Institut Pertanian Bogor * University of Wisconsin

GRADUATE EDUCATION PROJECT

Aid Project 497-0290

Report No. 38
Kean/O'Leary

CURRICULUM, DESIGN, MODIFICATION, AND EVALUATION

Guidelines and Rationale

Elizabeth M. Kean
Marion H. O'Leary
January, 1983

TABLE OF CONTENTS

	Page
INTRODUCTION	1
GOALS	3
Levels of Goals	3
Types of Goals	5
Meeting Goals and Objectives: Criteria	6
Characteristics of Effective Goals and Objectives	8
STUDENTS	9
Characteristics of Entering Students' Knowledge	10
Students Within the Curriculum	14
Conclusions	16
INSTITUTIONAL RESOURCES	17
Staff	17
Facilities	19
Materials	20
Relationship to Other Curricula	23
CURRICULUM	23
Describing the Curriculum	24
Expected Student Progress	28
Modifying the Curriculum	30
EVALUATION	30
Purposes of Evaluation	31
Data for Evaluations	34
The Evaluation Process	35
APPENDIX A	36
APPENDIX B	44

INTRODUCTION

A curriculum is a description of an educational program. Different levels of description of curriculum exist. For example, we can describe the "curriculum" for an entire educational institution, for example Institut Pertanian Bogor. Alternatively, we can describe a "curriculum" for a particular group of students, for example students in agronomy at the S_1 level at IPB. Alternatively, we can describe a "curriculum" for study of a particular subject at a particular level, for example introductory chemistry for agronomy students at the S_1 level.

We are concerned here with "curriculum" at the level of programs for a particular group of students. We are not concerned with the overall program of the institution or with the detailed content of individual courses within a given area. Our goal is to provide a document which can be used by staff and administrators to design, evaluate, and improve curricula.

Curricula contain many parts. At each stage, these parts are intended to define the goals of the curriculum a success, together with the means for deciding whether the curriculum is a success. Designing and implementing curricula is a complex process requiring much time and thought on the part of staff and administrators. The success of a curriculum depends upon the care and thoroughness with which the design process is carried out.

Sound educational planning requires that curriculum designers prepare written descriptions of their curricula which contain a variety of information. The categories of information include:

1. A statement of the goals of the curriculum
2. A description of the students who will use this curriculum.
3. A description of the staff, facilities, and curriculum.
4. A description of the components (courses, experiences) which make up the curriculum.
5. A protocol for evaluating the curriculum and a procedure for modifying the curriculum as needed.

Unfortunately, these five categories are not truly independent. In particular, goals (1) and evaluation (5) pervade all sections of the description. For example, particular goals for the curriculum may appear in the students (2) section as part of the description of desired student performance levels. Existing data with regard to student success in the program may be presented in the student's (2) section but may also be part of the evaluation (5). It is not possible to avoid this mixing of categories, and we may occasionally find some duplication of information in the different sections of the questionnaire. Still, these five categories provide a useful framework for organizing our analysis.

The information which is needed for evaluating an existing curriculum is slightly different from that which is needed for a proposed curriculum. For example, information on student success and

student response to the curriculum should form part of the evaluation of an existing curriculum, whereas such information is not available for a curriculum that is not yet in operation. On the other hand, consideration of the facilities, staff, and materials required for a curriculum is especially important for a curriculum which is still in the planning stage. The curriculum evaluation questions presented here are more appropriate for existing curricula than for planned curricula. However, it should be possible to use this document for evaluation of proposed curricula after only minor modifications of a few of the questions.

GOALS

Levels of Goals

A curriculum is set up to accomplish certain educational goals. Usually these goals are first expressed in terms of broad goals: the knowledge, skills, and attitudes which students who complete the curriculum will possess.

Example 1: After completing this curriculum, students will be able to solve chemical problems which arise in their work situations.

Such broad goals may be developed by government ministries, university administrators, the Faculty Senate, faculties, or departments. These goals are the exit standards by which graduates of a program will be judged.

Such broad goals are only accomplished over a long time period, after the student has completed the entire curriculum. They are not

accomplished by one action or one course, but by the cumulative effect of many educational experiences. Moreover, it is usually impossible to determine simply and unambiguously whether the goals have been met.

For these reasons, the broad goals must be reformulated as a series of subgoals, each of which makes up a part of the broader goal. We will call these subgoals general objectives.

Example 2: Students will learn to search the chemical literature for information relating to specific problems.

Example 3: Students will learn principles that govern relationships among chemical species.

These general objectives often describe the specific accomplishments desired for a specific course (or series of courses) within a program of study.

It is often difficult to determine whether general objectives have been attained. Therefore, it is necessary to break these down further into specific objectives to be accomplished within specific courses. These specific objectives will be defined in terms of student actions which can be measured according to definite criteria and within a specific context. For the general objectives in examples 2 and 3 above, the following specific objectives might be written:

Example 4: A student will be assigned a specific chemical compound for which the student is to find at least two possible synthetic routes by using the chemical literature. The student will report the two synthetic routes.

Example 5: For each of the proposed synthetic routes, the student will determine the cost, per gram, of the desired product.

In planning for specific courses, curriculum planners must decide not only what the student is expected to do, but also the conditions under which the learning will take place and the minimum acceptable level of performance. These issues are elaborated in Appendix A.

Types of Goals and Objectives

The goals and objectives described above fall into two broad categories: 1) Student knowledge--what the student is expected to know about the subject matter, and 2) student information-processing skills--what the student is expected to be able to do with that knowledge. These two categories will be considered in turn.

Student knowledge. As part of knowledge, we include facts, concepts, principles, and set patterns of problem solving.

Example 7: Students will learn the definition of pH.

Example 8: Students will learn how to find the pH of a solution of a strong acid.

The chief work for students within this category is efficient memorization and accurate recall of memorized material, together with developing the ability to solve simple problems.

Student information-processing skills. These skills include forming concepts from incomplete presentations, extending concepts, analyzing complex problems, developing new solutions to problems from the real

world, finding information independently, and so on. Example 2 above is an example of this type of objective.

In general, it is more difficult to formulate specific goals and objectives for information-processing skills than for knowledge. Yet the most important educational goals are often directed toward information-processing skills. Thus, it is particularly important to consider the development of information-processing goals.

Meeting Goals and Objectives: Criteria

In some cases, simple criteria exist for judging whether or not a particular goal has been met. For example, in example 8 above, a student is given a pH problem to solve; the criterion for success is whether the student can solve the problem.

Goals must also take into account the success rate for a class as a whole. For the whole class, we must set some arbitrary percentage of correct answers from students as the criterion for success. For example, we might consider that if 75 percent of students in the class can solve a standard pH problem, the class has accomplished the desired objective and the curriculum is a "success" with regard to that particular objective. But it should be recognized that such a percentage figure is arbitrarily set; such choices must be made very carefully.

Knowledge is easier to measure than skill. Students either "know" or "do not know" something. Pencil and paper tests may be used to decide which. However, skills must be viewed more as a continuum. Skill levels vary, and accurate measurement of skill is difficult.

Staff must judge not only whether the student can accomplish a given process (such as solving a new type of problem) but they must also judge how efficient and effective is the process used by the student. In spite of this increased difficulty, curriculum planners must attempt to set specific performance criteria for information-processing skills.

Likewise, specific goals are easier to measure against than general goals. The broader and more general the goal, the more difficult it is to set adequate performance criteria.

The following is an example of the kind of specific criterion that a department might set:

> Example 9: For students at the S_1 level in the chemistry curriculum, 50 percent of entering students should graduate in five years or less.

In setting such criteria for an existing curriculum which is being modified, the following process might be used:

1. Appraise the current progress and graduation rates. This establishes a baseline against which to measure change.
2. Project the level of improvement to be expected or desired in a given time period.
3. Use this information to set a specific goal.

The specific methods used to determine the baseline and the improvements should be described in detail (e.g., which students will be excluded from consideration, what time period is considered, what is meant by "progress").

We should recognize in this process that curriculum planners are using their judgment about a complex educational system in setting these achievement levels, rather than following established absolute standards. Moreover, although goals and objectives for a curriculum represent an ideal toward which the institution is working, this ideal may be impossible to achieve, given the resources available. Therefore, it is necessary to specify realistically the progress expected toward meeting an ideal goal in a given period of time.

Characteristics of Effective Goals and Objectives

An effective set of goals and objectives will have the following characteristics:

Consistent. Goals are not contradictory. Working toward one should not decrease the chance of achieving another.

Achievable. Goals and objectives are realistic, given students and resources.

Sequenced Properly. Prerequisites and subgoals are achieved in proper cumulative fashion.

Prioritized. If resources are limited, more important goals should be achieved first.

Complete. An adequate set of goals and objectives of various types has been written. Goals proceed from the more general to the more specific.

Measurable. Criteria for measuring achievement exist.

STUDENTS

Students are the raw material upon which a curriculum operates. Students enter the curriculum with knowledge and skills acquired from previous school and life experiences. By participating in a curriculum, students develop their knowledge and skills. When they reach the proficiency level which staff and faculties have set as the exit level for a program, they graduate and enter their profession.

Learning does not stop after graduation, but continues throughout life. Therefore, the curriculum which we establish for students must improve their skills and knowledge during their school years and must also prepare them to continue learning after graduation.

The goals of the curriculum determine the desired exit level of students. To be successful in bringing students to that level, a curriculum must begin at a knowledge and skill level which is appropriate for entering students. As students progress through the curriculum, these knowledge and skill levels must increase in a systematic manner in order to achieve proper exit levels in a proper period of time.

A curriculum is planned with an "average" student in mind. The planners anticipate how the majority of students will learn from the activities within the curriculum. However, all students are not the same; ideally, the curriculum should provide alternative activities for both the above-average and the below-average student. The challenge for curriculum planners is to develop learning options for both groups at reasonable cost. Failure to do so may be costly in the

long run in terms of both monetary costs and graduation rates. High achievers may otherwise waste their time in routine learning. Students who are initially below average may fail to develop and improve; eventually, they may leave the institution without a degree. In both cases, students cannot make effective use of the institution and its resources.

In the following sections we examine some basic concepts involved in assessing characteristics of entering students. Then we consider measurement of student progress through the curriculum. The two general questions to be answered in both areas are 1) What do you need to know about students at each stage, and 2) How can you obtain that information.

Characteristics of Entering Students' Knowledge.

Students begin their studies with some level of knowledge in both specific subject matter (e.g. chemistry, biology) and in tool subjects (e.g. written and oral language, mathematics). This entering level is largely outside the control of the university.

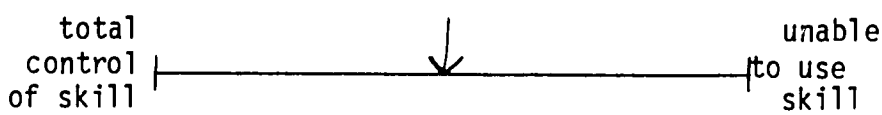
Specific testing is required to assess the knowledge level of entering students. Such entrance tests may be used 1) to measure the knowledge level of the "average" student, and 2) to identify students who are outside the expected range of knowledge. Information obtained from such tests can be used to determine the starting levels of first-year courses, to identify students who are in need of extra help, to identify students who are candidates for special programs, and to

accomplish other program objectives. The design of adequate entrance tests is, unfortunately, a difficult and time-consuming process.

If entrance tests are not given, staff must make assumptions about what students know at the beginning of a program or course. These assumptions will be based on previous courses that students have completed and on work of previous students in the same course or curriculum. Although such assumptions are often accurate, it is preferable to measure student background, rather than assuming it. This is particularly true for entering students.

Information-processing skills. As we noted before, information-processing skill is the ability to solve complex problems and the ability to find appropriate approaches to new situations. Although we are emphasizing thinking skills in this section, most of what is presented applies to laboratory and field work skills as well.

Information-processing skills fall into two broad categories: 1) How well students can process presented information (e.g. extending the information, drawing conclusions, applying it to new situations), and 2) How well students can find new information for themselves (e.g. by using the library, by identifying new sources of information, etc.). In each case, each student will fall somewhere along a continuum:



Like other general objectives, objectives regarding skill levels must be defined in terms of specific components of each skill. Such goals must, of course, be consistent with the entering levels and expected progress of students. For instance, an entering S_0 student might be expected to be able to read a paragraph in an instruction manual and identify all the main ideas. A beginning S_3 student might be expected to read a journal article and identify techniques which could be used in the student's own research.

Unfortunately, even when appropriate specific skills for a particular course or level have been identified, no easy method of assessing an individual or class achievement level exists. Paper and pencil tests are generally ineffective in assessing skill levels. To make such assessments, the staff usually must give the class an assignment which uses the desired skill and, on the basis of student performance, the staff must judge the level of skill. Again, the purpose of assessing entering skill levels is 1) to prepare a curriculum which does not repeat what is already known nor fail to teach what is needed, and 2) to identify students with specific characteristics in order to design alternative programs.

Personal characteristics. Students are more than a collection of facts and skills. They are people with fears, hopes, dreams, behaviors, work habits, expectations about being a university student, and so on. Each of these aspects helps to determine how easily a student will adapt to the curriculum. Students who cannot adapt to the curriculum often fail. Many times we do not know why they fail.

Data on student histories is easy to obtain: home town, income of parents, social class, general quality of high school, etc. However, such information is not directly helpful for curriculum planning. This information does not help us decide how to teach these students.

The following information is more useful to curriculum planners and teachers. Unfortunately, this information is much harder to obtain than the student history information.

Motivation: How hard students are expecting to work to complete their course or degree program.

Career goals: Whether students have a specific career in mind and can relate their career goals to the activities of the curriculum.

Support mechanisms: To whom or what students will turn when the course or program becomes difficult.

Dependency on teachers: Whether students are prepared to learn independently if the teaching is not adequate.

Knowledge of school "rules": Whether students know the unwritten expectations of the school (e.g., homework must be completed even when it is not turned in; some subjects must be studied daily).

None of these characteristics can be tested before students begin their studies, because paper and pencil tests are ineffective. When students begin their studies and difficulties arise, personal contacts and discussions with staff can identify some of these personal sources of trouble.

In our experience, such personal factors are often a hidden cause of failure of students. Curriculum designers should provide opportunities for contacts between staff and individual students. Information obtained from such contacts may ultimately permit modification of the curriculum in order to help future students avoid common problems.

Students Within the Curriculum

Student progress through a curriculum should be monitored by staff. Much information will be gathered as students take examinations, work assignments, and perform experiments. In addition, a curriculum should specify when staff and students will meet outside of the classroom for the purpose of monitoring student progress and obtaining student response to the curriculum. Such information is required for improving existing courses and curricula. Therefore, testing within courses (to gather information about student knowledge), analysis of student work (to assess skill levels), and interactive contacts with staff (to assess personal factors which influence success) will be needed at various stages in a student's development.

The ultimate success of a curriculum depends on orderly progress of students through the curriculum and on graduation of a set percentage of students within a specific time period and on their ultimate success in their field. Information on progress and graduation rates must be kept. The data may permit identification of major blocking areas or courses. These can then become the target for curriculum revision.

Graduates may be surveyed (interview or questionnaire) at specific time intervals after graduation to assess the functional value of the curriculum. This information can be used to modify specific courses or to provide a rationale for adding or deleting courses.

Student attitudes. The success or failure of a curriculum depends on more than simply the progress of students through that curriculum. It depends as well on student attitudes toward various aspects of the program. Motivated, interested students are successful students. A number of factors which influence student attitudes are listed below:

> Cost to students: The monetary cost to students for materials, books, equipment, transportation, etc.
>
> Feedback to students: How students learn of their progress within courses and within a program. Such feedback is needed if students are to correct mistakes in their study approaches or in selecting options.

Sequencing of courses: The order in which courses are taken. The curriculum should anticipate problems which arise when students deviate from the expected progression (e.g. by failing a course which is a prerequisite for others) and provide options in sequencing which minimize delay in completion of the program.

Skill development: The level of problem-solving skill in the program, and how this level changes as students progress through the program.

Information on options: Mechanisms for informing students about optional courses (content and purpose).

Time demands: Course credits vs. time required. Credits must realistically reflect the time which students must ordinarily spend on a subject. The overall student load for each semester must not exceed the time available.

Conclusions

Systematic records must be kept concerning student enrollment, progress, and graduation. Continuing information regarding knowledge and skill levels provides another measure of student progress. Student responses and attitudes also provide important data. Together, this information forms the basis for improving the ability of students to succeed in the curriculum.

INSTITUTIONAL RESOURCES

The resources of a university determine what learning activities can take place. In this section we look at three areas of institutional resources. 1) staff, 2) physical facilities, and 3) teaching materials and supplies. The projected cost of supplying new university resources for a new curriculum should be a part of any curriculum design.

Two issues are important with respect to resources: 1) what resources are currently available, and 2) what resources are needed to support the new curriculum. It is useful to consider both the ideal situation (relatively unlimited resources) and the minimum acceptable situation (limited resources). Since money for new programs is usually limited, creativity in using existing resources is needed.

Staff

The quality of a curriculum depends upon the education and experiences of the staff who present that curriculum. Particularly in the design of new curricula, it is essential that we consider whether adequate numbers of staff are available and whether their backgrounds are adequate for teaching all aspects of the new curriculum.

Ideally, each staff person should be familiar with a variety of teaching methods: lecture, use of demonstrations, small group discussions, tutorials, use of visual aids, etc. For instance, in order to teach students to relate real phenomena to principles

presented in a physics lecture, the lecturer might use demonstrations to supplement the lecture presentation.

Staff size must be large enough that the total workload is reasonable. Institutional guidelines with respect to teaching, research, public service, and other activities are useful in this regard. Decisions on staff size require a definition of a "normal workload" both in total hours and in distribution of hours among the various areas. Time spent in curriculum and course development must be included when assessing workload.

When a curriculum is planned in detail (i.e., at the course level), specific descriptions of the number of staff and their academic preparation should be proposed. This description is compared with the staff currently available to teach the new curriculum. On the basis of this comparison, the designers may propose 1) to add new staff, 2) to retrain current staff, or 3) to "borrow" temporary staff from other units or to hire temporary staff. In each case, costs and detailed procedures must be specified.

The balance between temporary staff and permanent staff should favor permanent staff. People who are hired temporarily to teach a small part of the program may have no long-term commitment to the program, nor do they have an understanding of the long-range goals of the program.

Facilities

A description of the physical setting in which educational activities will take place should be included when a new or modified curriculum is proposed. This includes lecture rooms, classrooms, laboratories, seminar rooms, staff offices, field stations, computer facilities, libraries, and so on. The level of use for each should be specified, as well as the numbers of students to be served. Again, we should consider what existing facilities may be used and what new facilities are needed.

Existing facilities. Relatively small changes in a curriculum may utilize existing physical facilities. If this is the case, decisions about class size, location of classrooms, etc., may be uncomplicated. However, when existing facilities are already being used at nearly the maximum level, it may be difficult and time-consuming to arrange space for even small curriculum additions. Curriculum planners may need to be flexible in utilizing available space and facilities. However, they should also have a clear idea of the minimum requirements for the proposed curriculum. Note that there are added operational costs to the institution when existing facilities are used more completely (e.g., added maintenance and utility costs). Some unit of the institution must eventually bear those costs.

New facilities. When major additions or changes are proposed, new physical facilities may be necessary. The process of designing new buildings is a complex subject, well beyond the scope of this document, except for the following general remarks: Curriculum

designers should be consulted when new buildings are planned. Their input is needed in areas such as 1) specifying the amount of physical space per student needed for major activities, 2) projecting the number of students to be served in the future, and 3) specifying arrangement of space for teaching purposes (e.g., arrangement of laboratory benches and fume hoods in laboratories). Curriculum planners may seek advice from institutional staff who are experienced in design, from professional societies, and from similar units at other institutions.

The more dispersed teaching facilities are, the greater the time needed by students and staff to participate in the curriculum. Extra expenses (transportation, etc.) may be encountered. However, a curriculum should use facilities away from the campus whenever the educational benefits outweigh the inconvenience and added expense. For instance, work in field settings or job settings adds important dimensions to classroom work. In practice, such experiences tend to be underutilized.

A change in one curriculum will often require changes in other units of the institution. For instance, addition of a course which requires increased use of a library may force the library to increase its staff. Changes in laboratory courses may require changes in the hours or number of support personnel.

Materials

Textbooks. Textbooks and other printed materials provide an essential guide to the content of most courses. Good teaching technique often

requires that there be a good correspondence between the lecture presentation and the textbook presentation. Preparation of new materials is costly in terms of staff time, as is translation of English language materials into Bahasa, Indonesia.

Use of materials in Bahasa, Indonesia vs. English is also an important issue. Although it is important that entering S_0 and S_1 students be provided with materials in Bahasa, Indonesia, it may sometimes be appropriate to rely on English language materials for the more advanced level courses. This is particularly true for technical fields in which students will have to use many English language materials after graduation.

Equipment and supplies. For programs involving a substantial laboratory or field component, the cost of equipment and supplies may be a significant part of the overall cost of the program.

Equipment which is to be used in instructional programs by large numbers of students must be sturdy and dependable. Such equipment must be easy to repair, and spare parts must be readily available. In many cases, repairs and maintenance may ultimately be a larger expense than the initial purchase. Staff time for maintenance and repair is another hidden cost of such programs.

The chemicals and supplies needed for laboratory programs may represent a significant and continuing expenditure. Modification of existing laboratory exercises (e.g., by decreasing the scale of chemical experiments) can sometimes provide a cost saving. Many of these chemicals and supplies are petroleum-based, and it is likely

that their costs will continue to rise much more rapidly than the general inflation rate in the next few years.

Calculators and computers. Hand-held calculators are becoming part of the armament of every university student. Both modest calculation facilities and more sophisticated units must be accounted for in curriculum planning. Access to major computation facilities must be allocated on an equitable basis.

Low-cost alternatives. Curriculum planners need to develop low-cost alternatives for providing equipment and supplies. For instance, existing translations of current English language textbooks into Bahasa, Indonesia might be obtained from other universities in Indonesia. Modifications of those translations to meet a specific local purpose could be made as needed. Similarly, short-term loans of equipment from other institutions can postpone some costs until the capital demands are less. Grants and gifts from corporate and international agencies should be aggressively pursued.

The trade-off in many of these cases is money vs. time. It costs more to purchase finished products (textbooks, etc.) but the material will be available in a shorter time. To produce the same material locally might be cheaper in monetary outlay, but more expensive in terms of staff time.

Curriculum planners must determine the minimum acceptable level of supplies and materials and must develop a means and time schedule for acquiring them.

Relationship to Other Curricula

It is wasteful of resources to duplicate courses that already exist within a university. It is probable that "service courses" at the introductory level in subjects such as mathematics, physics, and chemistry can be taught at less cost by a central faculty than separately within the various specialized faculties. However, it is not only at the elementary course level that duplication should be avoided. Since IPB has an agricultural orientation throughout its programs, it is possible that some upper-level courses might be profitably shared by various faculties.

When a new curriculum is planned, it is important that existing courses in other faculties be examined to see whether any of them might be appropriate for the new curriculum. Even if the existing course is not totally appropriate for the new curriculum, it may be possible to develop seminars or other presentations which can supply missing material. Cooperation and patience are needed in order to make such arrangements work. Students may benefit by having courses in their own subject area taught by another faculty. The institution may benefit by a saving of resources.

CURRICULUM

A curriculum is a description of educational activities designed to achieve certain educational goals. When a curriculum is proposed, part of the required documentation is a description of those activities--what is to be taught, and how.

The level of detail provided in a curriculum description depends on the size of the curriculum unit being discussed. For example, if an entire S_1 curriculum is being proposed, general objectives and goals and the courses designed to address them would be described. When individual courses are discussed, more specific objectives and more detailed subject matter and teaching activities would be specified.

In this narrative, we emphasize the design of curricula in larger units, rather than at the course level. The major issues include required and optional courses, types of educational activities, progressions in knowledge and skills, and modifying the curriculum.

Describing the Curriculum

Types of educational activities. There are many formats for educational activities: lectures, laboratories, field work, seminars, research, discussion classes, conferences between teachers and students, and others. The format chosen must correspond to the major educational purpose of the activity. For example, factual material can often be presented efficiently in a lecture format. Laboratory skills must be taught by experience rather than by lecture. Development of information-processing skills requires interactions between teachers and students.

Teaching and learning are not identical. Teaching provides opportunities for students to confront new knowledge and skills. But students must learn by taking what they encounter and making it part

of themselves. Various types of instruction differ in how much independence and self-motivation students must have in order to learn. When teachers know the approximate level of student capability and know what student growth they wish to bring about, then they can select activities that make learning possible. Although most learning takes place within formal course work, some will take place outside of courses.

Most university staff have little training in how to teach. They teach as they were taught: sometimes well, sometimes poorly. Perceptive teachers improve their skills by observing student reactions to their teaching and by observing other good teachers. Most staff could benefit from workshops designed to introduce them to new teaching methods.

Describing content. A curriculum proposal describes what will be taught in courses. Useful information includes 1) titles of courses, 2) objectives, 3) general topics and time allocated to them, and 4) skill and knowledge levels. For each individual course, specific objectives, conditions, criteria for achievement, and even the lecture notes may be included (see Appendix A).

Decisions about course content are made by the teaching staff. These decisions are based on their own past education (what they were taught) and on current standards in the field (what is taught elsewhere, what is in textbooks). A mature staff can modify a curriculum to introduce new material in the field. However, some deviations from accepted content in the field may come about because the teaching unit lacks appropriate facilities.

It is difficult for administrators outside of a particular discipline to judge the adequacy of proposed content in a curriculum. They can, however, ask how that content relates to accepted norms elsewhere and ask for justification of major deviations.

Teaching knowledge vs. teaching skills. The knowledge (content) which comprises a course is much easier to describe than the skills which are included in the course. Curriculum designers must be encouraged to consider what skills will be taught, how they will be taught, and how achievement of skill objectives will be measured.

Teaching skills is more difficult than teaching knowledge, and the methods which we use to teach skills are not well-understood. In general, students master skills through practice. In preparing students to use skills, teachers often only show students how they (the teachers) use the skill, rather than providing students with an explanation of the process involved. For example, a teacher will work a textbook problem in front of a class, without giving students any explanation of why each step is done. In general, students need more direct teaching of skills than they receive. Teachers should be encouraged to teach information-processing skills directly. A consequence of adding this to the curriculum is a modest decrease in the amount of content (knowledge) that may be taught.

Progressions in content and skills. The knowledge and skills of beginning and finishing students in a curriculum are clearly different. For example, a beginning student may be expected to solve textbook problems in which all the information needed is directly stated. At

some later time, that student may be expected to solve problems in which some of the information is not stated, but must be assumed.

It is difficult to design an entire curriculum so that students progress in an orderly fashion in knowledge and skills. Courses with high failure rates should be examined for gaps in content and skills. These courses may expect students to use information and skills which they have had no opportunity to learn. If gaps are found, curricula should be reviewed to fill them in.

Core vs. optional courses. As the size and diversity of IPB increases and as graduates of IPB move into new kinds of jobs, it becomes increasingly important to consider what parts of the curriculum are essential for all students and what parts of the curriculum should be left to the choice of the individual student. Every field has a "core" of knowledge and skills which should be required of all students. For example, it is generally agreed that a "core" curriculum at the S_1 level in chemistry should include work in the four major areas of chemistry: organic, inorganic, physical, and analytical. In addition, chemistry students must acquire proficiency in physics and mathematics. But these core subjects constitute only about half of the total courses taken by a chemistry student. All students should be required to take additional advanced work in chemistry, but the subjects chosen should reflect the needs and career aspirations of the individual student. This opportunity for individual options may form an important part of the curriculum.

In developing options within a curriculum, designers must consider a number of issues:

Sequencing: What core courses are prerequisites for each optional course?

Timing: In which semester will each course be offered, and how often will it be repeated?

Enrollment: How many students must enroll in order to justify offering the course?

Needs of graduates: How do these course offerings meet the needs of graduates?

Staff: Do the available staff have the interests and expertise to teach the course?

When individualized courses are offered to small numbers of students, costs will increase. However, there are significant benefits to students from such courses. Especially at the higher levels of education, students learn how to act and function as professionals by observing as staff practice their profession. Such learning is not quantifiable, but is nonetheless real. Opportunities for such interactions should be provided within a curriculum.

Expected Student Progress

In proposing a curriculum, the designers provide a time sequence for completion of the program. However, not all students are able to complete the courses on schedule. Once a curriculum is in operation, data must be gathered on student progress through the curriculum. This information may be used either to improve the existing curriculum

to remove barriers (see next section) or to provide alternative learning mechanisms for students who are unsuccessful learners.

Whether or not curriculum planners act on this information is related to the acceptable or expected failure rate in a course, department, or faculty If the failure rate is at the expected level, then no actions will be taken. However, all student failures are expensive in human and monetary terms. It costs money for the department to enroll students multiple times in a course or to provide courses to students who drop out after several years. The curriculum planners may ask how many resources they are willing to spend to modify the program and thereby decrease the failure rate. It is sometimes more efficient to spend resources salvaging existing students, rather than expending those same resources on admitting larger numbers of students, many of whom fail to graduate. The number of graduates and their skills must be balanced against the need to admit large numbers of students.

Low-cost options should be sought to provide assistance to students, particularly in their early years in the curriculum. For instance, peer tutoring programs can dramatically improve student success. Such programs are most effective when the institution can provide staff to coordinate activities and train tutors.

Information on failure rates can also be used to identify scheduling changes which may minimize delays in student progress through the curriculum. For example, if a student fails the first semester of a required two-semester sequence which is only offered on

a yearly basis, the student must wait until the next school year to try the course again. If both courses in the sequence were offered each semester, the delay would be decreased. The economic consequences of such changes must be carefully assessed.

Modifying the Curriculum

No curriculum is perfect. Designers must be prepared to modify the curriculum as problems become evident during its uses. As a part of any curriculum description, the designers should establish methods and schedules for evaluation.

It is essential to maintain a systematic improvement process for a curriculum. Modifications will usually be based on differences between expected and actual failure rates, identification of areas which block student progress toward completion of the program, or unexpected changes in staff. Those responsible for curriculum modification may find it useful to develop priorities for areas to be improved.

EVALUATION

In this final section, we discuss the process of evaluating a curriculum: purposes of evaluation, value judgments involved, proposals vs. existing curricula, data needed, and the evaluation process itself.

Purposes of Evaluation

Evaluations may be undertaken in order to make rational decisions about the direction of the institution: which programs to expand or contract, or how to correctly apportion scarce resources. In this case, evaluators are likely to be administrators with major policy-making responsibilities. Alternatively, evaluation may be undertaken to improve specific parts of existing programs. Such changes may or may not involve changes in financial support for a curriculum. These evaluators are more likely to be curriculum designers or teaching staff.

If the purpose of the evaluation is to provide direction for a unit, the evaluation seeks to determine how good the curriculum is (i.e., focusing on the end results of the curriculum). If the purpose is curriculum improvement, the evaluation centers on how the curriculum produces its results (focusing on the process at work within the curriculum and providing a basis for modifying the curriculum). These two approaches are obviously interconnected. For example, you cannot determine what activities within the curriculum are effective without considering how to measure that success. In practice, all evaluations must look at both issues, even though one may receive more attention.

Evaluating "success". The evaluation process provides data on which to base judgments about the success of a curriculum. These judgments are based on the values and beliefs of the evaluators, rather than on absolute standards.

For example, suppose an evaluation shows that the number of students who pass in a revised course has increased by 10 percent. Is this a successful modification of the curriculum? One person may view this as a totally satisfactory process; another may continue to seek further improvements.

Since absolute standards do not exist, "success" criteria evolve through concensus of the evaluators who examine a curriculum. When new curricula are proposed, success criteria should be included (e.g. projected graduation rates). These will be value judgments, but the basis for arriving at them should be specified (e.g., knowledge of success at other institutions, assessment of the capabilities of the student body). After a curriculum is in operation, these estimates can be realistically revised. Modifications will seek to improve this baseline rate of success.

Evaluating for curriculum improvement. In previous sections, we have provided guidelines for judging the adequacy of curriculum planning in the four major curriculum areas: goals, students, resources, and curriculum. During the actual operation of a curriculum, the adequacy of this planning becomes evident. Evaluators ask: 1) what factors weren't anticipated, 2) what further information about each is needed, and 3) what improvements are needed.

An evaluation must look not only at each area in isolation, but also at how these areas inter-relate. Congruence among these areas is assessed:

Curriculum vs. goals: How does the proposed curriculum address the goals and objectives? Which goals and objectives are not yet accounted for in the curriculum? How may the curriculum be changed to accomplish these?

Curriculum vs. students: How does the curriculum account for the characteristics of the average student or range of students? After the curriculum is in operation, which students survive? What is done to help failing students?

Curriculum vs. resources: Does the institution have all the needed resources? If not, what plans are made for acquiring them?

In the process of an evaluation, the evaluators become aware of constraints within the system which limit the effectiveness of the curriculum. For instance, it may become evident that the mathematics preparation of students in the first year is not adequate for a new second-year course. Identification of constraints leads to proposals for removing them (e.g. include the needed topics in the first-year mathematics course, or develop self-instructional teaching materials for students in the second-year course).

These are all complex issues. Most evaluations cannot tackle all of them simultaneously. Specific areas which appear to be most critical are addressed first. These areas are determined by the perceptions and value judgments of the evaluators.

Data for Evaluations

Data collected during an evaluation are the basis for making curriculum decisions. Data collected should have a specific purpose and must be appropriate to the questions being asked. Evaluation data fall into two general classes: quantitative data and interpretive data.

Quantitative data. Some data, often relating to success measures, will be quantitative and can be manipulated statistically. Examples include measures of student achievement on exams, graduation rates, and so on. Such data are unambiguous and allow for comparison between units within the university. Comparison within a unit over time is also possible.

Statistical measures must be used with care, as they show relationships, but they provide little information on the causes of those relationships. For example, correlating class rank after the first year with graduation rates does not tell us why the correlation exists or what we should do to improve the graduation rate.

Interpretive data. Other measures may be used to learn about the educational effects of specific parts of a curriculum. These include written descriptions of events, anecdotal information, questionnaires, and perceptions of staff, students, graduates, and administrators.

These data are subject to interpretation and are open to bias. However, by using more than one source of information and by searching for common patterns among multiple events, bias can be minimized. Such data can provide useful direction for modifications of an existing curriculum.

The Evaluation Process

Curriculum planners should include plans for evaluation as part of their curriculum design. The following areas should be considered:

Purpose: What are the purposes of the evaluation (measuring success rates, modification of curriculum, etc.).

Evaluators: Who will do the evaluation (curriculum designers, administrators, others; specific persons may be named).

Scheduling: When and how often will evaluations take place.

Changes: How will the results of the evaluation be used, and by whom.

During the evaluation, other specific questions may arise; e.g. the time available or needed for evaluation, need for specific data, cost of evaluation, etc.

Some of the questions for an evaluation may be determined on an institution-wide basis. Others will be determined by the curriculum unit and its resources. A sample set of questions for curriculum evaluation may be found in Appendix B.

APPENDIX A

PREPARING GOALS AND OBJECTIVES FOR COURSES AND CURRICULA

A. Approaches to Curriculum Development

Goals are defined as: "broadly conceived statements that express, in general, what schools should try to accomplish".

Goals are static. They do not change much over time. We must translate our goals to objectives, knowledge and skills.

There are several approaches to curriculum development. Two general objectives are to view curriculum as subject matter and experiences.

1. Subject Matter

   a) Primary goal is to give children (students) information that is considered important.

   b) "Knowledge for the sake of knowledge".

   c) Produce a well-trained person.

   d) Does not necessarily produce a critically aware person.

   e) Does not teach students how to process or use information.

2. Experiences

   a) Emphasis on a process or skill to be mastered, rather than knowledge alone.

   b) Subject matter is important to know first, experiences showyou how to use this information.

   c) Teach students how to solve problems and study things in greater depth.

The best approach to curriculum design is probably a combination of subject matter and experiences. The student should learn information, but also should be able to process and use information.

3. Curriculum and Individual Differences

Individual students are different, therefore their present knowledge and capacity for learning are different. When designing curriculum, we should remember the students:

a) Level of ability

b) Home environment

c) Interest and motivation

d) Goals for the future

We cannot design the perfect curriculum for each student, but if we know more about the students and their individual differences, it will help us.

4. Decisions to Make During Curriculum Development

Some of the things that affect the decisions we make about curriculum are:

a) geographic location of the school

b) types of persons hired to teach

c) social class orientatiorof the instructor and materials

d) instructional materials available to instructor

e) cultural, intellectual, emotional and social attributes of the student

f) need to produce a "consumable product"

We should make decisions, as educators, about the following subjects:

a) goals

b) objectives

c) levels of instruction

d) how to plan a lesson

e) interactions among students (discussions, panels, etc.)

f) classroom procedures

B. FROM GOALS TO OBJECTIVES

Goals are broad statements about what we hope to accomplish in a department or a course. It is important to translate these goals into more precise, clearer guidelines for expected student output. These are objectives. Objectives are important because they tell students what knowledge and skills they will learn.

Objectives:

1. Clarify the intent of the department/course for the staff/instructor.
2. Clarify intent of the department/course for the student.
3. Make it easier to measure student achievement.
4. Make it easier to measure the effectiveness of the department/course.
5. Help to develop more effective communication systems between teachers, students, administrators and parents.

There are two levels of objectives that we use:

<u>general objectives</u> - a general statement of something toward which an effort is directed. More specific than a goal.

<u>specific objective</u> - a specific statement of something toward which an effort is directed. More specific than a general objective. Describes a performance or behavior which the student will demonstrate.

Therefore, the steps in designing curriculum are:

GOAL ⟶ GENERAL OBJECTIVE ⟶ SPECIFIC OBJECTIVE

1. <u>General Objectives</u>

   a) General objectives are useful as guidelines but are not specific enough for direct implementation (use) in a course.

   b) General objectives are usually used in a course outline.

2. <u>Specific Objectives</u>

   a) There are three elements to a specific objective,

      (1) the performance term

      (2) the elaboration of conditions

      (3) the minimum acceptable behavior

   b) Specific objectives are used when an instructor is planning each lecture.

(1) The Performance Term

Every objective must state a performance or behavior which the student will learn. We use an "action" verb that describes an observable performance or behavior. For example:

"action" verbs list, classify, define, graph, memorize, predict, rank, specify.

"non action" verbs - know, learn, understand, analyze.

In the objective, we must use a verb that is easy to evaluate at the end of the course. How can we test if a student "understands" the nutritional requirements of the three-year old child? It is much easier to test a student by saying he should "list" the nutritional requirements of the three-year old child! Words such as know, understand, etc., are usually used in general objectives.

(2) Elaboration of Conditions

Here we describe the circumstances under which the learner must perform.

Usually, conditional elements refer to:

(a) What materials may be used.

(b) How the performance may be accomplished - for example, from memory, from the textbook, etc.

(c) Time elements

(d) Location of the performance.

Examples of conditional elements of an objective are:

"From memory....."

"Within a 10-minute span of time....."

"With a compass, ruler and calculator....."

(3) Minimum Acceptable Performance

The last element of an objective is the minimum acceptable performance element.

Examples:

"..... within 2 mm ....."

"..... 8 out of 10 trials ....."

"..... in 10 seconds or less ....."

These are standards within which the student must perform.

EXAMPLES

Here are some examples of goals, general and specific objectives:

Goal	General Objective	Specific Objective
1. Increase the student's knowledge about food.	1. Know the 4 main food groups.	1. Given a list of 10 possible food groups, the student must identify the four main ones.
2. The student will recognize Indonesian nutritional deficiency diseases.	2. Learn about protein-calorie malnutrition, anemia, Vitamin A deficiency and goiter.	2. After reading the handout about nutritional deficiency diseases, list the three main problems in Indonesia and suggest at least 3 ways to solve each one.

Remember that general objectives are usually used in a course outline, and specific objectives are used to plan each lecture.

C. DEPARTMENTAL LEVEL

At the departmental level, when we are planning the emphasis of our department, we do this in a general sequence:

1. Determine the goals of the department.
2. Look at the educational background and experience of incoming students.
3. Look at the requirements of future employers.
4. Determine the knowledge and skills needed to produce the desired result.
5. Determine the objectives (general) of the department.
6. Determine the "balance" of the department. For example, is the emphasis on nutrition? Food science? Family resources?
7. Decide how many courses are needed to teach all the stated objectives.
8. Determine the sequence of courses.
9. Examine each teacher's background, interest, and time allocation to decide who teaches what.
10. Design a standard evaluation form for all courses, (Appendix 4) given at the end of the course.

D. COURSE LEVEL

At the course level, we should already have a goal for the whole course. We break this down into general objectives. This becomes your outline. Then, we divide these general objectives further into specific objectives. Then, knowing how many weeks we

have for that course, we decide how many weeks to spend on each specific objective. We should also decide what activities (trips to the village, panel discussions, etc.) to include in each lecture, and what materials (books, films, handouts, etc.) we will use in each lecture. A sample planning form is given in Appendix 5.

SUMMARY

Planning the curriculum of a department, and the content of courses, is a difficult task. However, if we organize our planning and move in a logical sequence from GOALS ⟶ GENERAL OBJECTIVES ⟶ SPECIFIC OBJECTIVES, our task becomes much easier. The goals of the Indonesian Higher Educational System, the Institut Pertanian Bogor, and Department Gizi Masyarakat dan Sumberdaya Keluarga are well known.

APPENDIX B

EVALUATION QUESTIONS

The following questions are intended to serve as a guide for preparing a description of a curriculum. This is not a complete set of curriculum and evaluation questions. These questions are intended to stimulate consideration of a variety of issues which will ultimately determine the success of the curriculum.

Curriculum planning requires that an agenda and detailed goals be set for each course in the curriculum. However, this questionnaire deals only with overall curriculum evaluation and design, and not with the details of individual courses.

This questionnaire is divided into the following sections:

I Goals

II Students

III Institutional Resources

IV The Curriculum

V Evaluation

I. GOALS

A. Overall

1. What is the overall goal of this program?

2. How many students should complete the program each year?

3. What fraction of entering students should complete the program?

B. Graduates

1. What jobs will graduates of this program hold?

2. What specific body of knowledge is needed by these people?

3. What specific information-processing skills are needed by these people?

II. STUDENTS

A. Enrollments

1. How many students are currently/initially enrolled in the program?

2. How is this expected to change over the next 5 years?

3. What fraction of entering students complete the curriculum on schedule?

4. What fraction of students complete the curriculum at a later date?

B. Student Background

1. What method is used to assess knowledge and skill levels of entering students?

2. What is the knowledge level of incoming students?

3. What is the information-processing skill level of entering students?

4. What is done to help entering students who have deficient background?

C. Student Performance and Development

For each year of the curriculum, answer the following questions:

1. What prerequisites must students have?

2. What is the level of information-processing skills expected of students?

3. How much independence is expected of students?

4. Do students have enough time available to do the required work?

5. What fraction of students successfully complete this year's work on schedule?

6. What feedback is obtained from the students regarding this portion of the curriculum?

7. Why do students fail to complete this portion of the curriculum?

III. INSTITUTIONAL RESOURCES

A. Staff

1. How many staff are currently involved in this program?

2. How many additional staff are needed?

3. What is the educational background of the staff?

4. What improvements are needed in the educational background of the staff?

5. How much staff time is available for course and curriculum development?

6. How much staff time is available for helping individual students?

7. What is being done to improve staff competency?

B. Facilities

1. What classrooms, laboratory space, practicum facilities are needed for this program?

2. What equipment and supplies are needed?

3. What library and computing resources are needed?

4. Which of the above requirements are not currently available?

5. What contributions to the curriculum can be obtained from outside the institution?

6. What is the cost of the improvements/additions needed?

C. Resources and Materials

1. What texts, manuals, etc. are needed for this program?

2. Are they available?

3. What additional materials must be obtained or developed?

D. Relation to Other Programs

1. What courses in this curriculum are shared with other curricula?

2. What other courses in this curriculum might be shared with other curricula?

3. What facilities and resources can be shared with other programs?

IV. THE CURRICULUM

A. Normal Course of Study

1. Give the title and a brief description of each of the courses in the curriculum?

2. Do appropriate goals and outlines exist for each of these courses?

3. What is the normal sequence of courses (semester by semester)?

4. How does this curriculum compare to similar curricula at other institutions and to standards set by appropriate professional societies?

B. The Nucleus of the Curriculum

1. What courses in the curriculum are required of all students?

2. What aspects of the curriculum are directly responsible for meeting the goals of the curriculum?

C. Individual Options

1. What optional courses are available to students?

2. What kinds of independent study/field work are available?

D. Progress through the Curriculum

1. How does the expected balance between student knowledge and information-processing skills change as students progress through the curriculum?

2. What courses are most important in the development of information processing skills and why?

3. What courses are particularly difficult for a significant number of students?

4. What sources of help are available to students who have trouble?

E. Changes in the Curriculum

1. Who is responsible for maintaining and modifying the curriculum?

2. What areas of the curriculum are most in need of change?

3. What plans have been made for modifying the curriculum?

V. EVALUATION

A. Information Collected

What evaluation information regarding the curriculum is collected:

1. From students?
2. From staff?
3. From the administration?
4. From graduates?
5. From the community?
6. What evaluation information is collected regarding the individual?

B. Comparison with Goals

1. How do present progress and graduation rates compare with goals?
2. What is being done to improve this?
3. How does the current curriculum compare with the curriculum goals?
4. What is being done to improve this?

C. Changes

1. What changes are most needed in the program?
2. What is being done to implement these changes?