and the administration on the student's progress so as to enable the student to receive the attention, direction and help required to achieve his goals.

11. Instrument Design

Having defined competences and criteria levels, the question remains: How would one test for competence? i.e., how do we design assessment instruments?

Addressing himself to this problem, McClelland [9] makes the following points:

a. The best testing is criterion sampling, i.e., if you want to know how well a person can drive a car (the criterion) sample his ability to do so by giving him a driver's test.

b. Tests should be designed to reflect changes in what the individual has learned.

c. How to improve on the characteristic tested should be made public and explicit.

d. Tests should assess competencies involved in clusters of life outcomes, (i.e., should be holistic and in context).

e. Tests should involve operant as well as respondent behaviors, i.e., behavior elicited should be spontaneous (operant) responses in the absence of a very clearly defined stimulus as well as the result (respondent) of a stimulus situation clearly designed to evoke a particular kind of response.

f. Tests should sample operant thought patterns to get maximum generalizability to various action outcomes.

The form of the instruments will naturally have to be adapted to the competence to be assessed. They will be developed, under the guidance of the assessment committee and the groups responsible for the various competences, by the faculty members in charge of learning experiences and/or by the assessment center. Among the possible forms will be found:

Written - short answer exam (quiz), hour exam, essays, reports, portfolio.

Oral presentations

Direct observation

Performance - specific (i.e., done for the specific purpose of the demonstration of the competency).e.g., Analysis/Presentation/Group discussion Exercise. Integrated within a project or other activity such as a simulation, cases, role group discussions, in-basket etc.

Audit

12. Modes and Procedures of Assessment

The assessment procedures can be organized:

a. Internally to the school yet external to the teaching function of the school or completely internally to the teaching function of the school (perhaps best suited to the formative mode).

b. Completely externally to the school or externally only to the school instructional function yet within the school (these being perhaps best suited to the summative mode).

In addition it can be performed by individual members of the teaching staff teaching the students being tested or not teaching them. Alternatively or concurrently by non-members of the teaching staff from industry, from other schools or departments or from the assessment center.

For certain types of assessment it can be effected by juries composed of assessors who may be from outside academia, from academia but not necessarily from the school, from school only or from a combination of the above.

A jury or assessment team would vary in composition depending on the competency level and the domain and area of knowledge to be evaluated. All assessors should receive thorough and careful training and be provided with a manual clearly stating levels and criteria they are to monitor.

Given all these possibilities,various constraints, financial or traditional, will no doubt come to bear upon the freedom of choice. Experience at some colleges is that the assessment of students take place either under the direction of the instructor in a course or off-campus learning situations, or under the direction of the Assessment Center in collaboration with the competence groups.

In general, the Assessment Center is responsible for the more structurally complex assessment, involving interdisciplinary work and teams of assessors, and for providing assistance to faculty

on assessment.

Irrespective of where and under whose supervision the assessment takes place, the fundamental scheme remains the same. Fig. 4 shows a block diagram illustrating the assessment process. The stated criteria dominate the process and enter the system in three areas: both assessee and assessor must be familiar with the criteria, and the instrument of test must be designed in accordance with these criteria. For the assessor, the criteria will affect both his observation and his judgment. In any such system there also exist unexamined unstated criteria which, though even unconsciously perhaps, pervade the whole process. Such are prejudices, opinions or views to which everyone, to a degree, is subject and which should be reduced to a minimum in a fair system but have nevertheless to be considered.

The assessee, whose capability is to be assessed is given an instrument, or directions (task) to perform a certain activity (performance.) This can be recorded (as on videotape for instance or directly by the assessor himself) and/or a document, item, model, report or artifact may be produced and subjected to the assessor's examination.

The assessor makes then his judgment from his observation and his examination, based on the published criteria. This judgment is then fed back to the student, discussed and agreed.

In case of non-achievement, remedial action must be recommended by the assessor and a meeting of the student with the mentor set up for further action and follow-up remediation and reassessment. In case of achievement, credentialling must take place with the registrar.

Of course, assessment is not always a one-session operation. Though the scheme remains the same, it may extend over considerable time particularly in experiential learning situations such as projects. The instructor should be sensitive to the student's progress by careful attention to various stages of the work (formative assessment) making sure that the competencies contracted for at the outset of the learning experience are being adequately developed as the work proceeds. This is particularly true for the competences emphasizing the affective domain (values, human relations, discipline) where the assessment process itself is bound to be, by nature, the most subjective. Perhaps the most vital step in the assessment process is that of feedback. This step involves a careful account to the student of what went on during assessment and is in itself a learning experience.

The student is then presented with his strengths and weaknesses, of what has been accomplished and of what yet remains to be done. The task of the assessor is then double: first, to communicate accurately the results of the assessment on the basis of the stated criteria; second, to help the student realize his or her position in the developmental stage of the competence being assessed and map out further strategies toward the student's goals in consultation with the mentor.

The main purpose of a competence oriented program is to turn out competent professionals and one of the characteristics of a competent professional is his ability to assess himself. A well conducted feedback session may be invaluable in helping students acquire this ability.

13. Graduation Requirements

One of the purposes of assessment is for certifying that the student has reached a specific level of proficiency in a stated competence.

The competences, as they have been defined and developed by SHAPE, apply to all activities the student is engaged in. Working on any area of the subject matter of the curriculum, all nine competences are, to a degree or another, brought to bear at any moment. Of course, some will overshadow others in a given experience. Thus, in a course in mathematics, one may expect that "principles and concepts" or "analysis" will predominate over "human relations." Yet, "human relations" should not be discarded off hand. All possibilities are left open to the imagination of the learning experience designers. It may bear repeating that the nine competences are the reflection of pervading psychological functions and that it is in this light that the subject matter must be viewed. It is therefore, the responsibility of the learning experience designer to specify what competences will be developed and to what level in a given experience. The design of a learning experience will also include the design, in coordination with the assessment committee and the competence groups, of the test instruments for both summative and formative purposes.

Each learning experience successfully completed by the student will, therefore, develop specific competences to a given level (which may be assessed at the completion of the experience or at some other point later on as in connection with an overall assessment for example). Each learning experience will lead not to one "grade" as traditionally, but to a rating for each of the competences it purports to develop.

A student shall be considered to have reached a specified level in a competence when he has achieved that level, in that competence, in a specified number of learning experiences.

In order to satisfy graduation requirements, all competences should be developed to level 2, so that a total of 18 levels will be completed for the 9 competences. In addition, at least 5 more levels should be completed, i.e., at least 5 competences should be "fully developed", 2 of them being elective and 3 required as specified for the following options:

- Analysis: competences I, II and III, (Principles and Concepts; Problem Solving, Methodologies).
- Design: Competences I, III, IV (Principles of Concepts; Methodologies, Valuation).
- Management/entrepreneurship: Competences III, IV, V (Methodologies, Valuation, Human Relations.)

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Fig. 1. MATRIX OF PSYCHOLOGICAL FUNCTIONS

Mode of Knowledge (relation subject/object)		Psycho-logical Tendency	SUBJECT MATTER ORIENTATION: SKILL (Volitional)	APPLIED (Affective)	THEORETICAL (Cognitive)
	Cognitive	Synthesis (Active	THINKING FUNCTION — INDUCTION	INTUITION FUNCTION — BREADTH	ABSTRACTION FUNCTION — GENERALISATION
		Analysis (Passive)	DEDUCTION	DEPTH	CLASSIFICATION
	Affective	Extrovert (Active)	DISCIPLINE FUNCTION — SERVICE	FEELING FUNCTION — CONFIDENCE	VALUATION FUNCTION — JUDGEMENT
		Introvert (Passive)	RELIABILITY	ACCEPTANCE	VALUES
	Volitional	Instinctive (Active)	DEXTERITY FUNCTION — SENSE AWARENESS	DRIVE FUNCTION — ZEST FOR LIFE	PERCEPTION FUNCTION — MENTAL AWARENESS
		Voluntary (Passive)	PSYCHOMOTOR SKILLS	COURAGE	OBSERVATION

Fig. 2. MATRIX OF COMPETENCES

Mode of Knowledge	SUBJECT MATTER ORIENTATION: SKILL (Volitional)	APPLIED (Affective)	THEORETICAL (Cognitive)
Cognitive	III. COMPETENCE IN METHODOLOGIES	II. COMPETENCE IN PROBLEM SOLVING (Analysis and Synthesis)	I. COMPETENCE IN FUNDAMENTAL PRINCIPLES & CONCEPTS (Critical spirit, holistic view).
Affective	VI. COMPETENCE IN DISCIPLINE (Attitudes toward values, work, social responsibility).	V. COMPETENCE IN HUMAN DEVELOPMENT & RELATIONS (Self in relation to others in different setting, leadership).	IV. COMPETENCE IN VALUES (Human, Societal, Professional).
Volitional	IX. COMPETENCE IN BASIC SKILLS (Communication, computation, experimentation).	VIII. COMPETENCE IN ACTION (Initiative, drive, risk taking).	VII. COMPETENCE IN INFORMATION (Critical use & articulation of information; formulating plans of action

FIGURE 3.

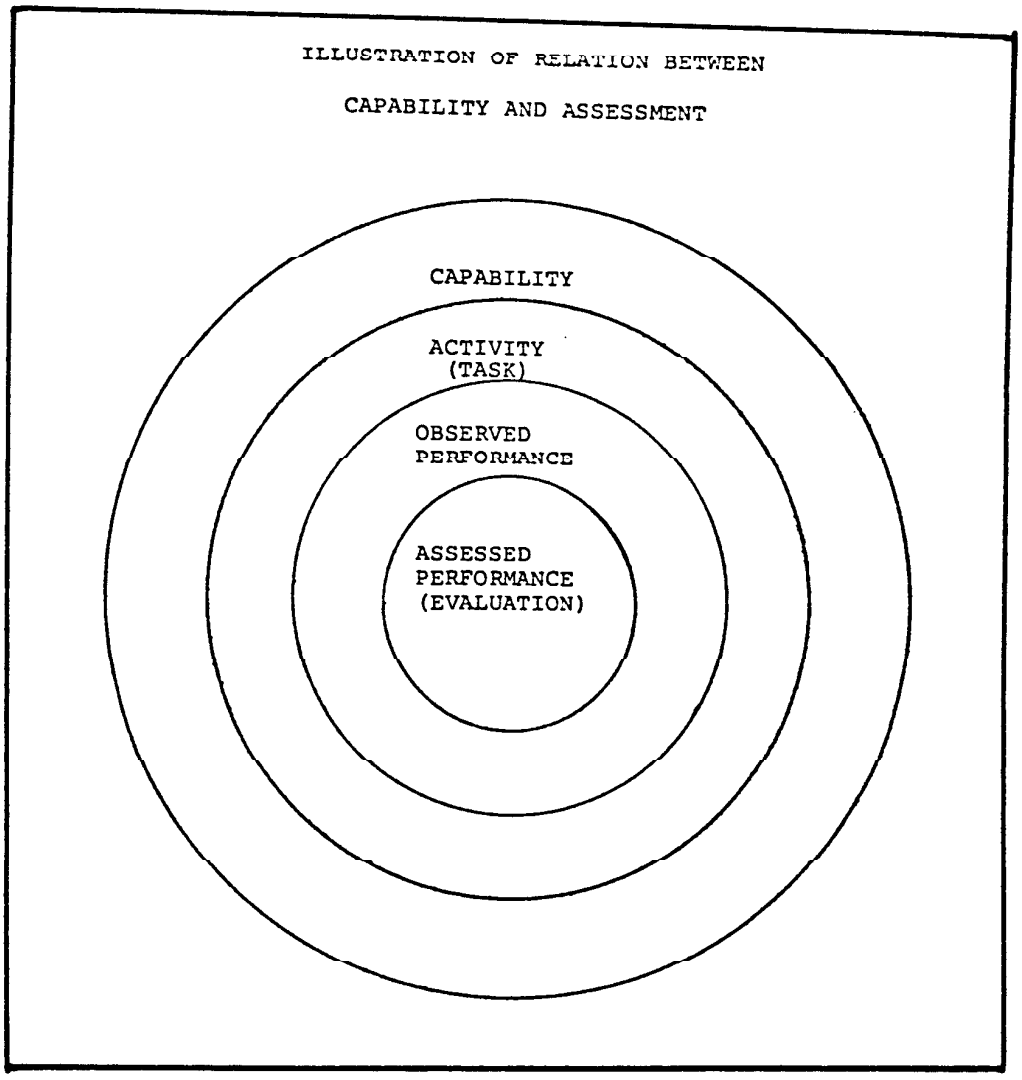
ILLUSTRATION OF RELATION BETWEEN
CAPABILITY AND ASSESSMENT
CAPABILITY
ACTIVITY
(TASK)
OBSERVED
PERFORMANCE
ASSESSED
PERFORMANCE
(EVALUATION)

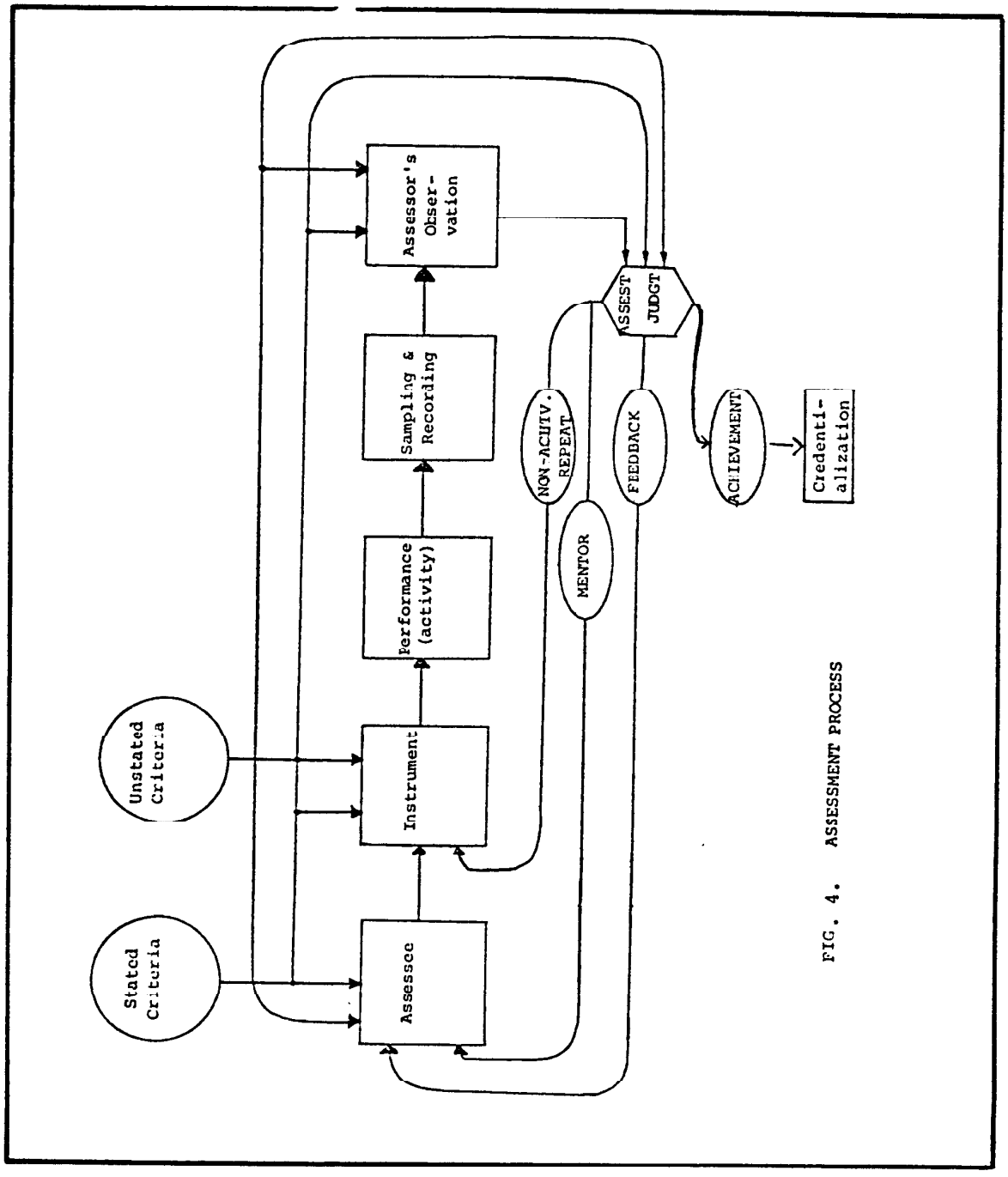

FIG. 4. ASSESSMENT PROCESS

Allen Rakow is Assistant Professor of Chemical Engineering and member of the SHAPE Project task force at The Cooper Union School of Engineering. His interests include environmental engineering, physiological systems, and technology assessment. He has research experience in both industry and government and looks forward to engineers playing a stronger role in decision making processes. Although he received formal education at Rensselaer Polytechnic Institute, Stevens Institute of Technology, and Washington University he believes that some of his most significant learning experiences have been as a Peace Corps Volunteer in Iran during 1968-1970, professional cook in Europe and father of three children.

Jean LeMee is Associate Professor of Engineering and Director of the SHAPE Project at The Cooper Union for the Advancement of Science and Arts in New York City. He holds an M.S. and Ph.D. from Carnegie-Mellon University. He teaches courses in systems and related areas at The Cooper Union School of Engineering. He has published a number of papers on engineering topics and on education and has served as an consultant for industry and the U.S. Presently his research interest lies in the area of outcome oriented curriculum design. He is a member of IEEE and ASEE.