Technological process skills for technological literacy: a case of few technology teachers at schools in Tshwane North District D3, South Africa

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ABSTRACT: Technology education, formerly known as technical education has been conceived as being associated with the acquisition of motor skills or a computer related activities. Modern technology involves higher technological process such as creating, designing, modelling, predicting and experimenting, in conjunction with practically problem-solving. There are misunderstanding and misinterpretation on technology education, because of lack of appropriate professional development and teacher training. This article provides the rationale for the development of technology education, which led to technology as a school subject. The study outlined the key technological process skills in the teaching of technology subject and should form part of the development of technology teacher education and training curriculum framework. The results showed that teachers are aware of key technological process skills required in the teaching of technology at schools.

INTRODUCTION

Since 1965, South African system of education could not train and produce the scientists and technicians and technologist, which the work force required. That is, South Africa is still facing a shortage of technically skilled workers at all levels i.e engineers, technicians and technical assistance [1-3]. The technological world known as informative age presents us with tremendous challenges and opportunities. Economic and technological forces have led to unemployment, and yet at the same time pushing our country to a new kind of global competitiveness, one that is resulting in products that improve the quality of our lives and which encourages people to develop new skills and to work in a more effective ways [4][5].

According to Galluzo, there is no faith in the ability of teachers and the present schools to produce students who will excel at the industrial job market [6]. The loss of confidence is fuelled by the beliefs that a) the present configuration of schools is incapable of producing youths who can meet the increasingly complex demands of the workplaces and, b) present school curriculum is outdated [7]. As Frantz put it, all students who graduate from high schools should acquire skills needed for employment as well as those required to continue their education [8]. The quality of technology education programmes is greatly determined by the successful students having acquired the skills, knowledge and values needed by society, more specifically the [9].

Technology education in South Africa has not gained a good recognition and status as in the case of other subjects (Mathematics and Science). Historically, technology education, formerly known as technical education has been conceived as being associated with the acquisition of motor skills or a co mputer related activities [10]. Modern technology involves higher cognitive process such as creating, designing, modelling, predicting, experimenting in conjunction with practically problem-solving tasks [11].

There are misunderstanding and misinterpretation on technology education, because of lack of professional development and teacher awareness of what technology education implies [12][13]. According to Makgato [10], the basic emphasis of technology education is to develop learners' abilities to creatively demonstrate their understanding in a range of knowledge and tasks such as:

- Content knowledge from technical subjects.
- Technical knowledge and skills (practical techniques and processes).
- Design.
- Make and modelling (vocational/technical/practical skills).
- Evaluate solutions to technological problems.
- Test product (prototype, artefact) [14][15].

It may be induced that technical education knowledge is a prerequisite for the effective provision of technology education. It is also true because the concept of design-make and evaluate requires graphic knowledge and skills. The design component overlap with Engineering studies, although in Engineering studies the design involve in-depth and precise calculations and numeric manipulation and measurement [15].

Technology education is fundamentally problem-based, whereas technical education is basically content-based consisting of high technical skills [15-17]. The following Venn diagram below illustrate the interrelationship among Technology education, Technical education and Engineering studies.

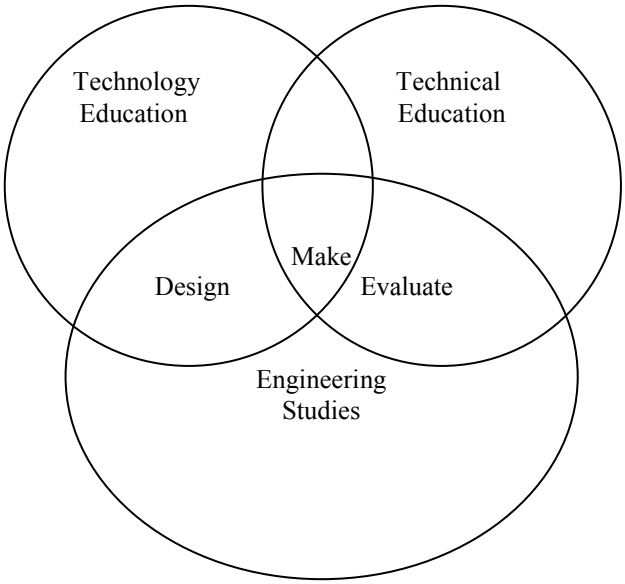

Figure 1: The interrelationship of technology education, technical education and engineering studies.

TECHNOLOGY EDUCATION VERSUS TRADITIONAL TECHNICAL EDUCATION

In many countries, worldwide, technology education is a new subject under development at schools [18][19]. This has, and continues to be the case in developing countries such as South Africa with the development of Curriculum 2005 and its implementation in 1997. There are other countries that have developed and implemented technology education, for example, in 1992 Botswana developed a national curriculum policy in which Design and Technology (Technology) became one of the eight core subjects [20].

In 1990, England introduced Design and Technology into schools [21]. The quality of technology education programmes is greatly determined by the successful students having acquired the skills, knowledge and values needed by society, more specifically the workforce [9]. In most of these countries, various modification has been made or currently been drafted. In South Africa, the C2005 was revised and approved as Revised National Curriculum Statement (RNCS) in 2002 and was implemented in the foundation phase in 2004 [22].

In 2009, the minister of basic education in South Africa announced another revision to the current curriculum (NCS) into the Curriculum and Assessment Policy Statement (CAPS). The revised CAPS differs from the previous OBE curriculum in that it doesn't contain the Learning Outcomes and Assessment Standards. CAPS is structured in terms of topics of the core knowledge of the subject and prescribed teaching , learning and assessment [23]. The revised CAPS will be implemented in 2012 and 2013 into all school grades (Grade 1-12). Curriculum reform in technology education seeks to modify the traditional workshop-based technical subjects tendency to focus on industrial hand and machine skills to a more emphasis in critical and creative higher order thinking skills [24]. Technology subjects are designed to respond to societal changes, such as those evident in many of world's current post-industrial technological societies [25].

Technical education is oriented toward a competency-based curriculum, structured from the perspective of industry needs and standards, and presented using a pedagogy that relies on pre-determined performance objectives including condition, task, and standard [26]. Technical education provides specific pre-determined skills demonstrated to industry standards. It provides occupations based on definable worker competency lists. According to Gardner and Hill, technical education emphasises using tools and making artefacts, with little attention to problem-solving, creativity, design skills, social and environmental concerns [27].

Technical education is viewed as education, which equips learners with marketable skills after Grade 12. In other countries such as Canada, technical skills training was meant to enhance the general education of students intending to

join the labour force on leaving school. It offered industrial skills for youth who had completed high school and occupational skills for adults [27].

The traditional pedagogy of workshop-type technical subjects was, and still in many cases, *demonstration and follow*, and it has been used to good effect in the developing of student competencies, particularly in industrial skills [28]. However, technology education's evolution is transforming the subject from one that requires learners to imitate teacher-prescribed industrial hand and machine skills to one that is argued to be unique in the school curriculum [24]. Technology education is developed to become a subject that is concerned with an individual learner' ability to solve real world problems by integrating specifically relevant knowledge of structures, materials, technological process and systems [29].

Technology has been defined as involving *...the purposeful application of knowledge, experience and resources to create products and processes that meet human needs* [30]. This definition, in common with international statements, stresses the importance of providing students with opportunities for participation in meaningful learning experiences in which they could draw upon their existing knowledge of materials, tools, machines, and systems, as well as gather and use information from a variety of sources.

The meaningful learning experiences should facilitate the engagement of students in problem solving to produce an end process, product, or artefact, thus enabling their construction of new and deeper understandings of technology concepts and processes [31]. The technology education learning outcomes and assessment standards reflect the attainment by students of range of problem solving skills, manipulative skills, and in particular, understanding technology concept knowledge [29].

The overall goal of technological literacy should be to develop technological skills which respond to the current and emerging economic and social needs of the nation and to provide those skills which will allow learners maximum flexibility and adaptability in their future employment and other aspects of life [32]. The following skills are essential to advance technological literacy now and the future:

- Skills of analyzing and problem solving;
- Skills of information-processing and computing;
- An understanding of the role science and technology in society, together with development of scientific and technological skills;
- An understanding of and concern for a balanced development of the global environment;
- Communication and entrepreneurial skills;
- A capacity to exercise judgment in matters of morality, ethics, and social justice [33];
- Designing and making skills [34].

The development of problem solving abilities is pivotal to technological literacy. Problem solving is a critical thinking skill necessary for addressing issues related to technology and developing effective solutions to practical problems [35].

Technology education is considered to be the panacea for the country's economic development and prosperity. Majority of learners in South African schools are characterised by a lack of exposure to technological products (e.g. mechanical toys) and hence lack experiences in *Do It Yourself* (DIY) tools [33]. Designing and Making in technology education will make learners technological literate.

A relatively small amount of research has been done on educators understanding of skills for technological process.

METHODOLOGY

A non-probability purposive and convenience sampling strategy was used in this study. Educators of technology education and technical subjects at the nearby schools in Gauteng Province, South Africa, were identified to complete questionnaires. The questionnaires had to be completed on a small scale. In purposive sampling, the researcher identifies respondents who have expertise and an interest in the field under study, while convenience sampling assists the researcher in including respondents who are available, volunteers or people who can be easily recruited and are willing to participate in the research study [36].

Given that technology education is relatively a new subject at South African schools, the above-mentioned sampling techniques are relevant for the purpose of this study. Three lecturers from Tshwane University of Technology and 28 educators from various schools in Gauteng North District D3 completed 31 questionnaires.

RESULTS

A list of key skills of technological process was mentioned in Table 1 below. Educators were requested to indicate the extent to which they agree with the list of the skills in Table 1.

Table 1: Skills of technological process as viewed by educators.

	FREQUENCIES AND PERCENTAGES				
SKILLS OF TECHNOLOGICAL PROCESS	1-SD	2-D	3-DNK	4-A	5-SA
Identify and clarify design problems			1(3)	11(37)	18(60)
Produce design briefs and specifications to model and generate solutions				12(40)	18(60)
Investigate a situation to gain information during design process			1(3)	10(33)	19(63)
Making using tools, equipment and materials to develop a solution to the identified problem			1(3)	10(33)	19(63)
Evaluate actions, decisions and results throughout the design process				10(33)	20(67)
Communicate using graphic strategies and techniques including sketching, scaled and annotated drawings			1(3)	9(30)	20(67)
Averages	-	-	2%	34%	63%

The table indicates that most educators (63%) strongly agree with the items listed in the table as the skills required in the technological process. The result indicate that educators are aware of skills that are required for technological process of designing and making. Skills is a notion that has only limited meaning without reference to knowledge, values and attitudes. These Skills draw on knowledge, attitudes and values implicit in the designing and making of products and artefact in technology education.

DISCUSSION AND CONCLUSION

Technological process forms the core of the National Curriculum Statement in Technology Learning Area in the GET (Grades R-9) [37]. Newly qualified educators should have skills of designing and making products which meet human needs.

The majority of educators were able to identify skills of technological process as believed to be essential for technological literacy. This awareness is essential and confirms with the same technological process identified by [34] in his study. The fact that educators were able to identify the skills of technological process does not imply that they can apply these skills in the teaching and learning of technology education at schools.

Almost all teachers at South African schools were not professionally trained to implement not only technology education but Outcomes–based curriculum which consist of eight learning areas at General Education and Training band (Grade R-9) [38]. The study helped to conscientise technology educators with the essential skills of technological process which will make learners technological literate.

An awareness of technology educators understanding of skills required in the technological process can have an impact in the teaching and learning of technology education at GET (Grade R-9). Although more professional development and training and classroom-based research are needed, the results of the study illustrated that there is common understanding of skills of technological process.

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