

Science and technology teacher educators: Profile, needs and responsibilities

Overview

1.1

In most developing countries the provision of a good basic education is a matter of great concern. High quality science and technology education depends on effective and efficient training of teachers. This in turn depends on the quality of the teacher educators. At present, there is little comprehensive information available about the academic and professional qualifications of science and technology teacher educators, or about their responsibilities and training needs. The best intentions for improving teacher education will fail unless attention is paid to improving the quality of science and technology teacher educators.

Objectives

1.2

The objectives of this monograph are to help teacher educators, policy makers and administrators to:

- identify the professional and academic qualifications and training needs of science and technology teacher educator;
- consider ways of improving the qualifications of science and technology teacher educators;
- enable the science and technology teacher educator to keep abreast of developments in their fields.

Profile of a science and technology teacher educator

1.3

Ideally the science and technology teacher educator should have the following qualities:

- 1 Academic qualifications indicating a broad basic grounding in science and technology, including, a first degree in a science related area or equivalent qualifications in technology.
- 2 An appropriate professional qualification such as diploma or degree in education.

- 3 Relevant teaching experience at the appropriate level (Preferably at primary or basic level of science and technology education).
- 4 Membership of some relevant professional organisations related to science and technology education.
- 5 Research interest and commitment to research in science and technology education as evidenced through academic, professional or popular writings.
- 6 Positive attitude towards science and technology education, including the gender perspective, and knowledge of current developments in science and technology education.
- 7 Ability to adapt to, and understand, the contextual needs of the specific institution and the community it serves.

1.4 Academic and professional needs

In order to improve the quality of science and technology education at the basic level, the science & technology teacher educators must meet the academic and professional needs. The quality of science and technology teachers depends on the availability of science and technology teacher educators with sufficient grasp of the challenge and complexity of introducing young learners to the basics of these disciplines in a holistic and integrated way.

Currently, there are no courses that specifically train such teacher educators. In the short term, quality In-Service Education and Training (INSET) for science and technology teacher educators will be required. In the long term, a clear route will need to be developed to enable potential, science and technology teacher educators to gain the academic and professional qualifications they need. Their **academic** needs may include updating on knowledge of subject matter and content. Their **professional** needs include an understanding of and confidence in the use of subject-specific pedagogical skills, together with an understanding of appropriate methods for science and technology education research.

Thus, the major components to be included in the training of science and technology teacher educators are:

- (i) **Liberal education** through mastery of content knowledge of various subjects at primary level and awareness of inter-relationships of science, technology, society and culture.
- (ii) **Professional education** which mainly includes the educational psychology, development of history and philosophy of science, specific knowledge and skills pertaining to characteristics of learners, techniques and practices in science teaching and basic process skills in science and technology education research.

These specific requirements exist within the wider context which will include gender issues, ethical and humanistic issues in science and technology, cultural awareness and communication skills. The academic and professional needs interact with one another as well as with the context, as shown in Figure 1.

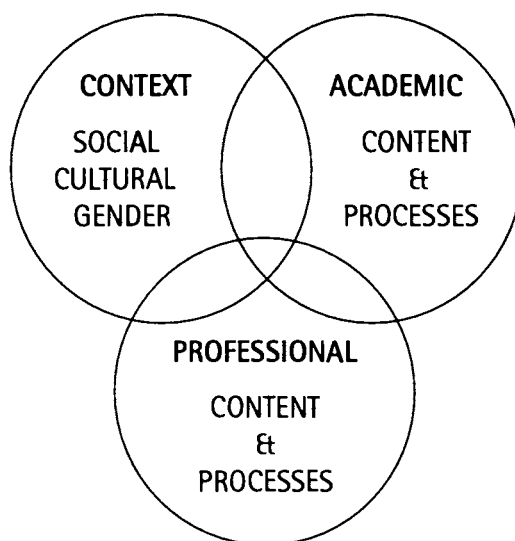


Figure 1:
The interactive
nature of the
areas of
training

Table 1 illustrates the broad training needs of science and technology teacher educators and indicates where subsequent training might be required for individuals with identified professional or academic shortcomings.

Academic		Professional		Context	
Science and technology subject knowledge	Science processes	Education studies	Subject-specific pedagogical skills	Curriculum Studies	Manpower development studies
• Concept, Facts, Principles • Computer Literacy	Observation Classification, Experimentation etc.	Education psychology, Philosophy of education. Sociology of education. Educational Technology	Teaching methods competency based teaching. Mastery learning. Team Teaching. Teaching Practices	Science and technology education research. Materials development	General liberal education. Cultural/community awareness. Communication (language skills, etc.)

Table 1:
Academic and
Professional
needs of science
and technology
teacher
educators

Science and technology teacher educators will have to develop competence in their teacher trainees across the whole breadth of science and technology, including coverage of all the areas that the teacher will have to teach. The teacher educator must therefore:

- be able to demonstrate the activity-based investigative and problem-solving approach to science and technology;
- be able to present examples of open-ended investigations and how to report them;
- encourage teacher trainees to generate their own investigations and follow them through, so that they in turn learn how to support and encourage their learners in the same processes at their own levels;

- be able to demonstrate the significance of classroom skills in relation to real-life problems;
- be up-to-date with current learning theory, such as the recognition that different learners build up knowledge in different ways.

1.5 Academic and professional responsibilities

In Asian countries science and technology teacher educators usually have the following responsibilities:

- **Teaching:** To organise, implement, and critically evaluate the content of science and technology curricula and appropriate teaching methods.
- **Practice teaching:** To support teachers trainees in teaching practice (see Monograph 2).
- **Research:** To design, plan, conduct, and publish research.
- **Evaluation:** To carry out continuous review of existing programmes and the diagnostic and formative assessment of learners' academic attainment and progress.
- **Documentation:** To keep accurate records of examination results, nominal rolls, laboratory stock, workshop materials, etc.
- **Development:** To contribute to curriculum development and other developmental programmes.

It is important for science and technology teacher educators to be academically well prepared and equipped to meet the demands made on them. They should be familiar with the subject matter and content of the curriculum. They should understand how science and technology, their philosophical foundations and sociological aspects, are interrelated. This is important, because problems in science and technology tend to require skills and knowledge that are cross-disciplinary in nature and best handled by team-teaching. Science and technology teacher educators also need to have a basic knowledge of everyday applications of science and technology, their social implications and how the concepts and processes are used in industry and commerce.

For professional growth, the science and technology teacher educators should explore the possibility of

- research opportunities;
- available grants;
- attending conferences;
- organising in-service training in research methods and report-writing and providing professional support at different levels of research;
- communicating research findings through newsletters or journals.

The science and technology teacher educator needs to possess pedagogical knowledge, both of concept and procedures, and to be able to pass this on to teacher trainees and in-service teachers to improve their effectiveness in the classroom. They therefore need to develop competence in the following areas:

- **Pedagogical skills:** These are the conceptual knowledge and procedural skills needed to enable teacher educators and teachers to bring about effective learning. They include selection and use of appropriate teaching strategies for particular objectives, class sizes, available materials, learning environments, etc. They also include the ability to guide teacher trainees in reflecting on their teaching and to encourage their involvement in the teaching-learning process.
- **Supervisory, guidance and counselling technique:** The science and technology teacher educator needs to develop skills in classroom observation, guidance and counselling of teacher trainees on academic and professional matters, including supervision of teaching practice and during competency-based teaching (see 2.6) sessions.
- **Social and psychological considerations:** Understanding the social and psychological characteristics of prospective science and technology teachers and learners at basic education level, and providing guidance to prospective teachers on how to deal with them. Understanding gender issues in science technology education and the strategies to deal with them.
- **Curriculum development:** Constructing curriculum materials and teaching-learning aids for pre-service and in-service teacher education and also for school education.
- **Research:** Carrying out 'action research' (see 6.6) and other types of research in education, which can contribute to understanding the needs of the learner, the classroom and the school in general.

There is currently an imbalance in the practice of these academic and professional responsibilities. Science and technology teacher educators need to put themselves in the place of teachers, attend seminars and spend time actually working in schools. This will make their own teaching much more realistic and effective, because it will be based on real classroom experiences.

Strategies for ongoing professional development

1.6

Science and technology teacher educators need support, throughout their teaching careers, to develop both academically and professionally. In the Final Report of the International Forum on Scientific and Technological Literacy for All (UNESCO, 1993), it was stated that such support should include:

- partnerships between the world of production and the community, which would allow teacher educators to be exposed to the latest technology and also to increase society's commitment to science and technology teacher education programmes;

- updating appropriate teaching/learning instructional materials, facilities and equipment;
- updating of teaching skills, knowledge of learners and content;
- induction programmes for beginning teacher educators;
- assistance in developing leadership skills;
- salary structures attractive enough to recruit and retain the proficient teacher educators;
- adequate reward for teacher educators for those activities which are related to maintenance of their continued involvement with teaching as a dynamic profession.

These measures can be realised through:

- in-service education programmes organised by universities, colleges of education, subject associations and employing authorities (i.e. Department/Directorate of Education);
- formal links, including visits and attachments, with industry;
- teaching at the school level and carrying out action research with science and technology teachers;
- provision of resources by governments, including improved salary conditions; and career paths;
- joining professional organisations;
- corresponding with other professional science and technology teacher educators.

1.6.1 Content of INSET Programmes

INSET programmes for science and technology teacher educators should include consideration of:

- the needs of the community in which the teacher educators are likely to work and of ways of orienting science and technology towards community problems;
- the content and objectives of science and technology education at different levels;
- problem-solving techniques;
- gender issues and how they can be addressed;
- the use and maintenance of science equipment and laboratory;
- learning science and technology in a second language;
- management, co-ordination and use of resources;
- hands-on activities which integrate science and technology;
- the cultures of scientific and technological enterprises, their values, attitudes, assumptions, organisational structures and limitations.

In-Service Education and Training (INSET) is essential for updating the knowledge and improving the professional competence of science and technology teacher educators. At present, there are no regular INSET programmes specifically designed for science and technology teacher educators. Provision should focus on development needs, current issues and policy matters, as well as training and certification needs. The following are suggestions for types of INSET programmes:

Issue-based INSET

- **Workshops:** Hands-on activities designed to cater for specific professional development in terms of knowledge and skills.
- **Seminars:** Discussion- usually of short duration – of academic and/or professional issues and problems. They normally consist of talks or presentations followed by discussion, often in small groups. There should also be opportunity for plenary, summary discussion.

Certification-based INSET

- **Sandwich courses:** These can be organised by colleges of education, universities and polytechnics during long vacations to upgrade science and technology teacher educators professionally. Periods of normal teaching are alternated with short periods of full-time attendance at local colleges. Sandwich courses can be supplemented by distance-learning modules or specific practical projects or tasks (action research). Follow-up field visits by course co-ordinators contribute to the effectiveness of sandwich courses.
- **Study courses:** Science and technology teacher educators are granted full-time study leave in order to attend courses leading to a qualification. Such courses are INSET in the sense that a serving teacher educator goes on leave to study. This is a means by which under-qualified teacher educators can obtain qualifications and qualified teacher educators can upgrade qualifications.
- **Distance-learning courses:** Structured learning modules are made available to teacher educators through a variety of media. There is minimal contact with tutors, and the teacher trainees does not need to obtain study leave to be able to participate. Professional elements such as teaching practice are assessed by specially designated local personnel.

Institution-based INSET

- **In-college activities and meetings:** Organised by college departments, these enable science and technology teacher educators to exchange ideas and experiences and thus improve the quality of their teaching.
- **Conferences:** These may be local or international. They usually involve presentations, by science and technology teacher educators, of innovative methods and examples of good practice in schools. They provide teacher educators with the opportunity to update themselves on the latest equipment and published materials

for science and technology education. Such conferences are a very valuable resources for sharing problems and new ideas.

School-based INSET

It is important for science and technology teacher educators who have been in a post for some years, to be officially released for a period to update their teaching experience at the level for which they are training teachers. This gives them a better understanding of the needs, characteristics and aspirations of the teachers and learners in schools, and encourages the teacher educators to see themselves first and foremost as educators rather than as subject specialists.

Peer-group INSET

Science and technology teacher educators meet together as equals to share their problems and success stories. They can develop learning materials during such meetings. These can be at least as effective as the traditional 'course' led by an 'expert'.

Visits

Science and technology teacher educators should be encouraged to visit industries and other science and technology-based establishments such as science museums to acquaint themselves with the applications of science and technology principles in daily life. Visits may be for a day or involve extended periods of attachment to an establishment.

Table 2:
A summary of
examples of
INSET
programmes
for science and
technology
teacher
educators is
given

Type	Organiser	Length	Activities	Outcome
1 Issue-based				
(i) Workshop	Professional association, educational agency, private organisation, Department/Directorate of Education, College of education, polytechnic, university	Varies	Lectures, demonstrations, discussions, practicals	Improvement of professional and academic competence
(ii) Seminar	As in workshop	1-3 days	Lectures, demonstrations, discussions	Improvement of professional and academic competence
2 Certification-based				
(i) Sandwich courses (vacation courses)	College of Education, polytechnic, university	2-10 long vacations of about 10 weeks each	Practical, lectures, demonstrations	Degree/Diploma/ Certificate
(ii) Study courses	College of Education, polytechnic, university	1-2 academic years	Lectures, demonstrations, Practical	Degree/Diploma/ Certificate
(iii) Distance learning	University	1-3 years	Self-instructional modules, with follow-up contact for lectures, demonstrations, discussions	Degree/Diploma/ Certificate
3 Institutional-based				
(i) In-college Activities and meetings	College of Education	Usually not more than a day	Discussions, demonstrations	Exchange of ideas, update of professional and academic knowledge
(ii) Conferences	Professional association, educational agency, university	1-5 days	Lectures, demonstrations, discussions, practicals	Exchange of ideas, update of professional and academic knowledge