

## CONDUCTING BIOLOGICAL SCIENCE PRACTICUM AT A DISTANCE AT UNIVERSITAS TERBUKA, INDONESIA

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### ABSTRACT

*Conducting biological science practicum at UT involves a series of activities, ranging from registration, implementation, practicum learning support, and evaluation of student learning. Some important factors to consider in conducting science practicum at a distance include location, student conditions, and availability of the needed resources. UT science practicum involves the use of resources of partner universities, so the practicum is conducted during the semester break of the partner institution. In order to be financially viable, practicum is conducted when there are a minimum of 8 participating students, otherwise students will have to meet the minimum quota of the practicum cost.*

*Keywords: biological science practicum, distance education.*

### Context of Distance Higher Education in Indonesia

An island nation located along the equator in the Southeast Asian region, Indonesia is the home of 234,693,997 people, with a per capita income of US\$ 1,140 in 2007. Internet users in the country have significantly increased to about 20 millions, rising from 2 millions in 2000, with internet penetration rate at 8.5% per 1,000 people. The national higher education comprises 82 state higher education institutions and 2,545 private higher education institutions, and accommodates a total student body of 4.5 million students, or a national participation rate of 15%. The distribution of the student body consists of 1.67 million students in the state higher education institutions, 2.27 million in the private higher education institutions, and 0.56 million students in other types of higher education institutions (such as Islamic and other state-department-run higher education institutions).

Universitas Terbuka (UT) is an open university, established in 1984 as the 45<sup>th</sup> state university to provide opportunity and improve access and participation in university education for in-service teachers, working adults and recent high school graduates. In 2008, UT registers 437,525 students (as of 4 April 2008) or about 10% of the total national student body, residing in cities as well remote parts of the country, with over 95% of whom are working adults. The profiles of the student body comprise 62% female students, 97% working students, and 86% in-service primary school teachers. UT has four Faculties, i.e., Economics, Mathematics and Natural Sciences, Teacher Training and Educational Science, and Social and Political Science, plus a Graduate Program with Master's Programs in Public Administration, Management, and Fishery Management. Since its foundation, UT has graduated more than

700,000, working in various fields of the profession. The target audience of UT are those opt for distance learning because they have work commitment, reside in locations where there is limited or no access to higher education, and they need to have flexibility, freedom and self-direction in learning. In terms of human resources, UT has a total of 1,834 staff, comprising 369 academic staff and 567 administrative staff in Head Office, plus 400 academic staff and 498 administrative staff in its 37 Regional Offices.

UT operations involve networking with participating institutions. It has Headquarters located in Jakarta, and it involves an internal network of 37 Regional Offices providing academic and administrative services for students in their respective regions, with 1,753 tutorial locations, and 671 examination locations. Externally, it involves networking with the public and private universities throughout the country for curriculum, course material and test item development, and provision of tutors to support the UT teaching, learning and assessment process. UT also establishes partnership with other organizations, such as the Post Office and cargo companies, a major national Bank, the television and radio network, mass media, regional and state university libraries, and with local educational offices and schools to support its operational activities.

### Teaching and Learning of Biological Science at a Distance in UT

The Faculty of Mathematics and Natural Sciences (FMIPA) of Universitas Terbuka has offered Bachelor degree programs in Mathematics and Statistics since the UT was established in 1985. In response to the changing needs of the stakeholders, the Faculty of Mathematics and Natural Sciences currently offers 5 Bachelor Programs, namely Mathematics, Statistics, Biology, Food Technology, Agricultural Extension, and Diploma Program in Environmental Management. The Faculty of Mathematics and Natural Sciences has the smallest number of student body compared to the other 3 Faculties of the University, as seen in Figure 1. However, even with this small number of student body, the Faculty of Mathematics and Natural Sciences maintains its status as the largest Faculty of its kind in Indonesia, compared to the campus-based universities. Currently, the Faculty has registered students to the amount of 3,733. This student body includes a sum of 171 students in the Biology Study program.

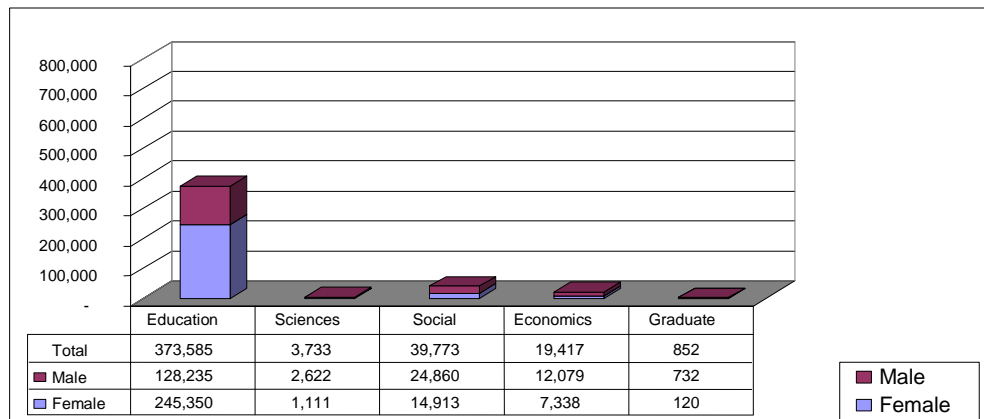


Figure 1. Number of students by Faculty and gender

Started in 2001, The Biology Study Program aims to develop professional graduates with cognitive ability and competency in the field of biology. As stated by Qing Yu (2005), learning in biological science is a combination of understanding, conceptualism, and practical experience. Practicum is a form of teaching and learning activity aiming at enhancing students' understanding of knowledge and concepts of biology through application, analysis, synthesis and evaluation of biological concepts. Practicum is necessary requirements for students, and it can be conducted in the laboratory or in the field. Practicum cannot be easily conducted in any higher education using distance education system, including Universitas Terbuka (UT) and many open universities throughout the world. For the dual mode distance education system, conducting science practicum can be fairly easier because many dual mode institutions have the necessary infrastructures and facilities for science practicum, as they are designed to meet the different groups of face-to-face and distance students. UT is a single mode open university, which offers programs using entirely distance education system.

Interests in taking science courses at a distance in Indonesia have so far never been greater than those in teacher training, economics, and social sciences. Implementation of science practicum depends on the number of registering students in Regional Office. There are also number issues to address the students' competency in science practicum. Other constraints relate to students' limited time in attending the practicum, as many of the students are working adults, and they miss the practicum schedule because of their busy work responsibilities. Not all Regional Offices of UT can organise science practicum course because of the limited number of enrolling students in the practicum courses, and limited availability of resources in the partner university.

There are reasons students having difficulties in conducting science practicum in distance higher education institution. One of those relates to students' time constraint in conducting the practicum during the time schedule designated by the institution or partner universities. Other constraints relate to the geographical distance of practicum location from the students' residences. For UT students, they have no requirement to purchase and have the learning materials on their own, and some students may have to share the materials with fellow students. Although many students taking practicum courses purchase the learning materials, many of them still do read the materials prior to practicum implementation. Students attend the practicum without proper preparation for reasons such as they are too busy with their work, or have little time for studying. This group of students is not well prepared to have a good understanding of the materials and conduct science practicum. They simply rely on the instructors' explanation prior to practicum, so that the instructors have to spend extra time for orienting the students with the practicum materials. Additionally, distance students must allow themselves to conduct practicum during the weekends, meaning that they have to leave family commitments during the period of time.

There are also constraints from the point of view of practicum services provided by partner universities. Conducting practicum in distance education system has a high degree of dependence on partner universities/institutions available in the local regions. Limitations relate to factors such as time availability and diverse quality of practicum facilities in each location.

### Strategy of practicum

Conducting science practicum in distance education involves three components, namely Study Program, Regional Office, and Partner Universities as described in the following chart.

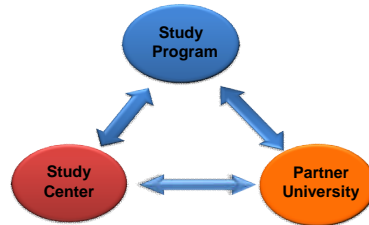


Figure 2. Practicum components in distance education

#### A. Study Program

The Study Program has central roles in ensuring that practicum can be implemented using common minimum standards for students throughout the country. The Study Program develops Practicum guidelines, evaluate practicum location, set costing standards, establish partnership contract, and supervise practicum implementation. The Study Program has the responsibility to write the practicum materials to ensure that students have minimum competencies to conduct practicum in different locations and supervised by different partner universities.

In implementing science practicum, the Study Program coordinates with partner universities and Regional Offices as part the effort to monitor and evaluate practicum implementation, and have agreement on practicum costs and other requirements with partner universities. Supervision of practicum is conducted by Regional Office and persons in-charge appointed by Partner Universities.

#### B. Partner University

Partner universities are can be public or private campus-based universities which have Biology Programs and meet minimum standards for resources and facilities to conduct science practicum. Generally these partner universities have good reference materials, such as access to internet and library materials, for use by students to enrich their learning process and practicum experience. Partner universities provide the necessary infrastructures, facilities, instruments, materials, and human resources to ensure that practicum activities can be implemented properly to facilitate the learning process of distance students.

Practicum supervisors evaluate students' progress and learning achievement and submit the results to the Regional Office for approval and then send them to the Study Program in Head Office. These practicum results are then forwarded by the Study Program to the Examination for further processing and final grading.

The Faculty of Mathematics and Natural Sciences has signed agreements with 7 partner universities, and during this semester practicum is implemented in three of the partner universities.

1. Universitas Pakuan, Bogor (for students of Jakarta, Serang, and Bogor Regional Offices).
2. Universitas Pendidikan Indonesia, Bandung (for students of Bandung Regional Office).
3. Universitas Negeri Semarang (for students of Semarang and Yogyakarta Regional Office).
4. Universitas Negeri Jakarta (for students of Jakarta Regional Office).
5. Universitas Negeri Surabaya (for students of Surabaya Regional Office).
6. Universitas Negeri Sebelas Maret (for students of Surakarta/Solo Regional Office).
7. Universitas Negeri Yogyakarta (for students of Yogyakarta Regional Office).

It is noted that some students have difficulties in arranging practicum schedule with designated partner universities, or in some Regional Offices a minimum quota of eight students per group cannot be met. UT allows for flexibility to conduct practicum in any of the nearest partner universities which are convenient and suit the individual needs of the students in the region. For example, students in the three Regional Offices of Bogor, Serang, and Jakarta can conduct practicum supervised by the partner university located in Bogor, i.e., *Universitas Pakuan*, for convenience reasons.

The number and location of partner universities depends on the number and geographical residences of registering students to the Biology program and the availability of resources in the partner university. The Study Program has to monitor the students conducting practicum to ensure that students are allocated proper practicum locations within easy access from their locations. The number of practicum locations allocated to students is dependent upon the number of registering students. The following table illustrates the number of students taking practicum courses since 2005.

Table 1. Number of students taking practicum 2005-2008

Practicum Location	Number of Students Taking Practicum							
	2005		2006		2007		2008	
	1	2	1	2	1	2	1	2
Bogor	-	12	25	35	22	29	21	-
Semarang	-	-	-	-	-	9	10	-
Bandung	-	-	-	-	-	-	5	-

In implementing practicum, each of the partner universities conducts the practicum in accordance with its own procedures and competencies. This can have consequences in terms of developing students' competencies in different regions. The Study Program has key roles in quality control through the development of standard guidelines for competencies for each of the practicum courses. As regards facilities and materials for use in practicum, partner universities have to meet minimum standards and requirements set by UT and in accordance with the partner universities' capacity and circumstances. It is important to note that Indonesia covers such a wide region with diversities in terms of infrastructures, facilities, and natural resources required for conducting practicum. Such flexibility allows for effective

implementation of conducting practicum in different locations that meet the competencies and standards set by the UT Study Program.

### **C. Regional Office**

The Regional Office has important roles in terms of coordination with partner universities, informing students about practicum arrangement, supervision, and informing students' grades. The Regional Office has to communicate with students to make the necessary arrangements for science practicum at the local partner universities. Regional Office informs students regarding practicum courses offered, arrangements and schedules. Informing students about the schedule is important to make sure that students can organize themselves into a group of eight students taking the practicum course. The UT has made agreement with the partner universities about the effective costs of practicum for the quota of eight students. When the number of students in the practicum group is less than eight, student group has to cover the remaining costs of practicum by themselves.

The Regional Office then has to coordinate with the partner university regarding the management of practicum activities in terms of courses offered during the semester, costs, and schedules. In this case, the Regional Office must have information about students' profiles taking practicum courses during the semester, including their contact information (telephone/mobile numbers, postal as well as e-mail addresses).

### **Implementation of Practicum**

The Biology Study Program is offered in 11 out of 37 Regional Offices on the island of Java. This policy has been implemented based on the considerations of limitations in the number of practicum locations and registering students in the Program. The offering of the Biology program outside the island of Java depends on the requests of the Regional Offices and approval of the Dean of the Faculty. The open character of distance education offers flexibility on the parts of the students. During the learning process, distance students have autonomy in making the choice for registration, courses taken, study groups, tutorial locations, and so forth.

*Registration.* Registration is conducted by students for practicum courses offered in the Regional Office. The Regional Office informed the student data to the Practicum Coordinator in the partner university. Students pay the practicum fees directly to the Practicum Coordinator in the Partner University. Selection of practicum courses by students depends on the resource availability of the partner university which supervises the distance students taking the practicum courses. The Study Program and Regional Offices have to rely on the partner university as regards the type and number of practicum courses, based on the considerations of availability of instructors and number of registered students in each particular practicum course.

*Pre-test.* Practicum can be implemented in the laboratory with the number of participants ranging from 8 to 40 students, or 1 to 5 groups, involving 1 to 3 instructors per practicum room. In reality, the number of students taking practicum courses is generally less than 40, as seen in Table 1, in which the maximum number of students in the practicum course is 35 participants during the 2006-2 semester. Students taking practicum courses come from

different backgrounds, so that they have different basic ability and competency in performing practicum work. For this reason, before conducting the practicum a pre-test is applied with the purpose of assessing the initial competence of the students. Post-test is also applied when the practicum is completed to have an assessment to what extent students' expected competence of the practicum has been achieved.

*Practicum supervision and assistance.* Practicum supervision is conducted face-to-face, where supervisors give one or two hour explanation about the materials and its relevance to concept discussed in the learning materials before practicum is conducted. The independent learning process of distance students has consequence on the fact that students miss the traditional human touch. Practicum activities allow possibilities for the students to simultaneously question and answer theory and concept which is difficult to understand in the learning materials.

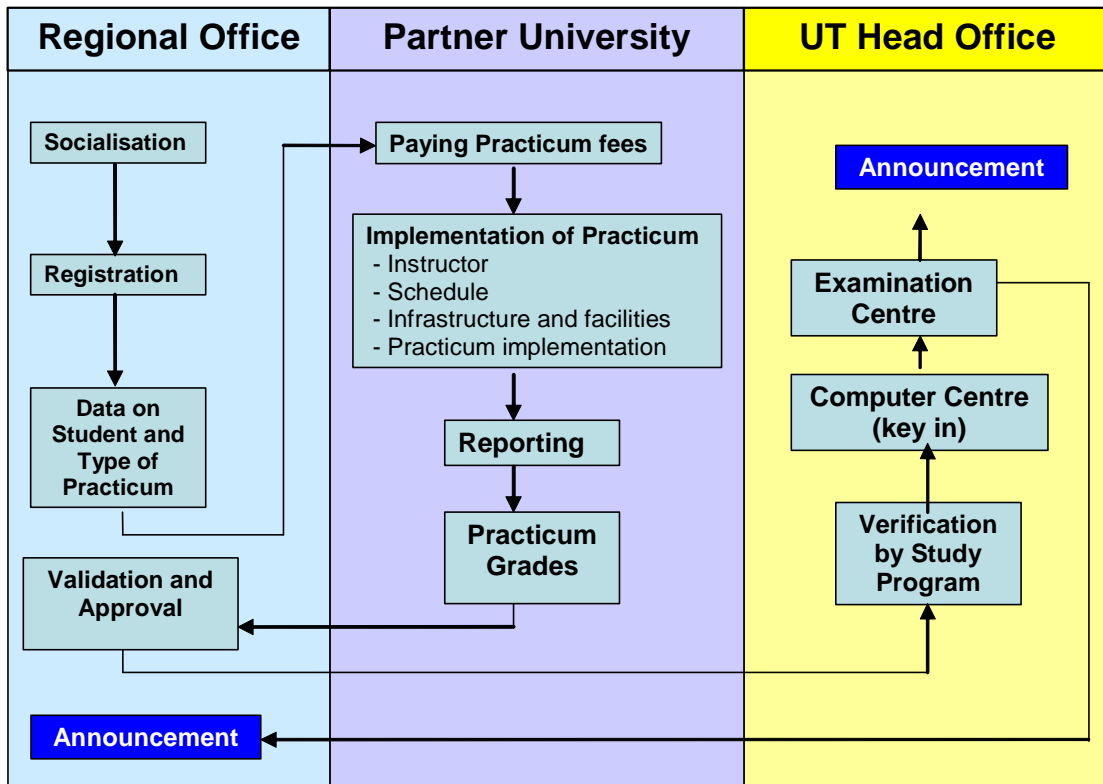


Figure 3. Science practicum process

*Practicum implementation.* Practicum is conducted face-to-face aiming at the development of the students' expected competency, and supervision is provided during the practicum session. The Practicum Manual is developed by the Study Program to ensure common quality standards for practicum activities implemented in various locations in collaboration with partner universities throughout Indonesia. In cases when the materials and resources as required by the Manual are not available, practicum has to be conducted using materials available in the

local partner university, without necessarily changing the purpose and competence expected from the practicum activities.

*Assessment and reporting.* Assessment is conducted based on the criteria of students' readiness, pre-test results, skills using or handling practicum materials and instruments, tidiness and attention to details during the practicum, observation results, and quality of practicum report beside on specified format. The results of practicum assessment are sent the Study Program for verification and then forwarded to the Examination Centre for further processing and final grading. The assessment component of the practicum final grade comprises 15% tidiness and attention to details, 50% practicum process, and 35% practicum report. Final grades are sent to the Regional Office for distribution to individual students taking the Practicum courses. The following Figure describes implementation of the practicum course at UT.

### Practicum fees

In order to efficiently meet the operational costs, practicum can be implemented when there are a group of eight students. Otherwise the student group members will have to agree to meet the practicum cost by themselves, when the number of students in the practicum group is less than eight.

Based on the materials used, instruments and costs, science practicum courses can be categorised into three different groups as the following Table. Category 1 groups courses that involve relatively expensive practicum materials, while Category 2 involves the use of less expensive materials, and Category 3 uses the least expensive materials.

Table 2. insCategory of Science Practicum Courses Based on Materials, Instruments and Costs

1st Category	2nd Category	3th Category
Microbiology	Animal Structure	Plant Structure
Biochimie	Vertebrate Taxonomy	Vascular Plant Taxonomy
Animal Physiology	Animal Embryology	Non vascular Plant Taxonomy
Plant Physiology	Genetic	Plant Embryology
	Avertebrate Taxonomy	Ecology

Source: Jurusan Biologi FMIPA, 2007, p. 8.

### Issues in practicum implementation

*Practicum schedule.* For many students, applying self-directed independent learning in distance education is no easy tasks. Science practicum for distance education is designed to overcome constraints in independent learning process by distance students. The following Figure illustrates the practicum implementation schedule, in which there are conflicting schedules of practicum and semester examination for students. Thus students are recommended to take practicum courses prior to the registration period of the previous semester. There are factors to take into considerations in developing practicum courses for distance education from the student as well as partner university points of views, such as (1) location, time schedule, and students' conditions, and (2) time availability and location of



Partner University. Practicum for UT distance students is conducted during the semester break of the partner university in between May and June. Special arrangements have to be made for this purpose.

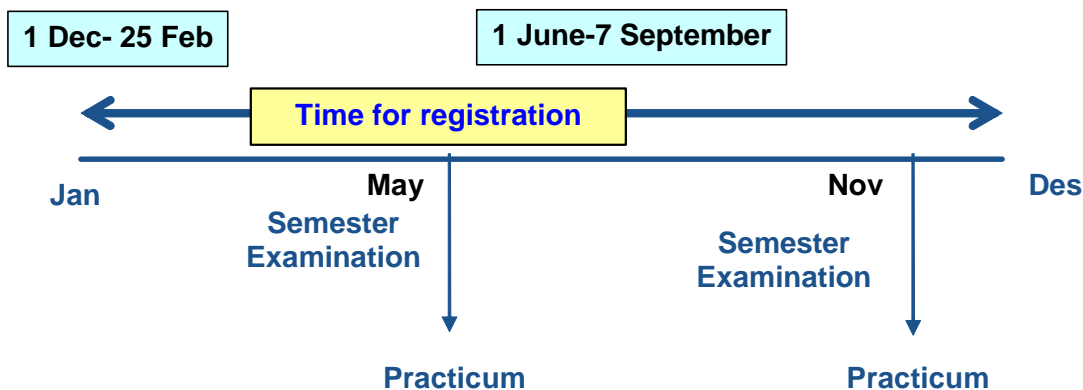


Figure 4. Practicum implementation schedule

*Standard competency in practicum.* Standard competency in science practicum for distance students poses a number of challenges to address for the following reasons. Students have varied backgrounds in terms of educational background, social, economic capacity, and professional experience. Many students are not well prepared for the practicum, as they have not yet developed their independent learning capacity. Some students express their concerns that the learning materials for practicum are too much and the time for learning is too short. The different entry backgrounds of students, in which students have common competency and fundamental knowledge in biological science, have complicated matters. Some students have difficulties in understanding the instructor's explanation of the concept and materials for science practicum.

On the other hand, for those students who have professional backgrounds related to biological science (e.g., those working in herbarium or wheat processing factory), where they are familiar with more sophisticated instruments, they think that the facilities for science practicum is inadequate. The partner university has the responsibility to provide the best available facilities for use in science practicum for UT distance students.

Students with diverse backgrounds are encouraged to work in groups so that peer learning and peer tutoring can take place. Students that have no backgrounds in biology can learn from their peers with backgrounds in biology so that such interaction can facilitate and enhance joyful learning process in small groups. Knowledge sharing in group motivates students' enthusiasm and positive spirit in learning and applying new concepts in science. This kind of practicum study group benefits students because they will sustain the group to conduct other practicum activities together.

*Student attendance.* There are constraints related to distance students' attendance science practicum for a number of factors. In some practicum group, there are not enough students

taking the practicum courses, and there is also a problem of absenteeism. Based on the results of monitoring, it has been found that students' absenteeism is caused by factors such as the inability to meet the costs and make the time to the practicum locations, busy work schedule, and distance to practicum location.

The demographic and geographic of Indonesia has required students to travel long distance and takes a long time to get to the practicum location. In some locations, many students have to stay overnight, arriving the night before and then leaving the day after the designated practicum schedule which begins at 8 in the morning. Interactive computer simulation (ICS) is implemented in order that students have better understanding of the materials prior to practicum, although it does not substitute the psychomotor competence of the students. In this way implementation of practicum becomes efficient in terms of time and costs.

*Delay in submitting practicum report.* Delay in submitting report by the students has consequence on delay in getting semester grades by the students. The solution to this problem is that students choose to conduct practicum as early as possible, even before the registration period. Students' attendance is compulsory. When students fail in a practicum course, they have to re-take the practicum course in the following semester.

### **Use of Interactive Computer Simulation (ICS)**

From the students' points of view, they have limited time to read the learning materials and prepare themselves for the science practicum. Consequently, it takes more time for the students to conduct the practicum and for the instructors to explain the concepts in detail to the students. Face-to-face meetings prior to the conduct of the practicum activities are important for the students, because they can exchange ideas, have discussions about the practicum topics with the instructors and their peers in the group. However, time limitation does not allow for in-depth discussions about the topics in details. Consequently, there must be a strategy to substitute the face-to-face meetings with other media which students can learn prior to attending the practicum course.

One solution to overcome the time constraint in the face-to-face session of practicum is through the use of ICS (Interactive Computer Simulation) technology in performing several types of practicum simulations (Hardjojo, et al, 2005). Practicum simulations can be used to enhance students' understanding the materials and the students' competency in conducting the practicum. The ICS-based materials can be developed by the Study Program, accessible as open source materials through the UT website. There remains a problem of access as only a few of UT students can have access to web-based open source materials. The requirements for the students to have hands-on practicum techniques still have to be met, and it cannot be substituted by computer simulations. Students still have to conduct practicum on site to develop their psychomotor skills.

ICS program is to be developed in the form of interactive learning activity (Hardjojo, et al, 2005). Students can study the procedures and practicum materials according to their needs and individual pacing so that they are better prepared to conduct practicum. At the moment, three practicum materials have been developed in the ICS format, namely microbiology,

genetics and biochimie in the form of CD which is relatively easy to use and accessible by students.

This ICS program has been tried out, and the results indicate that 14 out of 15 students using the ICS think that they are facilitated in their practicum learning process, and only one says that they cannot get benefit from the ICS program because he is not well trained in using the computer. Despite the fact that UT has uploaded the web-based materials, there is still difficulty of access by students because of the poor quality internet infrastructure in Indonesia. One solution to this problem is to integrate the ICS program into the printed learning materials of practicum in the form of CD.

### **Quality assurance in practicum**

The UT has implemented an internal mechanism of quality assurance in distance education coordinated by the Quality Assurance Centre. The UT quality assurance system is a comprehensive effort to improve the quality of distance education products, processes, services and philosophies continually, and it involves both internal and external assessment. Internal assessment is conducted through internal audit conducted regularly every six months. External assessment is conducted by independent assessment and accrediting agencies through external audit conducted every six months.

Since 2006, the UT has implemented the quality management system based on ISO 9001:2000 in the area of core business processes, including learning materials distribution services, development of learning materials and examination materials, distance learning services of Regional Offices, and academic administration services. In 2008, UT has held 14 ISO 9001:2000 certificates in learning materials distribution services (since 2006), development of learning materials and examination materials (since 2007), distance learning services of 11 Regional Offices (since 2007), and academic administration services (since 2008). Further ISO 9001:2000 certification process is currently taking place in the area of distance learning services of 14 Regional Offices, management of promotion and partnership, plus OHSAS 18001:2007 in occupational health. It is important to note that UT has been awarded the Certificate of Quality and International Accreditation by the International Council for Open and Distance Education (ICDE) Standards Agency (ISA) since 2005.

Quality assurance of practicum follows the Procedure for Practicum Supervision (JKOP PP01) issued by the UT Quality Assurance Centre. The purpose of assuring the quality of practicum is to enhance learning effectiveness and ensure that practicum grades can be processes timely and accurately. Practicum involves learning activities conducted through observation, experimentation, testing of concepts, principles, or materials in laboratory and or outside the laboratory. Implementation of the practicum Procedure involves various units in Head Office as well as Regional Offices. The Procedure itself has been reviewed and revised for improvement, based on feedback from users, students and results of internal as well as external audits.

## CONCLUSIONS

A number of conclusions can be made as the following. First, practicum is conducted to support the learning process of students on the Biology program. Students have different educational backgrounds, professional experience and social economic capacity, so that the practicum courses must be designed in such a way that attempt to address these differences in students' competency. Second, practicum in the Biology program has to be taken by students in order to meet the expected competency and psychomotor skills. Third, UT collaborates with partner universities with Biology programs in implementing science practicum courses, and students work in groups of eight people to conduct practicum supervised by the partner universities. Fourth, the availability of human resources, facilities, infrastructures and time at the partner university allows UT distance students to conduct practicum effectively.

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