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New *technology* curricula for South African FET schools (grades 10-12)

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ABSTRACT: Technical subjects at Further Education and Training (FET) schools are based on a rather narrow scope, commonly known as trade subjects that do not adequately respond to social, economic, cultural and industrial needs. These content-based subjects have a related problem involving fragmentation and over-emphasis on theoretical content at the expense of practical applications. The new technology subjects focus on technological processes from conceptual design to practical problem solving and the application of scientific principles. This paper describes briefly the historical background of technical subjects, as well as the new technology subjects that have been developed for FET schools, grades 10-12.

INTRODUCTION

The *technological subjects* in the Further Education and Training (FET) band have, historically, been packaged into a number of senior secondary school subjects. These subjects included electrician work, electronics, motor mechanics, woodwork, metalwork, welding and metalworking, plumbing, sheet-metalwork and technical drawing [1]. These subjects were offered at higher and standard grades.

Built into the system was the conversion route that allowed the standard grade to be converted into the lower grade. This differentiation of subjects into three grades had a multiplier effect of converting the seven subjects into the 21 *technical subjects* at senior secondary schools. This number of technical subjects has been radically reduced to the following three technology subjects in the new National Curriculum Statement (NCS):

- Electrical technology;
- Mechanical technology;
- Engineering graphics and design.

These three subjects are hereafter referred to as manufacturing, engineering and technology subjects. These subjects are not differentiated into different grades but are organised to caster for learners with differing abilities and talents.

Technical subjects were not historically underpinned by a single philosophical framework due to the previous apartheid era. However, a single philosophical framework now underpins the new technology subjects offered at FET schools. This framework outlines and advocates new ways of thinking and undertaking technology in the new *technology subjects*. These new methods to think about and carry out technology can be unpackaged under the following headings:

- Conceptual framework;
- Rationale;
- Age group;
- The GET-FET continuum;
- Contents and contexts.

CONCEPTUAL FRAMEWORK

The *technology* covered in the NCS includes electrical, mechanical and graphical communication. As stated above, these technologies are packaged into the following three subjects: electrical technology, mechanical technology and engineering graphics and design [2-4].

These *technology subjects* in the FET school build upon the foundation laid by the Technology Learning Area in the General Education and Training (GET) band [3]. This implies that these subjects are based on the concept of design and manufacturing.

Like all subjects in the NCS, the technology subjects are underpinned by the following key principles:

- Social transformation;
- Outcomes-based approach;
- High knowledge and high skills;
- Integration and applied competences;
- Progression;
- Human rights, inclusion and environmental justice;
- Valuing of indigenous knowledge systems;
- Articulation and portability;
- Quality, efficiency and credibility.

In line with the above principles, the new technology subjects recognise the contributions made by different nations towards

technology. It has been debated that technology or technical subjects traditionally mirrored skills and knowledge that were required in specific occupations. The argument has progressed that since workplaces and technologies are rapidly changing, it is extremely difficult to keep up-to-date with all of the skills and knowledge considered necessary in order to be competent in a specific occupation [5].

In applying the outcomes-based approach to education and training, these science subjects strive to work towards achieving the following critical and developmental outcomes:

- Utilise science and technology effectively and critically, showing responsibility towards the environment and the health of others;
- Identify and solve problems, and make decisions using critical and creative thinking;
- Collect, analyse, organise and critically evaluate information;
- Communicate effectively using visual, symbolic and/or language skills in various modes;
- Demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation;
- Participate as responsible citizens in the life of local, national and global communities;
- Reflect on and explore a variety of strategies in order to learn more effectively [6].

RATIONALE

South Africa has been blessed with rich materials under and above the ground. The minerals below the earth and a vibrant people of diverse cultures, the fauna and the flora above the ground make South Africa a richer country. Technology subjects play a major role in exposing learners to use effectively and efficiently these rich resources, knowledge and skills to design and manufacture technological products that can meet human needs in a democratic society, which is underpinned by human rights and inclusion.

While technical subjects historically benefited a minority, the new technology subjects for FET schools have broadened access to technology to the majority of learners. Reducing technical subjects (excluding their grades multiplier) from 12 to three will make more resources available in order to achieve this goal. Some of these subjects are offered to fewer than 10 candidates in the Senior certificate. The cost of developing appropriate learning support materials, providing qualified teachers and examining these subjects is huge and incommensurate with their size and status. The continued provisioning for these subjects compromises quality and is not economically viable [2-4].

Qualitatively, the three technology subjects should build knowledge and skills so as to exploit natural resources to contribute to South Africa's socio-economic and politico-cultural development. This includes the promotion of health education, sustainable management of the environment, technological advancement, mining, housing, rural development and urban renewal.

The labour market of today is being driven by three major developments, namely:

- The emergence of a competitive global marketplace;
- The use of new technologies in producing goods and services;
- The introduction of different forms of work organisation [7].

Meeting the demands of today's labour market requires a high level of skills and knowledge, the ability to solve problems individually, as well as be able to work as a member of collaborative work teams.

AGE GROUP

The FET schools learner is, in general, between 15 and 18 years old. The technology subjects are aimed at producing a technologist who can design and manufacture products that are traded worldwide by using high skills and knowledge, rather than focusing more on specific skills for a particular manufacturing industry.

Historically, technical subjects were designed and offered for the select few. This was both as a result of discrimination and gate keeping, and designed primarily to separate privileged learners from the majority of disadvantaged learners. In a nutshell, these subjects are structured to ensure that, in general, learners who choose technology subjects relate to and appreciate engineering and technology courses in higher education. The purposes of the new technology subjects aim to give learners not only access to higher education, but also expose them to career opportunities and responsible citizenship [6].

Against this background, the technology subject curriculum statements at FET schools are designed to accommodate differing worldviews that will enable learners to live in an open and democratic society.

THE GET-FET CONTINUUM

The Technology Learning Areas of the revised National Curriculum Statement for the GET band (grade R-9) are designed to achieve three prime learning outcomes that specifically cover knowledge, skills and technology in society. The core knowledge and concepts required to achieve the assessment standards of the Technology Learning Area are grouped into the following knowledge areas: design processes, materials and processing, structures, systems and control in mechanical and electrical, as well as environmental awareness [4].

The technology subjects at FET schools build on the foundation laid by the Technology Learning Areas in the GET band. The electrical technology subject builds on electrical and electronic systems and control. The mechanical technology subject builds on structures, materials and processing, hydraulics/pneumatics and mechanisms. Engineering graphics and design builds on the design process [4].

Table 1 shows the GET-FET continuum in terms of learning outcomes and assessment standards on the one hand, and core knowledge and concepts on the other.

CONTENT AND CONTEXTS

Historically, technical subjects were content-driven. In the GET band (primary and lower secondary schools), the learning areas

Table 1: The learning outcomes and assessment standards continuum between GET and FET.

GET		FET	
Learning Area	Learning Outcomes	Subject	Learning Outcomes
Technology	• Skills • Knowledge • Technology, society and the environment	Mechanical technology	• Skills • Knowledge • Science and society
		Electrical technology	• Skills • Knowledge • Indigenous technology
		Engineering graphics and design	• Skills • Knowledge • Indigenous technology

are broadly outcomes-based in nature, but become more focused at the lower secondary levels (grades 8-9). This form of outcomes-based approach is labelled *transformatory* Outcomes-Based Education (OBE).

The technology subject statements for Grades 10-12 (schools) build on the revised national curriculum, which will be implemented in 2004. This design specifies not only the learning outcomes to be achieved at the end of the band, but also the assessment standards to be attained per grade and the prescribed core knowledge and concepts required in order to achieve these assessment standards. Room has been made for the adaptation and input of local content from provinces (states) into the curriculum. This amounts to 30% in the GET band and 20% in the FET band [6].

The content and context section of the technology subject statements delineates the core knowledge, skills, values and attitudes required to achieve the assessment standards. These core content and contexts are policy and, therefore, included in the National Curriculum Statement for grades 10-12 (schools). Elaboration of this content and context is contained in the learning programme guidelines.

Learning outcomes and assessment standards drive the choice of what goes into the curriculum. The approach adopted in selecting and organising *content*, therefore, prefers a curriculum that leaves sufficient time for critical engagement, reflection, *experimentation* and analysis over a *content-driven curriculum* (where engagement was not emphasised). The content-based curriculum was characterised by rote learning and regurgitations of facts for examination purpose. However, the OBE approach makes it possible to value the experiences that learners bring in from their environment and communities.

The selection and organisation of curriculum also utilises *explanatory narratives* of *central ideas* or knowledge areas, instead of mere topics to be ticked. Topics are elaborated in the learning programme guidelines. The selection also ensures that the selected core knowledge will ultimately lead to the achievement of key critical and developmental outcomes.

In summary, the criteria used to select and organise core curriculum knowledge include the following:

- Achieve key critical and developmental outcomes;
- Link GET-FET learning outcomes and assessment standards;
- Build on the GET knowledge areas (see Table 1);
- Core knowledge in the FET schools ensure conceptual progression in a learning outcome;
- Establish the curriculum in authentic contexts.

The following are the selected central ideas for the electrical and mechanical technologies.

Electrical Technology

Electrical technology builds on the knowledge areas of technology beyond the GET band in the following fields:

- Safety;
- Measuring instruments;
- Principles of electricity and AC circuits;
- Power supplies;
- AC motors;
- Electronics and logic systems;
- Communication systems;
- Amplifiers;
- Switching and control circuits;
- Adder circuits;
- PLCs;
- Anti-intrusion systems;
- Human rights and access;
- Entrepreneurship and career pathways;
- Global patterns [8].

Mechanical Technology

Mechanical technology builds on the knowledge areas of matter and materials, energy and change, as well as earth and beyond in the GET band:

- Safety;
- Measurements;
- Structures;
- Mechanisms;
- Properties of materials;
- Power tools;
- Pneumatic systems [8].

The above central ideas are to be used in order to achieve the three learning outcomes of the two subjects.

CONCLUSION

The development of new technology curricula for the schooling system (ie grade R-12) has been given in this article. The article

also indicated how the new outcomes-based technology curricula differ from the content-based interim syllabi. The new thrust brought into the new technology subjects include the skill-laden and value-laden learning outcomes. The place of *content* has shifted from being an end in itself to being a means to an end by assisting the achievement of learning outcomes.

The challenge of the new technology subjects for the Ministry of Education, in collaboration with higher education institutions, is the preparation of qualified technology teachers. Currently, the number of qualified technology educators for schools are few and far between. This is because, historically, the technology subjects at the primary and lower secondary schools were not part of the mainstream curricula; it is envisaged that this will soon change for the better.

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