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and

INTERNATIONAL FEDERATION OF CLINICAL CHEMISTRY
EDUCATION COMMITTEE†

PREPARATION OF AIMS AND OBJECTIVES FOR THE TEACHING OF CLINICAL CHEMISTRY

(Guidelines 1986)

Prepared for publication by

C. G. FRASER[1], N. DE CEDIEL[2], A. DEOM[3], L. JOSEFSSON[4], H. G. J. WORTH[5] and O. ZINDER[6]

[1]Ninewells Hospital and Medical School, Dundee, UK
[2]15–47 Calle 49, Bogotá, Colombia
[3]Hôpital Cantonal Universitaire, Genève, Switzerland
[4]University of Copenhagen, Copenhagen, Denmark
[5]King's Mill Hospital, Sutton-in-Ashfield, Notts., UK
[6]Rambam Medical Center, Haifa, Israel

* Membership of the Commission during the period (1985–1986) in which these Guidelines were prepared was:

Chairman: O. Zinder (Israel); *Secretary*: H. G. J. Worth (UK); *Titular Member*: C. G. Fraser (UK); *Associate Members*: M. A. Drosdowsky (France); P. Garcia-Webb (Australia); N. Montalbetti (Italy); C. J. Porter (Canada); B. Straus (Yugoslavia); V. N. Titov (USSR); R. Vihko (Finland); C. W. H. Walker (Canada); *National Representatives*: M. M. Abdel Kader (Arab Republic of Egypt); J. Agneray (France); K. Bergström (Sweden); B. Christophersen (Norway); A. F. Delbrück (FRG); H. A. Fritsche Jr (USA); A. Gornall (Canada); A. G. Hadjivassiliou (Greece); T. Kanno (Japan); M. Nemeth Csoka (Hungary); P. Strom (Italy).

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Correspondence on these Guidelines should be addressed to: Dr. H. G. J. Worth, Clinical Chemistry Department, King's Mill Hospital, Sutton-in-Ashfield, Nottinghamshire NG17 4JL, UK.

Preparation of aims and objectives for the teaching of clinical chemistry (Guidelines 1986)

Contents

1. INTRODUCTION

1.1 The IFCC Education Committee and IUPAC Commission on Teaching of Clinical Chemistry have a broad remit in education in clinical chemistry (1). A major activity is the preparation of both *general* guidelines for the education and training of all groups associated with the discipline and *specific* guidelines for particular subject areas.

1.2 Guidelines for the education and training of science graduates (2), technicians (3) and medical students (4) have already been prepared and published. Moreover, strategies for continuing education of the clinician using request forms, reports and handbooks have been outlined (5) and the preparation of educational laboratory procedure manuals has been documented (6).

1.3 There are great differences in educational systems around the world which makes it difficult to define comprehensive unified courses for the various groups involved in clinical chemistry. In addition, any course must relate to the particular needs for clinical chemistry services and available resources in an individual country. For this reason, the recommendations and guidelines previously prepared have concentrated on the delineation of outlines (syllabi) which are to be used as frameworks for local or national development of more detailed programs appropriate to individual countries.

1.4 In order to develop or introduce courses which, although taught in many centres of learning in a country, are designed to be common throughout the country, perhaps with a view to introduction of certification, licensure or accreditation (7), it is of great advantage to adopt syllabi which use *educational aims* and *educational objectives*. This document is intended to provide definitions for these terms and to give guidance as to their correct development and use.

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2. DEFINITIONS

2.1 Aims

are statements which provide details of the overall purpose or intention of an educational course.

As one example, the details of the basic requirements of a trained technician in clinical chemistry as outlined by the Committee and Commission (3) include the statement that the trained individual will have "an understanding of laboratory instruments and the ability to operate and maintain them". Thus, a course for medical laboratory technicians in clinical chemistry will have, amongst other goals, the general *aim* of providing educational material to achieve this competence.

2.2 Objectives

are statements of the knowledge or skills that an individual will possess at the completion of the course.

For example, with the aim (general intention) detailed in Section *2.1*, a series of objectives could be developed; these could include statements such as the following:

a) the technician should be able to describe, without recourse to texts or other written material, the basic principles of measurement employed by the following:
- spectrometers
- fluorimeters
- nephelometers
- osmometers
- pH and blood gas analysers
- flame photometers
- atomic absorption spectrometers
- β- and γ-counters
- discrete analysers
- continuous-flow analysers
- parallel fast analysers,

b) the technician should be able to operate, when provided with the laboratory procedure manual, particular models of the instruments detailed in objective a) above and

c) the technician should be able to draw up, with the aid of the operation manual provided by the manufacturer of an instrument, simple guidelines for routine maintenance suitable for inclusion in a laboratory procedure manual prepared according to IFCC/IUPAC guidelines (6).

2.3 The two terms *aims* and *objectives* are often used interchangeably. It should be realised that aims are general while objectives are more specific and show the educational material that must be mastered. It is emphasised that objectives can be constructed in a number of ways. The IFCC/IUPAC scheme for a two

year postgraduate course in clinical chemistry (2) states that a course objective is "to teach the fundamental principles of clinical chemistry through a systematic course of lectures and tutorials": this is a very general objective designed for the *teacher* or *instructor* and is actually an aim and not an objective. Similarly, the IFCC/IUPAC guidelines for the teaching of clinical chemistry to medical students (4) state that "the medical student should be able to collect specimens of biological fluids and be able to make sure of the transport, preservation and storage of these so as to ensure stability": this, although specifying competence required, is a general objective designed for the *student*; the statement is again better described as an aim rather than an objective.

3. AIMS

3.1 Aims indicate the purpose of the course but do not specify how the competence achieved should be performed. Moreover, aims generally do not show what standard of competence should be achieved.

3.2 Aims, as illustrated by the guidelines prepared by the IFCC Committee and IUPAC Commission, are of great assistance to those planning to set up courses but they do not

(i) illustrate the detailed scope of a course,
(ii) allow the setting of examinations by an external examiner, or
(iii) truly permit granting of licensure or accreditation by external bodies.

Objectives, in contrast, can allow these functions to be fulfilled.

3.3 Aims are visionary in character and their publication can play a useful role in making both explicit and public those activities which are regarded as being educationally valuable and worthwhile. In some countries, development of, and wide publicity given to, necessary educational aims would undoubtedly enhance the stature of the profession in the views of other professions in or allied to medicine and of governmental bodies. Aims do allow development of specific objectives and are considered by many to be a necessary prerequisite for development of this type of educational approach.

4. OBJECTIVES

4.1 Objectives indicate the detail of the educational material which should be mastered. They are therefore collections of words defining the behavioural characteristics the student should possess at the end of the course.

4.2 The use of educational objectives has a number of advantages.

4.2.1 For *curriculum planning*, objectives:

a) stimulate the educators to consider in detail what exactly is to be achieved by the course,
b) encourage faculty members to communicate and work together to produce more cohesive and better integrated teaching,
c) minimise the overlap and repetition between course segments,
d) assist in the determination of the most logical order in which to teach the topics of the course,
e) facilitate communication between institutions offering similar types of course and
f) can better define standards of performance required for licensure or accreditation.

4.2.2 For *educators*, objectives:

a) simplify the planning and implementation of specific course topics,
b) allow feedback of the effectiveness of teaching, particularly if the objectives do delineate acceptable standards of performance which can be measured and
c) can be used specifically to direct students to means of learning other than traditional formal didactic lectures.

4.2.3 For *students*, objectives:

a) provide a comprehensive guide to the course which facilitates all aspects of learning,
b) encourage cooperation between student and educator because the educator has clearly laid down what is expected of the student and is consequently seen as a resource individual and not as an opponent or threat,
c) aid in the planning of study by provision of clear targets and
d) can provide criteria against which the student, in an ongoing manner, can monitor individual performance.

4.2.4 In assessment and examinations, objectives:

a) facilitate the setting of these since the knowledge acquired (and therefore examinable) is directly related to the objectives and
b) clarify the standards required for acceptable performance.

4.3 The use of objectives does, however, have the following disadvantages:

a) the time taken to construct the objectives is considerable,
b) a very comprehensive list of objectives is a necessary prerequisite to the avoidance of ambiguity,
c) it may be difficult to write specific objectives to allow achievement of a specific educational aim,
d) very strict adherence to material associated with the set educational objectives can limit the many unexpected opportunities for education that spontaneously arise in any course,
e) there may be a tendency for educators and students alike to concentrate on the more trivial objectives,
f) students find it more difficult to acquire professional values and attitudes and
g) examinations dealing with more philosophical or controversial facets are difficult to structure.

5. DEVELOPMENT OF OBJECTIVES

5.1 Objectives can have a number of components. The three main components are:

a) the identification of the overall behaviour required,
b) the definition of the important conditions under which the behaviour is to occur, for example, the environment, the equipment or documentation to be used or the staff members involved and
c) the criterion of acceptable performance.

For example, the objective "the science graduate should be able to list, without recourse to texts, at least five of the common causes of hypercalcaemia" demonstrates this approach. The behaviour component is "the science graduate should be able to list ... common causes of hypercalcaemia". The conditional component is "... without recourse to texts ...". The criterion of acceptable performance component is "... five ...".

Although desirable, not all objectives have these three components; in particular, many useful objectives do not have conditional or criterion of acceptable performance components.

5.2 If educational objectives are to assist in the learning process, then the terminology used must be clear and concise and never loose and ambigious. Clarity can be achieved best when only *one type of ability* is required to fulfil an objective. Abilities can be described as:

(i) *psychomotor* – for example, in the objective – "technicians will be able, using the laboratory procedure manual, to prepare saline solutions of varying molarity in water using a balance, volumetric flasks and pipettes",
(ii) *cognitive* – for example, in the objective – "technicians will be able to calculate the correct weight of sodium chloride to make up in different volumes of solution to prepare saline solutions of varying molarity" and
(iii) *affective* – for example, in the objective – "technicians will be able to calibrate analytical methods more confidently using their knowledge of the molarity of solutions".

5.3 Objectives of *psychomotor* type stress the acquisition of muscular or motor skill in manipulation of materials or instruments. These objectives are relatively straightforward to set up although often cognitive skills are required to perform tasks which, on the surface, appear to simply require neuromuscular coordination.

5.4 Cognitive skills are those involved with knowledge, recall of facts, understanding, application of concepts to other areas, analysis of data, synthesis of concepts, testing of hypotheses and judgement of the value of data.

There are many terms (8) which can be used to construct educational objectives dealing with cognitive skills including the following, arranged in level of complexity:

to define	to recall	to recognise
to identify	to interpret	to explain
to estimate	to infer	to predict
to apply	to relate	to employ
to analyse	to deduce	to propose
to judge	to assess	to appraise
to adapt	to calculate	to test

5.5 Affective objectives deal with concepts which are professional, more subjective and depend on attitudes, interests and appreciation and, of the many terms used in the construction of educational objectives dealing with this type of topic, the following are most likely to be used in courses for clinical chemistry:

to follow	to debate	to discuss
to balance	to organise	to revise
to avoid	to resist	to volunteer

5.6 Courses for the different types of staff member employed in the clinical chemistry laboratory may have different types of educational objectives.

The emphasis for laboratory assistants and technicians will be almost totally on psychomotor skills and simple cognitive skills which emphasise recall of basic knowledge and comprehension of basic facts with less emphasis on problem solving and more complex cognitive skills. In contrast, for science graduates and more senior technicians, there will be more emphasis on development of attitudes (affective objectives) and the more complex cognitive abilities relating to comprehension, application of data, analysis of facts, synthesis of opinions and evaluation of alternatives. In the teaching of clinical chemistry to medical students (4) the material recommended to be taught early in the course mainly requires simple cognitive objectives whereas the clinically oriented topics require both more complex cognitive and affective objectives.

6. CONCLUSIONS

Although the development of educational aims and objectives does have some disadvantages (9), it is considered that they are a most useful adjunct to a logical and systematic approach to the education of staff employed in clinical chemistry laboratories and of medical students (10).

The IFCC Committee/IUPAC Commission have here detailed guidelines for the development of aims and objectives. It is planned to develop syllabi based upon this approach in the future.

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