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ABSTRACT

Eight topics relating to institution activities, project developments, and bibliography preparation are presented in this newsletter issued in December, 1972. A brief history, purposes, and functions are discussed for three centers: the Center for Unified Science Education at Ohio State University, the Environmental Education Center at Portland State University, and the Regional Center for Education in Science and Mathematics in Malaysia. Introductory descriptions are included for two colleges: the Metropolitan State College in Denver and the College of Environmental and Applied Sciences at Governors State University. Moreover, the lake restoration inventory of the Inland Lake Demonstration Project and the Science, Technology, and Society (STS) project among high schools in Maryland are introduced in connection with their sponsoring institutions and present and future developments. In the lake inventory article, an appeal is made for special assistance to gather information concerning nutrient enrichment and reservoir sedimentation. The remaining topic is related to a bibliography published as the third edition of "Science for Society." As an overall purpose, a broad view on the trends in science education is provided in this article. (CC)

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December 1972

Trends in Science Education

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Center for Unified Science Education, Ohio State University

The Center for Unified Science Education has been established to accomplish two distinct purposes. The first is to disseminate the concept of unified science education. The second is to facilitate the development of high quality unified science programs in local school districts.

The Center is located on the edge of the Ohio State University campus and was established by a grant from the National Science Foundation, Division of Pre-College Education, Program of Curriculum and Instructional Development. Additional support for Center activities comes from Ohio State University's Department of Science and Mathematics Education, the Federation for Unified Science Education, and the ERIC Center for Science, Mathematics, and Environmental Education. The Center has been in operation since June 1, 1972.

The concept of unified science education as conceived by the Center involves several basic premises:

1. The principal purpose of science education programs in grades K-14 is the development of scientific literacy in future citizens. This does not deny the public school's responsibility to provide an adequate background for those students who will pursue a career in science.

2. The most appropriate basis on which to achieve scientific literacy is that in which science is viewed as a unity. This unity can be perceived in many ways. Among these ways are: the common set of processes which are used by all the specialized sciences, the common set of values that underlie all sciences, the pervasive set of concepts that permeate all sciences, the epistemology that can be articulated for all science, and, last but not least, the fact that all natural phenomena are truly part of a single universe.

3. The best curriculum or instructional program that will enable learners to achieve scientific literacy is that program or curriculum which is developed locally; that is, by the teaching staff that will be teaching the curriculum. This does not mean that every high school science department should write, from scratch, its own instructional materials. However, it does mean that each school science staff should synthesize its program from currently available materials plus whatever locally developed materials are feasible given the usual restrictions of time and other resources.

Thus, the Center for Unified Science Education does not aim to endorse or foster the use of a given set of instructional materials, but instead aims to encourage schools to develop their own science curriculums over as wide a grade level span as is practical.

Current Center Problems

In order to achieve its mission based on the premises stated above, the Center for Unified Science Education now faces the task of solving several specific problems. The first of these problems involves a reeducation of many science teachers in the field to viewing science as a holistic humanistic endeavor. This new image of science that the Center seeks to develop will, for most teachers, involve a broader outlook on what it is that actually constitutes science. Most science teachers at the elementary, secondary, and junior college levels tend to view science as being limited to the traditional biology, chemistry, and physics which constituted the conventional science program in which they received their own general education. In the 1970s and later it will become apparent to more and more people that science extends to areas that ordinarily have not been included in general education programs. Examples of specialized sciences that contribute to the complete spectrum of science are those of experimental psychology, anthropology, space science, and many of the earth sciences.

It is reasonable to assume that the broadening of science teachers' perceptions of science and the nature of science is a necessary precondition to the development of unified science programs in the schools.

The second main problem being faced by the Center for Unified Science Education is that of developing models by which real science teachers and real schools can actually develop unified science programs given the constraints of time and other resources that are im-

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posed by one's teaching full time, nine months of the year. At the present the Center recommends an approach that is referred to as "the modular unit approach." This approach is based on the selection of a theme for a unit's work which will extend over a period of four to eight weeks. The theme may be derived from one of four principal types: persistent problems, natural phenomena, processes of science, and concepts that permeate all of the specialized sciences. Once a unit theme is determined, the next step is to select learning modules from the vast bank of learning modules that exist today. This selection should include modules or activities that utilize subject matter from many of the separate sciences and which contribute to achievement of specific objectives related to the theme or topic chosen for the overall unit. The modules or coherent chunks of learning activities are conceived as components of the overall unit much the same as electronic components are used to make an electronic device such as a television receiver. Thus, the educational modules are also subject to change in time if it is determined by classroom use that the particular modules being used are producing less than optimum results.

A total science curriculum, then, would consist of a sequence of these modular units. The modular units would be strung together in such a way that they would provide a story line or sequence in the eyes of the developing science teachers. However, it is felt that the specific sequence of modular units is not nearly so crucial as teachers once believed.

The third problem being treated by the Center for Unified Science Education is that of designing learning experiences that will enable science teachers to gain skill in putting together unified science modular units on a practical basis.

Current Center Activities

The activities of the Center for Unified Science Education in its first year of operation have been designed to provide at least first approximations of solutions to the problems identified above. One activity which is designed to have relevance for all three problem areas is that of assembling a collection of resources or working files that will be useful to science teachers in the field. One of these files is composed of science instructional materials developed and in use by various unified science programs that currently exist. A second working file contains program descriptions in the form of articles, questionnaire responses, and position papers that relate to the nearly 100 unified science programs that are known to exist. Other files include ideas for modular units, ideas for module activities within those units, and test instruments that are applicable to the concept of scientific literacy. Other activities involve developing several prototype modular units that may be used by teachers as models for their own work.

Once the resources are established, there comes the task of making them accessible to science teachers in the field. One way this is being done in the current school year is to conduct five workshop-conferences located around the nation. One workshop-conference is conducted each month for five months starting with December. The December workshop was located in Columbus, Ohio, and the January workshop in Norman, Oklahoma. The Lawrence Hall of Science in Berkeley, California, will be the site of the February workshop-conference. Manhattanville College, Westchester County, New York, will be the site of the March workshop. The concluding workshop for the year will be in April at the University of Maryland. In these workshop-conferences teachers will have an opportunity to become more familiar with the concept of unified science education as well as to participate in learning activities to develop individual skills in designing modular units and initiating unified science programs.

Certain components of the regional workshop-conferences will be packaged and loaned by mail for use by local science teacher groups. These packages will be called "Remote Workshops" and will be announced as they become available. Specific "Remote Workshops" currently in developmental stages are "What Is Unified Science Education?," "Testing and Evaluation Procedures for Unified Science Program Development," and "Strategies for Initiating Unified Science Program Projects in Local School Districts."

Working visits by school science groups to the Center for Unified Science Education are encouraged as a very effective way of utilizing the Center's resources.

The Center also prepares and distributes specialized documents relevant to unified science education. For example, currently available are a collection of abstracts of unified science programs, a collection of abstracts of research and evaluative studies related to unified science programs, and a collection of abstracts of unified science instructional materials.

Short articles dealing with unified science education and descriptions of Center services and resources as they become available are reported in *Prism II* which is published quarterly and is available to interested science teachers and educators on request. Such requests should be addressed to: Center for Unified Science Education, Ohio State University, 1460 West Lane Avenue, Columbus, Ohio 43221.—VICTOR M. SHOWALTER, *Director.*

Science for Society: A Bibliography

The third edition of *Science for Society: A Bibliography* is now available. The bibliography is prepared for secondary school teachers and students of science and social studies, for college and graduate teachers and students of the natural and social sciences, and for lay groups interested in science-society issues. It is offered as an aid to all who are concerned with the social problems that have arisen from scientific and technological advances. The references are about evenly divided between books and periodical literature. There are a total of some 4,000 entries including 2,500 new entries. A new feature of this edition is the marking of "key" references with an asterisk. A starred entry

is intended as a suggested starting point for reading and obtaining further references on the topic.

The bibliography is priced at $1.00 per copy, or 75 cents each for ten or more copies. Orders totaling $5.00 or less must be accompanied by remittance. Orders should be addressed to: American Association for the Advancement of Science, Department SF, 1515 Massachusetts Avenue, N.W., Washington, D. C. 20005.

Portland's Environmental Education Center

The Environmental Education Center was funded in July 1971 under the Environmental Education Act (USOE) and is a cooperative project of Portland (Oregon) Public Schools and the Education Department of Portland State University. It is located at the university and is designed to serve people of all ages and walks of life in the surrounding tri-county area.

The EEC is housed on the fourth floor of a building located in an area where there is a critical parking problem. It was felt that this handicap could be overcome if the Center's environment was made unusually attractive and its services easily available through self-learning materials. The many hours needed to evolve the Center design were contributed by seven architects from Skidmore, Owings and Merrill. The building and implementing of the Center was largely accomplished with donated materials and involved hundreds of hours of volunteer time by a wide assortment of people.

The Center's two main goals are to

1. *Stimulate action*
   - by helping people of all ages to know about environmental problems and the alternative solutions to them.
   - by helping to motivate people to *do* something to alleviate these problems.
2. *Provide access*
   - to information, agencies, organizations, people, and resources that will assist people in their work concerning environmental issues.

The following services were developed to fulfill these goals and are available for use through the Center.

1. *Sources of information in the form of*
   - temporary displays created by volunteers.
   - permanent charts locating environmental agencies, bicycle paths, structure of agencies, field trips, and so on.
   - files that refer the user to environmental groups that have information on pollution, land use, transportation, recreation, city planning, consumer concerns, population, and so on. The files describe whether the information is printed in brochure form or in abstracts, whether speakers or films are available, and whether telephone information is given.
   - file of gatekeepers (key people in organizations) who will help people with their environmental concerns.

Entrance to Portland's Environmental Education Center.

   - handouts about issues and concerns available at the give-and-take rack.
   - collections of games, simulations, futures materials, curriculum kits, bulletins, newsletters, exemplary environmental proposals, and sources of materials categorized on open shelves.
2. *Video tape porta-pak equipment for use to*
   - help groups or individuals in dealing with local environmental issues by assisting them in making their own tapes about the problem.
   - bring awareness to the community by showing video tapes to groups and at meetings.
3. *The EEC's staff and friends will serve as environmental consultants on*
   - proposal ideas, funding sources, and strategies.
   - community action.
   - career and educational opportunities pertaining to environmental concerns.

4. *The EEC's facilities may also be used by*
   - contacting us about the availability for meeting, workshop, and laboratory space for individuals and groups.
   - browsing/studying/researching on a drop-in or an arranged basis.
   - "people mixing" in many informal ways.

The Center had its formal opening in March 1972. Since that time visitors, workers, and volunteers have increased steadily. Last month, in round numbers, the Center had 1,400 visitors. There were 38 groups ranging from World Future Society to preschoolers, from a university poetry class to a teen-age church group meeting there. The phone rang 500 times with a wide range of requests. Center helpers served 325 hours and included Neighborhood Youth Corps, College Work-Study students, Junior Leaguers, Explorers, and high school students. Also contributing were college students obtaining credit for working on projects in City Hall, County Commissioners' offices, Portland Forest Park, and in the Center itself where they helped devise a self-learning lab apparatus. In fact, since there are only two staff members paid by the grant, we were in the unusual position of not using all the help that was available.

The Center is now being expanded from 2,000 to 5,000 square feet. An Explorer group working under the leadership of some of the architects in the previously mentioned organization are planning the design. This should help to continue the increase in community and student participation which the Center is enjoying. —DONALD W. STOTLER, *Director.*

Staff member Laura Williamson uses self-learning display of 156 environmental agencies in tri-county area, Portland's Environmental Education Center.

Science, Technology, and Society Project

This past summer eight high school students, eleven secondary science or social studies teachers, and Richard G. Netzel of the AAAS staff worked at Winston Churchill High School in Potomac, Maryland, on the development of learning materials as part of the Science, Technology, and Society (STS) project jointly sponsored by the AAAS Commission on Science Education and the Montgomery County (Maryland) Public Schools. AAAS provided eight consultants to the curriculum development workshop.

In a three-day planning conference held during the 1972 spring holiday, teachers and students elected six topics for initial development in the summer workshop:

Aging and Death
Genetic Engineering and Society
Technology, Work, and Leisure
Science, Technology, War, and the Arms Race
Science, Technology, and Privacy
Science, Technology, Mathematics, and the Arts

The first five were selected because they raised complex, controversial issues of high interest to students. The sixth, in the words of its authors, "is designed to raise not controversy but consciousness."

The STS planning group also developed a model for the learning modules designed to provide maximum ease and flexibility for the teacher and to support the teacher and students as decision-makers. Each module consists of a number of teacher-initiated starting activities that will help students to define the particular science, technology, and society issue, to propose tentative solutions to the problems involved, and to suggest lines of inquiry that might be required. The class materials necessary for these activities are to be provided in the module. The teacher may choose activities for a two- to five-day study of the issue and conclude after this brief exploration of it.

Each module will also contain an "Activity Array" that will assist students and teachers who wish to pursue a more in-depth study of an issue. The Activity Array for each module will consist of 25-50 activities that students may carry out individually or in small groups. Suggested activities include laboratory experiments, community surveys, interviews with public officials, simulations, community education or action projects, and art projects. If time permits, the teacher may encourage every member of a class to engage in one or more activities. Alternatively, individuals or small groups of students may pursue these studies independently. Students are provided guidance so that they will be able to pursue the activities with a minimum of teacher help and supervision.

Another integral part of the curriculum design is the development of a research handbook that will help students design research projects and give them specific information on six social science research methods: observer, participant-observer, survey, structured interview, unstructured interview, and simulation.

Elements of this project will be field tested in selected Montgomery County schools next spring and refined and further developed in a second writing conference planned for the summer of 1973. Materials developed in this project are not available at this time.—NANCY HOON, *Curriculum Coordinator, Montgomery County Schools, Maryland.*

Metropolitan State College

In 1965 the Centennial State's legislature allocated funds to open Colorado's only four-year state-supported urban college providing both liberal arts and career education for the swelling student population in the area. That year Metropolitan State College (MSC) of Denver opened its doors to 1,189 students staffed with a faculty of 34. Today Metro is the fourth largest college in the state with a student body of over 8,700 and a faculty of more than 260. Further, it is already recognized as a quality educational institution.

The concrete campus of MSC is sprawled out over 350,000 square feet of leased space in 18 buildings. The proximity to the downtown business area allows many students to pursue their education while maintaining employment. Eighty-five percent of the student body work and twenty-five percent carry less than 7 hours. At fall registration the full-time equivalent student count was just under 6,700 illustrating the growing number of Denver residents taking a part-time load in an effort to increase their professional and vocational competency. The urban student body is substantially different in nature from the standard residential college. The average age of the MSC student is just over 25 years, approximately 22 percent of them are veterans, and the number of minority students continues to increase. First generation college students of all ages see for the first time a chance to achieve upward economic mobility.

"Metro's basic concept of operation," according to James D. Palmer, MSC president, "is complete involvement with the city, its people and its problems." According to Palmer, the urban institution today is coming to grips with the commitment of equal educational opportunity for people of all backgrounds, particularly the urban disadvantaged. It is to this ignored segment of the population that Metro is addressing itself.

Skills development assistance, advisement programs, tutorials, field experiences, individualized instruction, personal development seminars, credit by examination, and internships are a few of the distinctive learning modes that are working well with the nontraditional student. The Metro Skills Center has human and physical resources to develop courses and tutorial and advisement programs to help men and women of all ages to overcome educational handicaps. Career ladder opportunities are being expanded through new approaches to

Students outside of the Forum Building, headquarters for Metropolitan State College, Denver. Colorado State Capitol is in background.

curriculum development and by careful articulation of the associate and baccalaureate degree programs. In addition, traditional patterns of study impacting the bulk of the student body are developing around new career programs aimed at satisfying definite urban needs.

In keeping with its constant expansion trend, Metropolitan State College is currently partner in one of the most innovative concepts in the United States—the Auraria Higher Education Center. The college will join two other institutions of higher learning, the Community College of Denver and the University of Colorado Denver Center, to offer a full spectrum of educational opportunity to the commuter student on a single campus in the heart of metropolitan Denver. Auraria is scheduled to be in full operation by 1976. A common calendar, library, cross-registration, equivalent course development, and faculty exchanges are a few of the cooperative arrangements planned for the Center.

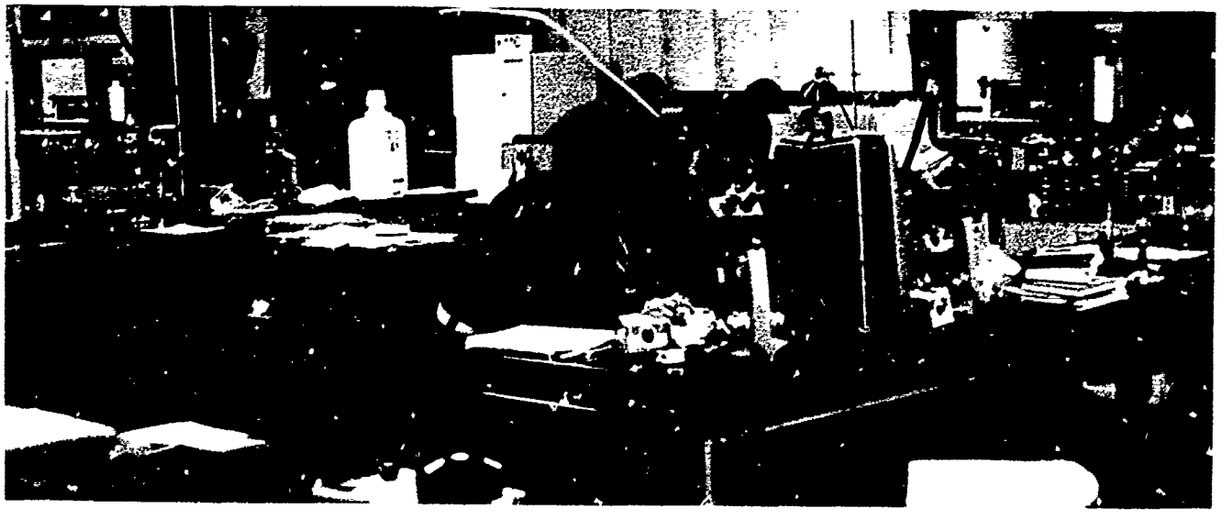
"Even in a decade of disenchantment with higher education," says Dr. Palmer, "the future of Metro is brighter than ever. Although we haven't turned our backs on the pure academic, we are emphasizing a realistic education that prepares our students for specific career opportunities. As a result, our graduates have a clear notion of their future. They become an integral part of the communities in which they live and work just as Metropolitan State College has become an integral part of the total human services delivery system."—RICHARD G. NETZEL, *Vice President for Academic Affairs.*

College of Environmental and Applied Sciences at Governors State University

Governors State University was established by the General Assembly of the State of Illinois in July 1969 as a senior-division university. It was mandated to offer baccalaureate and masters degrees, to be experimenting and innovative, serving middle- and lower-income students primarily from community colleges within commuting distance. Beginning in September 1969, an administrative faculty team of six persons and numerous consultants established broad-gauged educational planning guidelines for the university. A 753-acre campus was purchased in Will County about 30 miles south of the Chicago loop. Preliminary plans for Phase I of the permanent building, a 300,000 square foot modular structure, were developed.

The university is comprised of three wings, each headed by a vice-president: (1) academic, (2) research and innovation, and (3) administration. There are four colleges: (1) Cultural Studies, (2) Business and Public Service, (3) Human Learning and Development, and (4) Environmental and Applied Sciences. In addition to the president and three vice-presidents, there is a dean of each college and a director of each of the eight support units (library, computer services, instructional communication, etc.).

The College of Environmental and Applied Sciences (CEAS) offers the Bachelor of Arts and Master of Arts in Environmental Science. There are three instructional programs—science, science teaching, and health science—but no discipline-oriented departments. Areas of emphasis within the science program are: interdisciplinary science, environmental technology, and human ecology. Health science has emphasis in health science education, administration, and practice. The science teaching program emphases are: elementary, secondary, and community college teaching of environmental science. The areas of emphasis were planned to produce graduates with occupational orientations such as environmental analysis, environmental planning, environmental managing, environmental law, human ecology, nursing education, nursing administration, environmen-



Open laboratory in interim facility showing stations with quick disconnect utilities, Governors State University.

tal health, education and administration in various allied health fields, environmental conservation, environmental education, environmental science teaching, and the like. Each of the areas of emphasis and occupational-oriented studies have specified expected terminal competencies that are performance-based. There are no grades. The transcript is a print-out of student competencies that are performance-based. Employers in businesses and industries like the transcript; it has to be explained to graduate schools.

Commons area, interim campus, Governors State University.

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A faculty of six—ecologist, geologist, science educator, physiologist, health planner, and biochemist—comprised the CEAS faculty during 1970-71. This group, with assistance of consultants, developed preliminary plans for the instructional programs and planned the physical facilities for the interim campus and Phase I of the permanent facilities. During this planning year, 11 additional faculty members were employed to aid in additional planning during the summer of 1971 and to implement the instructional programs.

In September 1971, the University opened in a 2½-acre warehouse which is serving as an interim campus for two years while the permanent campus facility is being built. During the first year, which consisted of six 2-month sessions, about 650 students were registered. Of these about 150 were registered in CEAS. Full-time equivalent students equaled about 75 percent of head-count. The average age of the CEAS students was 29 years. About half of the students were registered in health science (nursing education and administration) and the others equally divided between science and science teaching. During the spring of 1971, 11 additional faculty members were employed to begin work in July, August, or September.

The registration of students in September 1972 was about 1,300 in the University, with about 260 in CEAS. In the November-December session, 1,385 were registered in the University, with 289 in CEAS. The distribution by age, sex, and ethnic background remained about as in 1971. The faculty of 26, including life scientists, physical scientists, behavioral scientists, health scientists, social scientists, urban planners, and science educators, is planning, developing, and implementing learning modules (competency-based instructional packages), designing and developing curriculum in the various areas of emphasis, and developing master plans for instruction, research, and community service—each of which is supportive of the other.

Cooperative education is an integral component of the instructional program. The student is gainfully employed and a learning module is designed around the work experience. Hence the student obtains credit and wages. Twenty-five students participated in the cooperative education program during 1971-72. We expect to have about 20 percent of the students in cooperative education on the average throughout the year in the future.

As planned, new students are enrolling and others are graduating in each session. The first five students graduated in June and two students, one with bachelors and one with masters, graduated at the close of the September-October 1972 session. Others will graduate at various times during 1972-73 and thereafter.

In July 1970, the University received Correspondent Status with the North Central Association. Application has been made for Recognized Candidate for Accreditation. The on-site visitation team has been selected and will make its visit in December 1972. The University looks forward to full accreditation in late 1973 or early 1974.

Projections for 1973-74 call for a CEAS professional staff of 45, including administrators and faculty, and a student registration of about 400 full-time equivalent. University enrollment projections call for 2,000 in 1973-74, with an increase of about 1,000 per year until an enrollment of 6,000 is reached. It is anticipated that about 20 percent of the University enrollment will be in CEAS. When a college reaches an enrollment of 1,200-1,500, it is anticipated that a new college or some other educational unit will be developed.—TED F. ANDREWS, *Dean, College of Environmental and Applied Sciences.*

Lake Restoration Inventory

An inventory and assessment of the status of lake restoration activities worldwide has been initiated by the Inland Lake Demonstration Project, a joint venture of the University of Wisconsin and the Wisconsin Department of Natural Resources. The final report (due in June 1973) will include a review of lake restoration experiences and a comprehensive bibliography. Future lake restoration programs and related research should be greatly aided by this report.

Preparation of the report will require the assistance of every agency and individual involved in lake restoration. Information is desired concerning any activity initiated to remedy or prevent problems caused by nutrient enrichment and/or sedimentation of a lake or reservoir; this activity may be in the area of research or management. Anyone acquainted with a past or current lake restoration project is requested to contact Russell Dunst, Inland Lake Demonstration Project, 215 N. Brooks Street, Madison, Wisconsin 53706, U.S.A. (telephone: 608-262-3454) for further details. All contributors will be acknowledged and furnished a copy of the completed report.

RECSAM

Improvement of education in science and mathematics in eight southeast Asian countries is the mission of the Regional Center for Education in Science and Mathematics (RECSAM) in Malaysia. RECSAM serves a catalytic role in modernizing the teaching of science and mathematics in elementary and secondary schools and in teacher training colleges in the southeast Asian region.

Educators from schools and colleges go to RECSAM to attend three-month-long courses on modern methods of teaching science and mathematics, and then return to their home countries where it is expected that they will stimulate the improvement of teaching in various ways including curriculum development and preservice and inservice teacher education.

At RECSAM the educators work with materials that have been produced by U.S. and British curriculum development projects as well as some southeast Asian materials such as the elementary science and biology programs developed at the National Science Center, University of the Philippines. The emphasis in the RECSAM courses is on "learning by doing" rather than from lectures, which is the traditional mode of instruction in southeast Asia (as it is in most of the world). Participants in the courses are urged to consider how active modes of learning can be applied to education in their countries.

RECSAM is the science and mathematics education center of SEAMEO (the Southeast Asia Ministers of Education Organization). There are eight member countries of SEAMEO—Indonesia, Khmer Republic, Laos, Malaysia, Singapore, Thailand, and South Vietnam. Since RECSAM began a full-scale training program in 1970, several hundred educators from the SEAMEO countries have attended courses at RECSAM.

RECSAM is one of the six centers that operate under the aegis of SEAMEO. The other five centers include an English language center in Singapore and a center for graduate study in agriculture at the University of Los Banos in the Philippines. Half of the operating costs of each center are provided by the member country and the remainder by the U.S. Government through USAID.

In addition to its training function, RECSAM is concerned with research in science and mathematics education in the SEAMEO region. The research activities so far have been limited to a few planning conferences and short courses.

In the next few years RECSAM will establish a clearinghouse of information and will provide bibliographies and other special services to education in southeast Asian countries.

Two of the nine members of the International Advisory Council of RECSAM are Bentley Glass, Professor of Biology, SUNY, Stony Brook, New York, and Marshall Stone, Professor of Mathematics at the University of Massachusetts. Arthur Livermore, Deputy Director of Education, AAAS, served as training advisor at RECSAM from February 1971 to June 1972.

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