LABORATORY ACTIVITIES FOR STUDENTS OF UNIVERSITAS TERBUKA INDONESIA

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Abstract

One of the characteristics of the Department of Mathematics and Science Education, Faculty of Education and Teacher Training, Universitas Terbuka Indonesia, is the need of laboratory activities for some courses offered to students. Regular universities or universities with face to face interaction have no problems regarding this. But, laboratory activities for students of Universities Terbuka using distance education face many problems.

Since the year of 2002, Department of Mathematics and Science Education has been trying to implement networking models for laboratory activities for their students. Ten regional offices were used as pilot project for the implementation of the networking models for laboratory activities. Study showed that there were many problem occurred in the implementation of the networking models, such as: 1) some students especially who live in remote areas find it difficult to locate laboratory that fit the criteria of good laboratory; 2) the number of students among regional offices (UPBJJ-UT) vary; 3) the amount of money spent by students to conduct laboratory tend to be a lot; 4) lack of coordination among regional offices, UT center, and host universities which have laboratories.

The networking models for laboratory activities have been developed by promoting regional offices as a center of laboratory activities. This means regional offices control coordination among students, host institutions, and UT central offices. This article also discussed the characteristic of modules for laboratory activities of the Departments of Mathematics and Science Education, components of networking of laboratory activities, and problems in implementing networking models of laboratory activities and how to solve them.

Key words: networking, laboratory activities, distance education, component of networking models

I. Introduction

Universitas Terbuka (UT) founding was based on the decree of the President of the Republic of Indonesia (Keppres No. 41 year 1984). Some considerations why UT established were to increase the availability of colleges that are able to handle higher education in remote areas in Indonesia. Other consideration was to improve the quantity and the quality of well educated resources for the national development and give a chance to educators to continue their education without leaving their schools or offices.

UT is a public university with the use of distance education. Until the year of 2004, UT has 35 regional offices which are spread out all over Indonesia. Actually, one province has one regional office, but for some cases one province can has more than one regional office. Almost all of regional offices located close to the host institution. Meanwhile, only a few of UT students live in big cities, most of them live in remote area of Indonesia from Sabang to Merauke. Location of regional offices is shown below.

Figure 1. Map of UT Operational Network

UT was established based on two big issues: low capacity of university, and low quality of teachers. For the easier operation, UT was designed as a university with networking system which covered all of state university in Indonesia. With this networking system, UT can use the facilities of the university as well laboratories from private universities close to the regional offices all over Indonesia.

In the distance education, learning materials has to be self contained. Learning materials is divided into main component of learning materials and complement of learning materials component. Main component of learning materials is in the form of printed materials or modules. In the other hand, complement of main learning materials is in the form of printed and non printed materials.

Some courses offered by UT are practical courses. Students who take practical courses need to conduct laboratory activities under supervision of instructor. Laboratory activities can be done individually or in a group by using kit saints or laboratory belong to host institutions located close to the regional offices, (Catalog UT 2004, p. 21).

Especially for practical courses, UT has already made practical courses containing certain topics that need laboratory activities, procedure of each experiment, and observation sheet. The main purpose of systematic practical courses was to make students conducting laboratory activities in an easier and more systematic ways.

Science laboratory activities required by certain courses in the Departments of Mathematics and Science Education of Faculty of Teacher Training Universitas Terbuka and Faculty of Mathematics and Natural Sciences. In the conventional universities (universities with face to face interaction), there is no big problem for the instructor as well as for students in conducting laboratory activities.

The implementation of science laboratory activities by using laboratory facilities located close to regional offices that were not simple as what has already planned by staff of UT's center at Jakarta. Science laboratory activities for UT's students face many problems. These problems can be mentioned: 1) the availability of representative laboratories to conduct laboratory activities, 2) the various number of students who conduct science laboratory in regional offices, and 3) lack of coordination among students, instructors, regional office staff and central office staff of Universitas Terbuka, (Report on the study of laboratory networking, Department of Educational Mathematics and Science, 2000).

Since the year of 2002, the Department of Mathematics and Science Education of the Faculty of Teacher Training tried to solve the problems in science laboratory activities by using networking models. The networking or collaboration with public universities located close to the regional offices is conducted in almost all big Indonesian cities from Sabang to Merauke. The study on the networking model in 10 regional offices showed that there were difficulties faced in implementing a networking model for the laboratory activities such as: the differences of perception among the people, staff of each institution, and lack of science staff as well as science equipment, location of students, and so on.

II. The Nature of Science and Laboratory Activities

Science is knowledge gained through experience. Science is also any activities that appear to require study and method. Science is any methodological activities discipline or study. Science is the observation, identification, and theoretical explanations of natural phenomena. (Nelson, 1984).

Laboratory mean: 1) a building, part of building, or other place equipped to conduct scientific experiments, tests, investigating, etc., …; 2) any place, situation, set of conditions, or the like, conductive to experimentation, investigation, observation, etc., anything suggestive of scientific laboratory; … (*Random House Webster's, 2000*).

In general, laboratory has functions as a place: 1) to conduct laboratory activities and understanding concepts which has already studied in class; 2) to strengthen knowledge as well as to discover new concepts and principals; 3) to develop methods in teaching science; and 4) to conduct research not only on the field of knowledge but also on the delivery methods.

There are a lot of goals that can be achieved by using laboratory activities in teaching learning process, they are: 1) to study between theory in the class with the result of laboratory activities; 2) laboratory activities with function as a duplicative activities; 3) verifications activities or proving that data collected by scientist is the same with those by other people; 4) laboratory activities as an explorative functions by following certain steps there are: identifying problems, formulating main problems, making hypothesis, conducting experiments, analyzing data, making conclusions.

Old proverb says that: ”I hear and I forget, I see and I remember, I do and I understand”. From this proverb, it is clear that science is supposed to be taught as a process. Feeling to see the light from a flashlight is different with observing how to make an electrical circuit works. The later is a process of science. Furthermore, Solomon (1994) explains that learning science is about doing experiments.

In actual practice, what is known in science is inseparably linked to the methods of investigation. Knowing science is more than knowing content, it also means knowing how to gather evidence, and how to relate the evidence to interpretations. Science process skills have been called life long learning skills, as they can be used for daily living and for learning in school in any subject area. A well-known proverb advises, "*Give a man a fish and he eats for a day. Teach him how to fish and he eats for a lifetime*".

II.1. Study Program Needed Laboratory Activities at UT

Universitas Terbuka (UT) has Faculty of Mathematics and Natural Sciences and Department of Mathematics and Science Education Faculty of Teacher Training has a consequence to develop knowledge on Mathematics and Science. One requirement of exacts science is the need of laboratory activities.

Laboratory activities are activities conducted by students guided to: 1) have enough skills in using science equipment; 2) understand and know how to use science equipment; and 3) understand science concepts as well as science principels by experimenting in laboratory.

Until the year of 2004, program study obliges their students to conduct practical work and the number of students who enrolled in the following program.

a. Faculty of Mathematics and Natural Sciences (FMIPA):
   Study Program S1 Biology
   Study Program DIII Agriculture Field Worker (Penyuluh Pertanian)
   Certificate Program Post Harvest (Pasca Panen)

b. Faculty of Teacher Training:
   Study Program of S1 Biology Education
   Study Program of S1 Physics Education
   Study Program of S1 Chemistry Education
   Study Program of S1 Teacher Training
   Study Program of D III Science Education
   Study Program of DII Teacher Training

The number of students register for practical courses about 15911 students (Puskom UT, 2004)

II.2. The Implementation of Networking Models for Practical Work Department of Mathematics and Science Faculty of Teacher Training

One of characteristics of Departments of Mathematics and Science of Faculty of Education Universitas Terbuka Indonesia is the need of science laboratory activities for some courses offered. In the conventional universities (university with face to face interaction), there is no big problem for the instructor as well for the students in conducting laboratories activities. On the contrary, students of Universitas Terbuka with the use of distance learning, science laboratory activities for students faced many problems such as: the availability of representative laboratories to conduct laboratory activities, lack of equipments, variety of number of student who conduct science laboratory among regional offices, and lack of coordination among students, instructors, regional office staff and center of Universitas Terbuka.

Program Studies in the Department of Mathematics and Science was opened since 1984. Before registration period of 1990.1, laboratory activities was not compulsory for students. But, by registration periods of 1990.1 and later, laboratory activities should be conducted by students. List of activities can be shown in the practical courses. Laboratory activities can be done individually or in group. At the end, students sent their practical report to the Faculty of Teacher Training UT center office to be evaluated.

Since the year 2002, with the support of Program of Semi Quality Undergraduate Education (Semi-QUE IV), Department of Mathematics and Science Education Faculty of Teacher Training has been trying to solve problems in science laboratory activities for students by using networking or collaboration with public universities located close to the regional offices spread out all over big Indonesia cities from Sabang to Merauke (from Sumatera island into Irian Jaya island).

Study from pilot project in 10 regional offices show that there are difficulties faced in implementing networking model of practical activities such as: the differences of perception among the people, lack of staff or institution familiar with networking models, and/or science as well as science equipments, various locations of students, and so on.

The networking models for laboratory activities have been developed by promoting regional offices as a center of laboratory activities. That mean that regional offices control coordination among students, host institutions, and UT central office. Models of networking involve: students, regional offices staff, instructors, counterparts, and central UT staff.

1. Students.
   Students are the students who registered for one of practical courses.
   (PIPA3228, PIPA3342, PABI4448, PAKI4448, or PAFI4445).
2. Regional Offices Staff.
   Regional offices staff coordinate all activities starting with preparation, implementation, and monitoring & evaluation laboratory activities for students under coordination of student's registration at regional offices.
3. Instructors
   Instructors are lecturers from local universities (public or private universities) who are eligible as an instructor. Instructors must help students who have problems in preparing equipment as well as in conducting experiment, and evaluating the process of practical activities.

4. Counterparts.
   Counterparts are public as well private universities or other institutions which has laboratories.
5. Central Office of Universitas Terbuka
   Universitas Terbuka central staffs are staff from Department of Mathematics and Science who are eligible to evaluate students report

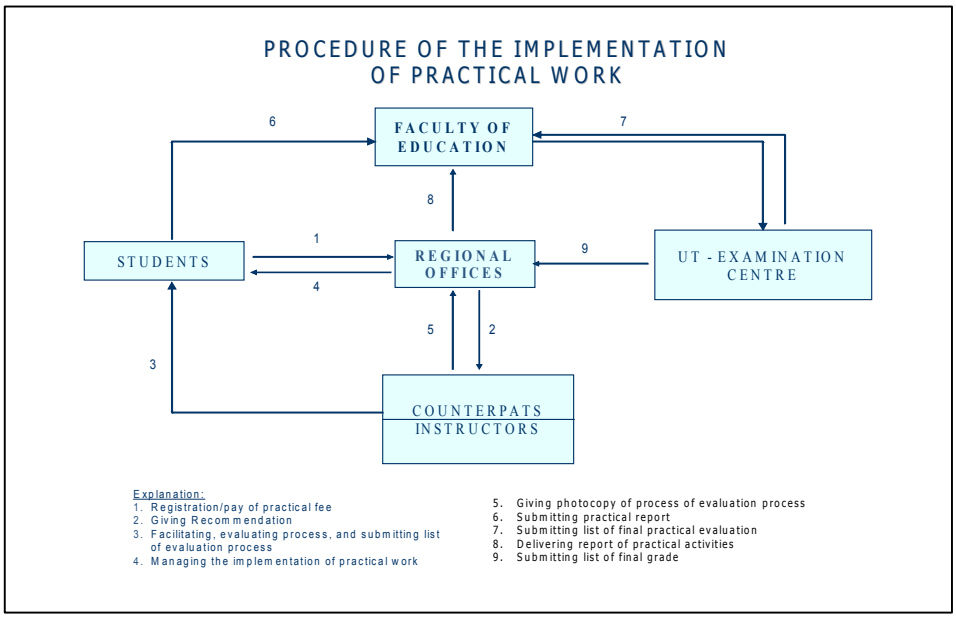


Figure 2. Procedure of the Implementation of Practical Work

Managerial Activities

Managerial aspects of laboratory activities include: 1) preparation, 2) implementation, 3) monitoring and evaluation.

1. Preparation.
   Student must follow step by step activities before conducting laboratory activities They are: 1) registration the practical courses; 2) contacting regional offices staff; 3) paying amount of money; 4) reading practical guidance; 5) reading practical courses/modules.
   Meanwhile, regional offices staff are responsible to: 1) make list of students who will take a practical work and grouping them for Biology, Chemistry, and Physics; 2) read practical guidance; 3) contact counterparts; 4) contact instructors for a specific subject; 5) arrange time schedule; 6) calculate the amount of money for students to pay; 7) socialize all students about the new system of practical work.
2. Implementation
   The task of students before conducting laboratory activities are: 1) preparing equipments needed for practical work with the attendance of instructors; 2) doing all of topics for practical activities; 3) making report of the whole activities they have done; 4) sending practical final report to the central UT office; 5) notifying regional offices; 6) paying the amount of money for the whole activities.
   Regional offices staff are responsible for: 1) informing all student who will conduct laboratory activities; 2) coordinating practical activities; 3) calculating the amount of

money for the whole activities; 4) collecting copy of letter from students; 5) giving a license to instructors who are eligible for a certain subjects; 6) announcing final grade for students who take practical work.

The task of instructors are: 1) studying practical guidance; 2) studying and understanding practical courses; 3) guiding students in preparing, implementing, and making practical report; 4) evaluating process of practical activities; 5) grading students activities; 6) making a list of grade of students.

Counterparts are responsible for: 1) preparing facilities (equipments, tools, Kit) for practical activities; 2) preparing instructors for the certain subjects (Biology, Physics, Chemistry); 3) giving recommendation letter for students who had done the practical activities.

Central office Universitas Terbuka staff has to: 1) collect final report from students from post office; 2) check and giving grade for students report; 3) combine grade for process (30%) and final report (70%); 4) make a list of grade for all students to the evaluating unit at central office.

3. Monitoring and Evaluation

Monitoring and evaluation is conducting by regional offices staff and central office staff. Monitoring and evaluation include: 1) preparation of practical work; 2) managerial aspect of practical work; 3) practical activities for students in laboratories; 4) relevancies of practical activities with a practical courses; and 5) background of instructors. Regional offices staff conducts intensive monitoring and evaluation. Meanwhile, central office staff conduct monitoring and evaluation not as intensive as regional offices staff.

The realization of the implementation of networking models for practical work can be shown as in the table below.

Table 1. The realization of the implementation of networking models for practical work by the year of 2002 and 2003

No	Activity	Base Line	Year of 2002		Year of 2003		Information
			Target	Result	Target	Result	
1	2	3	4	5	6	7	8
1.	Socialization of guidance of the Implementation of Practical Work	Unsystematic regulation of practical work	Students from 5 regional offices conducted practical work followed guidance of networking models of the year of *2002*	Students from 5 regional offices conducted practical work followed guidance of networking models of the year of *2002*	Students from 10 regional offices conducted practical work followed guidance of networking models of the year of *2003*	Students from 10 regional offices conducted practical work followed guidance of networking models of the year of *2003*	*Target was fulfilled even though some problems arised and in the 2004 and later the networking models can be implemented in all regional offices*
2.	Implementing networking models for practical	Students conducted practical work in their school lab. Or other lab.	Systematic coordination of the implementation of networking	5 regional offices have been implementing coordina-	Systematic coordination of the implementation of networking	10 regional offices have been implementing coordination of practical	*Target was fulfilled even though faced some problems.*

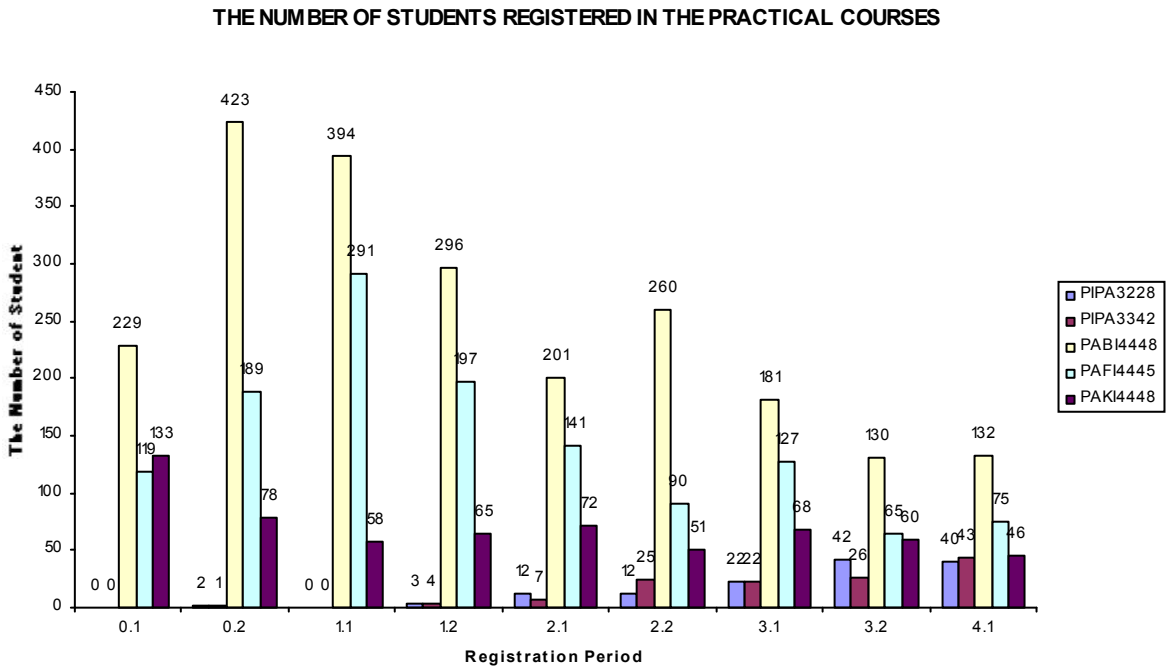
No	Activity	Base Line	Year of 2002		Year of 2003		Information
			Target	Result	Target	Result	
1	2	3	4	5	6	7	8
	work	Without coordination from regional offices/UT central offices	models for practical work	tion of practical work based on guidance of networking models of the year of *2002*	models for practical work	work based on guidance of networking models of the year of *2003*	
		Scored on practical courses: A (5, 78%), B (57, 76%), C (26, 71%), F (9, 75%)	Scored on practical courses: A (10%), B (60%), C (25%), F (5%)	Scored on practical courses: A (0, 91%), B (23, 64%), C (36, 82%), TL (38, 63%)	Scored on practical courses: A (10%), B (60%), C (25%), TL (5%)	Scored on practical courses: A (3, 07%), B (29, 89%), C (22, 07%), TL (44, 97%)	*Target can not be fulfilled because criteria used for scoring is not clear*
		2 manuscript of video for practical work (IPA 1 and IPA 2) ready to produce	2 videos for practical work (IPA 1 and IPA 2) ready to use by students and 3 manuscript of video for practical work (Biology III, Physics III, Chemistry 3) be filmed	2 videos for practical work (IPA 1 and IPA 2) ready to use by students and 3 manuscript of video for practical work (Biology III, Physics III, Chemistry 3) ready to produce	3 videos for practical work (Biology III, Physics III, Chemistry 3) ready to use by students	3 videos for practical work (Biology III, Physics III, Chemistry 3) ready to use by students	*Target was fulfilled 5 videos program* (IPA 1, IPA 2, Biology III, Physics III, and Chemistry 3) *have already been used by students*
3.	Monitoring and Evaluation of the implementation of practical courses (IPA 1, IPA 2, Biology III, Physics III, and Chemistry 3)	M&E conducted by using telephone, mail, facsimile, and about 5%-10% of the problems can be solved	About 60% problems on the implementation of practical work can be solved	About 60% problems on the implementation of practical work can be solved	About 70% problems on the implementation of practical work can be solved	About 70% problems on the implementation of practical work can be solved	*Target was fulfilled even though extensive coordination of the implementation of practical work must be done*

(Source of Final Report of Program Semi Que IV, 2003)

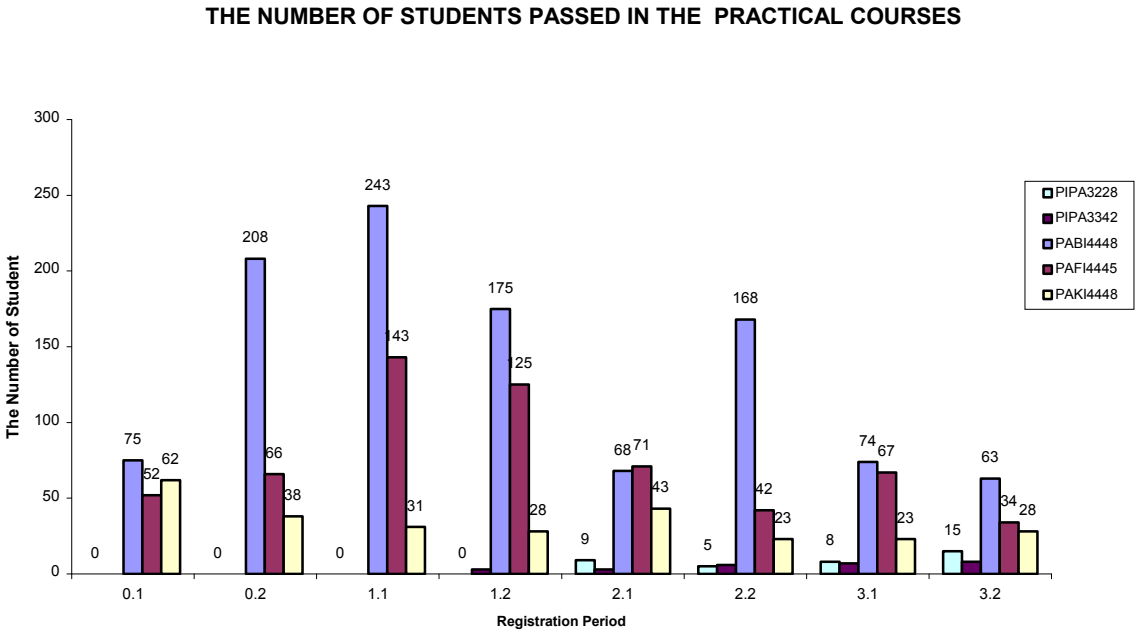
Students who Registered and Passed Practical Courses on the Department of Mathematics and Science Faculty of Teacher Training Registration Periods of 2000.1 through 2003.2

Every student who takes practical courses must register and send their practical report to Faculty of Teacher Training UT's center offices to be evaluated. Students passed practical courses if they passed the entire requirement. The table below depict the number of students who registered and passed practical courses from all regional offices spread out all over Indonesia.

Courses Code	Number of Students							
	2000.1	2000.2	2001.1	2001.2	2002.1	2002.2	2003.1	2003.2
PIPA3228	0	2	0	3	12	12	22	42
PIPA3342	0	1	0	4	7	25	22	26
PABI4448	229	423	394	296	201	260	181	130
PAFI4445	119	189	291	197	141	90	127	65
PAKI4448	133	78	58	65	72	51	68	60



Course Code	Students Passed the Practical Courses							
	2000.1	2000.2	2001.1	2001.2	2002.1	2002.2	2003.1	2003.2
PIPA3228	0	0	0	0	9	5	8	15
PIPA3342	0	0	0	3	3	6	7	8
PABI4448	75	208	243	175	68	168	74	63
PAFI4445	52	66	143	125	71	42	67	34
PAKI4448	62	38	31	28	43	23	23	28



II.3. Structuring Sentra for Practical Work as an Effort to Improve Quality of the Implementation of the Practical Work

Practical work is a kind of learning process. With these activities, students are expected to have knowledge, attitudes, and skills to work as a teacher. Until today practical work has not been implemented properly. A recent study show that: 1) practical work that is not fully under control of regional offices as well as UT'center staff; 2) not all of practical activities conducted by students relevant with the practical's topics on the modules; 3) geographical constraint and the number of students who conduct laboratory activities vary for each regional office. This conditions make the amount of money spent by students tend to be costly.

The term of sentra can be define as a place in the center, as a central of the city or as a center of activities (KUBI, 2001 p. 1040). Relevant with the practical work, sentra can be defined as a place used by students to conduct laboratory activities with its location easy to reach by students in all regional offices. Every regional office has to have at least one sentra for practical work. Every sentra for practical work representing wide spread of geographical living of students at each regional office.

The criteria to determine laboratory that can be used as a sentra for practical work are as follow: 1) priority is given to laboratory belong to Public Universities (PTN), Private Universities (PTS), and Academy. If it is not possible to find laboratory belong to higher education because of the geographical problems, practical work can be done on regional science center (P3G/LPMP IPA), Local Education Center (LEC), any senior high school (SMA or MA) which has laboratory for practical work in Physics, Biology, and Chemistry; 2) the availability of suitable instructor; 3) the amount of money spent for practical work can be afforded by students; 4) the availability of the sentra for practical work for student's of Universitas Terbuka. The activities for determining sentra for practical work has been continued until today.

Laboratory Activities at UT and the Trend of Using Virtual Laboratory as a Supplement

Laboratory activities for UT's students were conducted in local laboratory close to the UT Regional office. Local laboratory is a laboratory that belongs to local university or institutions. Laboratory activities were conducted individually or in a group under the supervision of instructors.

To help students in the implementation of laboratory activities, currently the plan to use virtual laboratory were introduced. Several modules and software's has already been produced. On example of which is produced by Bandung Institute of Technology. The modules present la. Activities in basic science courses in the level of Bachelor degree. They are one module for physics, two modules for biology, and two modules for chemistry. These modules have been socialized nationally for science lecturers in August 2002.

As complement to virtual lab, UT has produced computer assisted instruction (CAI). CAI is a learning method with the use of computer as its hardware. The teaching and learning process occurred in the interactions between users and the learning materials in the computer program. (Heinich, et. Al, 1986 in Benny A. Pribadi: "Potensi CAI Sebagai Media Interaktif Dalam SBJJ"). In other word, CAI is the use of computer as part of instructional system where the users interact with computers. Further more, the use of computers as facility or learning media help teachers explain concepts to students. These are due to the following characteristics: 1) CAI is an integrated multimedia that are able to provide a learning material package or tutorial that contains both audio and visualization simultaneously and 2) CAI offers intelligence parts that are able to process and respond the data given by the users.

To design CAI program, the skills to analyze materials is needed. Material analysis cover instructional development to produce the step of the program, flowchart, and the development of the presentation format. The other skills is programming by using Authorware software. CAI are developed by content expert, instructional expert, and computer programmer. Content expert are responsible for the content materials, instructional expert responsible for the steps of instruction, and computer programmer implements the ideas by using software. The development of CAI at UT begins in August 1993 and since then 73 topics has been produced (PAU, 2002).

III. Summary

A couple of effort has been done to give better services to students in the implementations of practical work. But, some problems still arise. With the use of networking models in the implementation of practical work for UT's students, regulation for practical work, the use of audio and video program, and the use of virtual laboratory, it is hoped that the implementation of practical work is getting better and better in the future.

At last, wise man says that to achieve a good result and a noble result, including that in the field of education, is not a simple matter. Student's achievements were bad. But, as long as there are strong will and wishes to be succeed (De Bono), and with the use of infrastructure collaboration or constructive collaboration (Kanter, 1995), and with the development of networking with society (Hargreaves, 2001), sooner or later the effort will produce something. This notion is in accordance with that noted by famous philosopher about 2400 years ago, "*The roots of education are bitter, but the fruit is so sweet"* (Aristoteles: 385 – 322 SM).

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