

TECHNOLOGY EDUCATION IN SOUTH AFRICA SINCE 1998: A SHIFT FROM TRADITIONAL TEACHING TO OUTCOMES-BASED EDUCATION

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ABSTRACT: Over the past few years, educators in South Africa have been subjected to many changes. Not only was a new approach to education, namely Outcomes-Based Education (OBE) implemented, but the curriculum was also changed and now consists of eight learning areas, some of which are groupings of traditional school subjects (e.g. languages). Technology, however, is a new and for most educators an unfamiliar learning area. Many educators were caught unprepared when this was implemented in 1998 because they had not been trained to present this new learning area.

Using OBE as the point of departure, the educator is now not only expected to present a new learning area, but also to apply instructional approaches and strategies to adjust to the requirements of the new approach. According to Killen (2000, pp. vii, xiv-xv) all decisions pertaining to planning, instruction, assessment and evaluation in OBE are determined by the following four principles: the outcomes educators want learners to achieve; the content used by educators to help learners to achieve the outcomes; the process (instructional approach and strategies) educators employ to assist learners to achieve the outcomes and the assessment of learners. Very little educator support material (ESM) which complies with the essential features of technology education exists (Reddy, Ankiewicz, De Swardt & Gross, 2003). The purpose of this paper is to address the shift from traditional to appropriate instructional approaches and strategies that educators of technology should be utilising and to discuss how educator support can be provided for these educators.

Keywords: outcomes-based education; instructional approaches; instructional strategies; outcomes; conceptual knowledge; procedural knowledge; educator-control; learner-control, educator support material.

INTRODUCTION

Outcomes-Based Education (OBE) clearly means focusing and organising everything in an education system around what is essential for all learners to be able to do successfully at the end of the learning experiences (Killen 2000, p. vii). This means starting with a clear picture of what is important for learners to be able to do, compiling a learning programme and planning instruction and assessment to make sure this learning ultimately happens. Thus, OBE involves the formulation of outcomes that learners need to achieve at the end of their schooling. The system of education has to be organised in such a way that it makes it possible for learners to achieve these outcomes. According to Killen (2000, pp. vii, xiv-xv) all decisions pertaining to planning, instruction, assessment and evaluation in OBE are determined by the following four principles: the outcomes educators want learners to achieve; the content used by educators to help learners to achieve the outcomes; the process (instructional approach and strategies) educators employ to assist learners to achieve the outcomes and the assessment of learners.

By means of research (Bak 1999, pp. 2, 3; O'Connell 1999, p. 21; Marrow 1999, p. 37; Naicker 1999, p. 52; Jansen 1999, pp. 88, 92) it was established that educators in South Africa do not possess sufficient knowledge of OBE. OBE focuses on the outcomes that must be achieved by the learners. The educator must therefore ensure that the learner achieves this outcome by means of sound planning, presentation and organisation. The Technical Committee on the Revision of Norms and Standards for Education (1998) developed descriptions of the roles of the educator and the competences (practical, foundational and reflexive) that are required for each role. For the purpose of this paper, these roles cannot be discussed fully, but it is sufficient to say that it is expected of the educator to be a mediator of learning as well as a learning area specialist. This means that the educator will be sensitive to the diverse needs of learners, will construct learning environments that are appropriately contextualised, will demonstrate sound knowledge of the learning area and will know about different instructional approaches, strategies and skills (Killen 2000, pp. 189, 190; Technical Committee on the Revision of Norms and Standards for Educators 1998).

Translated into technology education it would mean that the educator is expected to possess technological (conceptual and procedural) knowledge; to have the ability to control specifically the technological process (procedural knowledge); to grasp the various learner activities (resource,

capability and case study tasks); and have a sound knowledge of learning and instruction that will support the learner in the technology class.

The majority of educators in South Africa have been exposed to technology for the first time in their careers, and although some educators may be familiar with some of the “... concepts, content and methods associated with technology education, the vast majority have had no formal training in this regard” (Potgieter 2004, p. 205). In many cases the educator in the technical subjects (woodwork and metal work) and home economics continued the instruction of technology education in the traditional way, and is not aware of, or motivated to make the adjustment required by OBE (RAU Rapport 2002, p. 60). In South Africa technology educators do not have the privilege of having a recorded best practice experience and a history of technology education which they can draw on, and therefore there is a dire need for support and guidance (training) for these educators (Potgieter 2004, p. 210). However, although technology educators have experienced success by trial and error with the instruction of technology education, they have lacked a powerful connection or grounding between well-researched theories on learning and instruction (De Miranda 2004, pp. 64-65).

The purpose of this paper is to address the shift from traditional to appropriate instructional approaches and strategies that educators of technology should possess, and to discuss how educator support can be provided for technology educators.

The research questions addressed in this paper are:

- What is the relationship between learning and instruction in technology education?
- Which instructional approaches and strategies are suitable in technology education?

LINKING INSTRUCTION IN TECHNOLOGY EDUCATION TO RELEVANT LEARNING THEORIES

Introduction

There can be no claim to effective instructional practice unless possible ways in which learning takes place are explored (Fraser, Loubser & Van Rooy, 1994, p. 37). Literature contains many suggestions about what educators can do to help their learners develop knowledge or skills (Good & Brophy 1991, in Killen 2000 p. x). However, these researchers agree that no single instructional strategy is effective for all the learners all the time. The reason is that instruction and learning are very complex processes that are influenced by many different things, such as learners’ attitudes,

abilities, educators' competencies, context, etc. Effective instruction requires active involvement of learners and an emphasis on academic achievement (Killen 2000, p. x; De Miranda 2004, p. 65). The educator may therefore not find it easy to decide what instructional strategy to use for a particular lesson because the number of factors that should be considered is quite large. An important first step for the educator is to accept that having content knowledge is simply not enough to teach effectively. The educator must also know how to engage learners in the learning process and know how to organise information so that the learners can profit from their experiences. The desired learning outcomes, the requirements of learners, the learning context, and the content must serve as a guide for the selection of instructional strategies, which means that the educator should never select the strategy before considering these facts (Killen 2000, p. xiv).

A brief view on the relationship between learning and instruction

According to Killen (2000, p. xix) approaches to learning can, or should, be translated into approaches of instruction. With the implementation of OBE there is an increasing need to emphasise learning outcomes that lead to the development of understanding and the improvement of intellectual skills. These types of learning outcomes require that instruction be designed around constructivist learning theories (Royer, 1996; cited by Johnson, 1997, p. 47). This will result in the establishment of stimulating learning environments in which flexible, highly interactive, group and project-orientated strategies of instruction are employed (De Miranda 2004, p. 65).

Banks (1992, p. 167) is of the opinion that for educators to cope with the particular demands of teaching technology education, there is a need for an approach which will develop reflective educators who have a grasp of the theoretical background to select appropriate instructional strategies. Technology educators should therefore match their desired learning outcomes and instructional strategies to appropriate learning theories (Johnson, 1997b, p. 47). This implies that the **activities** of the Technology educator (instructional approaches, strategies and skills) are primarily determined by the learning outcomes and subject content (guided by the epistemology, methodology and volition) (Ankiewicz 2003, p. 17). Based on this, and given the nature of the subject/learning area, contemporary educators in Technology education are required to use a variety of instructional approaches and strategies to complement the unique requirements of the curriculum and to enable learners to learn optimally (Reddy, Ankiewicz & De Swardt 2005, p. 2). Since technology education is consonant with the view of learners as active participants in the instructional process, these strategies require that learners become active and self-directed in their learning, which is a direction towards constructivism (Reddy, et al. 2005, pp. 3-4).

a. Constructivist approach to learning

The basic premise of constructivism is that knowledge is obtained and expanded through active construction and reconstruction of theory and practice, which means that learning is not a passive process (Reddy, et al. 2005, pp. 3-4; Taylor 1999, p. 258). The construction and reconstruction of theory and practice claim to be meaningful learning in the sense that it is the active creation of knowledge structures (for example concepts, rules, hypotheses, associations) from personal experience. This means that a learner builds a personal view of the world by using existing knowledge, interests, attitudes, etc. to select and interpret currently available information (Biehler & Snowman 1997, p. 365).

Originally, 'constructivism' was used to describe a theory of learning. More recently, it has become associated with a theory of knowledge that says that the world is inherently complex, that there is no objective reality, and that much of what we know is constructed from our beliefs and the social milieu in which we live (Borich & Tombari 1997, p. 177). When the term is used to describe cognitive models of learning, constructivism can be defined as 'an approach to learning in which learners are provided the opportunity to construct their own sense of what is being learned by building internal connections or relationships among the ideas and facts being taught'. The perspectives representing constructivist theories of learning are radical, cognitive and social constructivism (Cobb 1994; Killen 2000, p. xviii) which are relevant to learning and instruction in technology education (Reddy 2005, pp. 7-9).

The view of knowledge suggested by *radical constructivism* is that human beings are, from birth, constantly engaged in the process of adaptation of knowledge. According to Zietsman (1996, p. 72) human knowledge does not consist of real, true facts, but is viewed as knowledge that is viable to the individual, in making sense of the world that he/she lives in. The implication for teaching is that such a theory of knowledge does not reveal facts to the learners, but creates opportunities for them to test "whether their construing of situations adequately accounts for what they see, hear or experience" (Candy, 1991, p. 265; Reddy et al. 2005, p. 7). Arising out of the radical constructivist approach to learning is the question of reflection and choice on the part of learners (hence the freedom for alternative conceptions) implying that any person can be an autonomous learner (Zietsman, 1991, p. 73). This does not suggest that learners should be left to their own devices, since they have the potential to perform on their own, but radical constructivism suggests that

educators “create situations in which learners could develop and exert their innate drive towards acting independently” (Candy, 1991, p. 258). Radical constructivism as an approach to learning has some important implications for learning in technology education since each learner needs to be provided the opportunity to experience knowledge construction through the processes of creative and critical thinking, decision-making, problem-solving and design on an individual basis (Reddy, et al. 2005, p. 7).

The notion of *cognitive constructivism* focuses on the cognitive processes that “learners actively construct knowledge for themselves by forming their own representations of the material to be learned, selecting information they perceive to be relevant, and interpreting this on the basis of their present knowledge and needs” (Dart 1994, p. 1). Abbott and Ryan (1999, p. 2) express it this way: “A person learning something new brings to that experience all of their previous knowledge and present mental patterns. Each new fact or experience is assimilated into a living web of understanding that already exists in that person’s mind”. Although this view draws heavily on the work of Piaget (essentially focusing on individual constructions of knowledge that are developed through interactions with the environment), it fits well with current models of cognition (Killen 2000, p. xviii).

Whilst the experiential world of the learner is the central focus of the Piagetian perspective (radical constructivism), learning in the Vygotskian perspective (*social constructivism*) is placed firmly in the social and cultural domain. It places the learner in a specific “cultural space” so that the learner is seen to be engaged in constructing knowledge not in isolation, but in a “context that is shaped and modified by the influence of the society he/she finds himself/herself in” (Magadla, 1996, p. 83). Social constructivists see learning as a process of “enculturization”, whereby learners are inducted into the cultural practices of the societies they live in. This implies that the learner appropriates meaning from the social and cultural environment (Magadla, 1996, p. 86) before meaningful learning takes place. In support of this, Ellsworth (1989; cited by O’Loughlin, 1992, p. 337) states that all learners possess multiple frames of reference with which to construct knowledge, by virtue of their ethnic background, race, gender, language, and religious, cultural and political identities (Reddy, et al. 2005, pp. 3-4). From a social constructivist perspective, the role of the teacher is that of mediating between learners’ “personal meaning” and the “culturally established meanings of wider society” (Cobb, 1994, p. 15). The implication for learning and instruction is that learners’ social and cultural environment, i.e. home and family milieu, living conditions, religious and socio-economic factors, need to be considered in the teaching and learning environment.

The focus of intellectual development from the solitary individual to the individual in a highly interactive social milieu has opened other possibilities for education, such as co-operative learning (Black & Ammon, 1992, p. 325). Rogoff and Lave (1994; cited by Johnson, 1997, p. 171) state that all cognitive activity is socially defined. By interacting with others, learners have the opportunity to learn from one another, share knowledge, engage in co-operation and competition and negotiate meaning. Through the social activity of learning, therefore, teachers have the opportunity to develop a community of learners (Reddy, et al. 2005, p. 9). The nature of technological activities lends itself amply to learners interacting with one another in a co-operative learning environment. Social constructivist theories of learning therefore have important implications for learning and instruction in technology education. Based on this, different competencies could be derived which can serve as a basis for content selection and methodologies in technology education (Reddy, et al. 2005, p. 8).

Arising from the constructivist approach to learning are various sub-approaches and concomitant instructional strategies (Black & Ammon 1992; Reddy, et al. 2005, pp. 7-8). The sub-approaches include co-operative learning, discovery learning, enquiry and experiential learning. Instructional strategies associated with co-operative learning, for example are group work, discussion, debate and role play (Wheatley, 1991, p. 10; Johnson, 1997, p. 172; Banks, 1996, p. 10).

Johnson (1997, p. 177) asserts that if intellectual skill development is to become the larger focus of the technology education curriculum, it does not imply that the behaviourist theories of learning be tossed aside in favour of the more contemporary social-constructivist theories. In fact, some approaches could entail a combination of both theories (Ankiewicz 2003, p. 18; Hammer 1997, p. 488). It is, however, important to establish a balance between both forms of learning. Bowen (1996, p. 19) alludes to the fact that content-based learning is not the antithesis of cognitive-based learning.

b. Behaviourist approach to learning

Royer (1996; cited by Johnson 1997, p. 48) provides a taxonomy of learning outcomes that helps clarify which learning theories are appropriate for different types of learning to occur in technology education. These learning outcomes include memorisation of important information, development of motor skills and understanding of concepts and relationships. Embedded in this are factual knowledge and basic skills (Biehler & Snowman 1997, pp. 250-255). Designing instruction around the behaviourist learning theories, states Royer (1996; cited by Johnson 1997, p. 49), is appropriate

when the learning outcome is to help learners remember important information or to develop their skills in using and operating tools and equipment (Reddy et al. 2005, p. 3). Ankiewicz (2003, p. 18) acknowledges this as well and states that factual knowledge (embedded in conceptual knowledge) and basic skills (as lower-order procedural knowledge) are part of the epistemology of technology, and therefore it opens the door to an instructional approach related to behaviourist learning theories and can be achieved with lectures and demonstrations as instructional strategy. Although it may sound paradoxical within the general perception of OBE in South Africa, a behaviourist approach is permissible in OBE. The planning of instruction based on behaviourist learning theories is admissible if these theories are aimed at helping learners to remember important information or to develop their skills in the use of tools and equipment (Johnson 1997, pp. 177-178), or as Killen (2000, p. x) puts it: "... no single teaching strategy is effective all the time for the learners".

The instructional strategies related to the above-mentioned approaches to learning will be discussed below.

RELEVANT INSTRUCTIONAL STRATEGIES FOR TECHNOLOGY EDUCATION

Introduction

From an OBE perspective, one important change in instruction is that we now emphasise the fact that the educator's main role is to facilitate learning rather than to be a source of all knowledge. This means that educators have to help learners construct their own knowledge, rather than simply supplying information that they are expected to memorise.

From the discussion on learning theories it can be deduced that the educator features prominently in learning events where a learner has to memorise content, but features much less prominently in situations where the learner has to give his/her own meaning to the learning event. Killen (2000, p. xi) refers to this behaviouristic and constructivist learning as "educator-centred and learner-centred ... an unfortunate set of labels to use because learning (and therefore, learners) should be at the centre of all teaching".

The different instructional strategies applied by the educator are ways of helping learners to learn, in other words, to help learners achieve the learning outcomes that are important. Choices should range from a totally educator-dominated approach in which the learners are simply passive recipients of the information given to them, to totally independent learning where the educator plays

no active role. Between these extremes are several major instructional strategies that can be employed (Killen 2000, p. xiii). The selection of an instructional strategy for a particular lesson will be guided by beliefs about instruction and learning, knowledge of the subject matter, the overall outcomes of the course, the specific learning outcomes learners must achieve, knowledge of the characteristics of learners, and issues such as time and resources (Killen 2000, p. xxix).

Killen (2000) and De Miranda (2004) claim that instructional strategies grounded in cognitive science attempt to transfer the self-regulation and monitoring of cognitive functions such as memory, process, control of thinking process, reflection, appropriate application, and the cognitive tools for thinking and learning from the teacher to the learner. Kimbell (1994, p. 73) refers to this as progression: "... a progressive unpeeling of layers of meaning should be employed in all fields of technology ...". In order to illustrate this gradual transfer of control (regulation) the strategies of direct instruction, classroom discussion, small-group discussion, group and project work will be discussed as indicated in Figure 1. Discussion of this figure will reveal the increasing shift to the constructivist side, but also that teaching continues taking place between the two extremes on the continuum, depending on what the teaching-learning situation demands.

Direct instruction

Direct instruction as a strategy (Figure 1, a.) is widely applicable and can be used to teach concepts, factual knowledge and basic skills through whole class instruction, lectures (sometimes called 'talk and chalk') and demonstrations (Gunter, et al. 1995, p. 60). When direct instruction is used the educator assumes major responsibility for structuring the content or skills, providing opportunities for practice and giving feedback (Eggen & Kauchak, 1996, p. 181).

Gunter, et al. (1995, p. 73) state that every educator, of every subject/learning area, at every level of schooling has learning outcomes related to the acquisition of factual knowledge and the mastery of basic skills before the learner can move to higher levels of thinking and learning. Certain types of outcomes require that practice and feedback should receive particular attention. Outcomes in the psychomotor domain in particular, necessitate drill and practice (for example practical skills in technology education), whilst outcomes in the knowledge domain (conceptual and procedural knowledge) may require information to be committed to memory (Royer, 1996; in Johnson, 1997, p. 49).

In technology education, like most other subjects and learning areas, there is a body of content (conceptual) knowledge that needs to be learnt, and there are basic practical skills and techniques that have to be mastered before these can be applied meaningfully (McCormick 2004, p. 24; Dugger, 1997, pp. 126-7). This means that the educator instructs and demonstrates and learners model themselves on the educator, by learning the content knowledge and applying the skills (Down, 1996, p. 231). This strategy clearly places the educator at the centre of instruction.

This does not mean that direct instruction excludes the use of constructivist approaches to instruction because "... the educator cannot tell the learner everything" (Biehler & Snowman 1997, p. 366), but simply emphasises that sometimes learners need careful guidance in their learning. As soon as a knowledge base has been established, the educator can move towards classroom discussion.

Classroom discussion

Classroom discussion (Figure 1, b.) is an orderly process of face-to-face group interaction in which educator and learners exchange ideas. The purpose of the discussion might be to solve a problem, answer a question, enhance the learners' knowledge or understanding or reach a decision (Gunter et al. 1995, p. 174). Discussion is a versatile instructional strategy that can be adapted to suit any subject/learning area at any level. Discussions can involve the whole class or may be used with small groups. As with other learner-centred instructional strategies, discussion can often be used to complement other strategies of whole-class instruction, rather than as the sole method of instruction (Killen 2000, p. 31).

When discussion involves the *whole class*, the lesson will have some of the characteristics of both direct instruction and whole class discussion (Killen 2000, p. 32). It will resemble direct instruction because the educator will determine the desired lesson outcomes, control the learner activities, and maintain the focus of the lesson on some form of academic outcome. It will also resemble whole class discussion because a large part of the input of the lesson will come from learners and they will be actively engaged in learning. Discussion can be considered as the art of co-operatively thinking aloud and exchanging ideas. Because learners are expected to share their thoughts, it is both active and learner-centred (Killen 2000; Reddy 2001; De Miranda 2004).

During a productive classroom discussion learners will be thinking, offering opinions, developing reasons and providing justifications. This takes time and the interactions will be unpredictable

which does not mean that the discussion is not within the educator's control (Killen 2000, p. 33) but that the educator has less control here than during direct instruction.. Discussion can be viewed as a bridge between direct instruction and learner-centred instruction but can also proceed to discussion in smaller groups (Killen 2000, p. 34).

In *small-group* discussions (Figure 1, c.) learners brainstorm their ideas before exposing them to a wider audience, and the pooling of ideas could help the further development of vague ideas. Learners may find it difficult to formulate novel ideas, especially during the initial idea-generation stage of the technological process, and through sharing learners are stimulated to arrive at exciting technological insights of their own. This way, richer and more challenging views emerge, learners are pushed to higher levels of cognitive thought (Reddy 2001, p. 157) and it paves the way to collaborative (co-operative) learning.

In technology education small-group discussion provides learners with a way to generate their own ideas and to gain ownership of them when they consider a topic, argue their findings, suggest solutions and draw conclusions. Because the educator will have even less control during small-group discussion than was the case in whole-class discussion, it is still the responsibility of the educator to pose the problem, initiate discussion and allow learners to pursue interaction towards the attainment of solutions. It is important to create an open atmosphere in which learners feel free to contribute and analyse their ideas. Learners must be encouraged to share thoughts openly, even though the conclusions they draw may sometimes seem far-fetched. That is why the educator will be more in the background in comparison with whole-class discussion, but must be available to keep the learners on track towards the learning outcome (Reddy 2001, p. 155).

Group work as instructional strategy linked to co-operative learning

Group work (Figure 1, d.) is when two or more learners work together to attain learning outcomes (Gunter et al. 1995, p. 222). All approaches to group work have the distinguishing feature that learners are working together without direct intervention by the educator, for at least some of the time. In comparison to the small-group instructional strategy the educator's control further decreases. This does not mean that learners are left to their own devices to learn whatever they like. It means that the educator has to structure the learning environment so that the learners can interact productively under the indirect guidance of the educator and be able to work towards achieving particular learning outcomes. The principal reason for using this instructional strategy is that, in some circumstances, it offers greater opportunities for learners to learn than would be possible in

whole-class instruction. The educator has to consider the outcomes that the learners must achieve, the characteristics of the learners and the resources and time available. There is no point in using group work as an instructional strategy unless it is likely to lead to the achievement of desired outcomes that cannot be achieved more easily in some other way (Killen 2000, pp. 72-73).

The nature of technological activities lends itself amply to learners interacting with one another in a co-operative learning environment (McCormick 2004, p. 29). Constructivist theories of learning (social) therefore have important implications for learning and instruction in technology education. The thinking processes fundamental to technology education are creative and critical thinking, decision-making and designing, leading to problem-solving and design (Sharpe 1996, p. 29; Johnson 1997, p. 163).

There is wide consensus that co-operative group work is the norm in practical settings outside schools, especially in technological activities, where learning is characterised by the sharing of knowledge and the construction and negotiation of meaning (Hennesy & McCormick 1994, p. 95). It is universally accepted in industrial settings that success in any technological venture requires participation in groups. Simulations of industrial settings in a technology education classroom can contribute significantly to enhancing technological literacy (Edminson 1995, in Reddy 2001, pp. 152-153). Through co-operation it is possible to help learners achieve far more than through working independently and it is logical to conclude that two or more learners working co-operatively on a technological activity nearly always produce higher levels of achievement than that produced by individuals working alone (Reddy 2001, p. 153; De Miranda 2004, p. 67). During this time the educator assumes a non-judgemental but facilitative role, encouraging learners to negotiate their differences and work towards consensus (Reddy 2001, p. 108; De Miranda 2004, p. 74). During classroom discussion the educator is much more “visible” and in the foreground than during group work, but not as much as during direct instruction.

Reddy (2003, 379) warns, however, that for meaningful learning in technology education to take place, co-operative learning and group discussion (social constructivist approach) need to be balanced with individual involvement and active participation of every single learner in his/her own intellectual development (radical and cognitive constructivist approach). Whilst co-operative learning and group discussion are essential for the holistic development of learners, they should at the same time be provided with opportunities to engage in problem-solving tasks and activities on an individual basis. There is therefore a danger of over-reliance on the co-operative learning and group discussion approach to learning.

Project work

Project work (Figure 1, e.) is important in a number of curricular areas, particularly in technology education (Reddy 2003, p. 128). This is because it provides opportunities for learners to experience genuine technological activity, which can be a response to a human need or problem (Ankiewicz, De Swardt & Stark 2000, p. 129). The importance of project work as an instructional strategy to engage learners in experiential activities is highlighted by Cross and McCormick (1996, p. 254). They state that project work in technology education seeks to develop skills in the application and use of knowledge and expertise in solving particular problems; the ability to work with others; divergent and convergent thinking by giving due consideration to intuitive inspiration, accidental developments, as well as logical step-by-step progression and self-discipline and responsibility, as the learner is responsible for the success or failure of the project.

During project work learners make an inquiry into a real-world problem and the educator is in the background. Learners investigate, record and report and take greater “ownership” of their work (Jakovljevic, Ankiewicz & De Swardt 2005, 4). Projects should supplement text-based instruction, and should focus on searching, solving, creating and sharing. Time planning is also important because projects must be completed within certain time frames. The role of the educator is to start with a discussion/demonstration; manage learners (act as facilitator), monitor the project and allow time for a conclusion/assessment. Instructional time will be organised in such a way that it favours interaction of learners to examine common problems and seek solutions to problems collaboratively. The educators provide support to learners through specific feedback, coaching and hints (De Miranda 2004, 73-74). The emphasis throughout is on co-operative effort by the educator and learners to bring meaning to the ideas in the context of the technological dilemma, rather than merely teaching the solution. “... the responsibility shifts gradually from the teacher doing much of the work to the learner taking over the major thinking role while the teacher observes and helps only when needed” (De Miranda 2004, p. 74). When compared to the direct instructional strategy it is clear that this strategy is positioned at the opposite extreme of the suggested continuum. Project work is effective if educator-control is less than in the other strategies discussed.

Conclusion

In the above discussion it was indicated that the educator can gradually transfer the control and responsibility for learning to the learner through the application of direct instruction to project work. The involvement of the educator is, for example, much more prominent and visible during direct instruction and gradually decreases to where it is more subtle and in the background during group and project work. This is also demonstrated in Figure 1. Furthermore, this implies that the flexibility in teaching, through the educator’s application of teaching strategies, must enable to and fro movement on the continuum when the situation demands it, in order to optimise learning opportunities for learners.

DESCRIPTION A DEMONSTRATION OF THE CONTINUUM OF DEVOLUTION OF TEACHER CONTROL

APPROACH	More towards Behaviourism	Constructivist			
FOCUS	Teacher-centred	Learner-centred			
EDUCATOR-CONTROL	High educator-control	Low educator-control			
THINKING	More towards low learner thinking – learners participate “passively”	High learner thinking – learners are forced to construct their own meaning			
STRATEGIES	a. Direct instruction	b. Class-room discussion	c. Small-group discussion	d. Group work	e. Project work

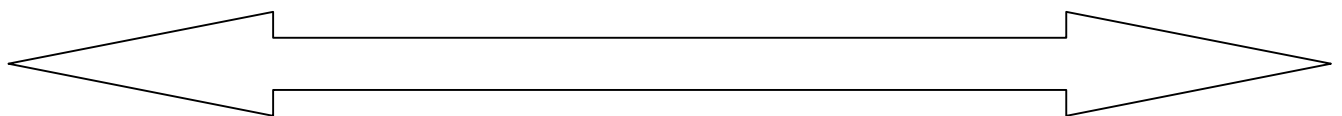


Figure 1: RELEVANT INSTRUCTIONAL STRATEGIES FOR TECHNOLOGY EDUCATION

THE IMPLICATIONS FOR OBE-RELATED INSTRUCTIONAL STRATEGIES FOR EDUCATOR SUPPORT MATERIAL (ESM) IN TECHNOLOGY EDUCATION

Only a small percentage of educators are ready and well-equipped to deal with the demands of OBE and with the de-emphasis on subjects, content and textbooks, educators are left with a huge and unmanageable task (Taylor 1999). The effective implementation of curriculum transformation presupposes a clear understanding and preparation of the educators. It also presupposes good “subject” knowledge and many researchers have pointed out that OBE will demand more, not less, conceptual understanding, advance availability of materials and ongoing support. Educators and learners must have access to materials which systematically explore the entire knowledge field of each learning area (Schreuder 1999, pp. 82-84). It stands to reason that very little or no learning support material (LSM) and educator support material (ESM) were available when the learning area technology was introduced. RAUTEC (a university-based school technology centre) has identified this need and established a writers' forum, consisting of experienced technology educators, identified on the basis of their knowledge and skills, to participate in a project to develop learner and educator support material in technology education (Ankiewicz & De Swardt 2002). Based on a part of the preceding theoretical foundation of the instructional methodological aspects of technology education, the extent to which the ESM developed by RAUTEC is structured according to the four principles determining OBE, namely outcomes, content, the process of instruction and assessment, will now be indicated.

Outcomes

In order to comply with policy, specific outcomes (first principle), one or more out of seven, are chosen for a specific module from the policy document (Gauteng Department of Education 1999). The formulation of these specific outcomes is, however, general in nature and it is necessary to be more specific. In the various modules of the RAUTEC ESM, which is subdivided into units, module and unit outcomes are furnished to serve as a map for the educator for the teaching-learning events. These also guide both the educator and the learner in being more focused on specific learner activities, including resource, case study and capability tasks (Ankiewicz, De Swardt & Engelbrecht, 2005, p. 10).

Content

From the framework given in the policy documents for the learning area (Gauteng Department of Education 1999) the educator can make a choice regarding the content (second principle) that will serve as the vehicle for learners to achieve certain outcomes within the technology learning area. Content consists of conceptual knowledge aimed at the learner learning factual knowledge and

basic skills by means of resource and case study tasks. Direct instruction with accompanying demonstrations where necessary, is normally used. Based on the stage model of the technological process, the learner develops procedural knowledge through practise, as well as through repetitively working through more modules (McCormick 2004, p. 29; Ankiewicz et al 2005, 11).

Instructional strategies and skills

As the educator's intention would be to optimise learning in learners, different teaching strategies (third principle) are presupposed by means of the learner and educator activities that are best suited to the specific types of content and outcome. In the case of basic skills and factual knowledge the instructional strategy is associated with behaviourism, and in the case of complex thinking it is constructivist. This does not preclude facts from being acquired through cognitive construction (Sfard 1998). In this way the educator is practically "forced" to follow a teaching strategy which will optimally promote learning in technology education (De Miranda 2004; McCormick 2004). The module is structured in such a way that learning opportunities and the role of the educator on the continuum, as indicated in Figure 1, will become more constructivist in nature. The module is structured as a project and learner activities are also planned around group work or individual activities, depending on which is most meaningful for optimal learning. This necessarily results in the learner increasingly being able to accept more responsibility for his/her own learning. The different activities are, however, carefully planned so that there is not only a wide variety, but also a balance between group work, characterised by the social constructivist approach, and individual work, characterised by the radical constructivist approach (Reddy et al. 2003, p. 42), as well as the cognitive constructivist approach (Sfard 1998), so that each learner is given the opportunity to experience knowledge construction through creative and critical thinking, decision-making, designing and problem-solving on an individual basis.

Instructional strategies also presuppose that the educator possesses instructional skills for their successful execution. In technology education the instructional skills mentioned below are relevant, and in the ESM it was endeavoured to furnish guidelines, especially as regards planning, time-management and organisational aspects and questioning (Biehler & Snowman 1997, p. 490; Gunter et al. 1995; Ankiewicz & De Swardt 2001).

Planning skills: In the investigation and making stages of the technological process thorough planning for readying tools and material for learning activities is a prerequisite. The timely

planning of, for example, a field trip, the preparation for a demonstration or having the resource material available, will have a positive influence on the learning events.

Time management: All the stages of the technological process do not take up the same amount of time and the duration per module and per unit is indicated as a guideline to ensure completion within a realistic time span. Complying with the time framework during the presentation of a new learning area is a challenge – even for the experienced educator.

Organisational and managerial skills: These skills are necessary in the technology class, where it concerns not only the timely preparation of tools and material, but also the management of events in a workshop situation. This is essential for the completion of tasks and certainly in the precautions taken for the safety of learners. The management of group work demands certain grouping skills from the educator as grouping does not merely entail placing learners together. Group work must be planned and managed carefully. “Good teachers are in charge of their classrooms” (Gunter et al. 1995, p. 349).

Questioning skills: Questions of different styles asked on different levels and at different moments, etc. direct the teaching-learning events. They demand prior reflection and planning in order to be executed meaningfully. The tendency to ask questions only on the knowledge level (reproductive) is prevalent, and in this way the cognitive input of learners is not elicited. In technology education the technique of asking provocative questions, or answering learners’ questions with questions, is more productive.

Assessment

Educators/facilitators receive assistance for assessment (fourth principle) with regard to the types, techniques and use of instruments in assessment. Reminders are periodically given to assist the educator/facilitator in recording the assessment results. Prototype "answers" are enclosed, assisting the educator/facilitator in assessment (Van Niekerk, Ankiewicz & De Swardt, 2005).

Feedback/responses from technology education educators

The effectiveness of the RAUTEC ESM is currently being researched and documented. The RAUTEC writers' forum has received numerous positive reports from the users of the ESM, namely:

“The books assist me with my lesson preparation and time planning. They remind me well in advance to get tools and materials ready for the next activity”

“For me as a novice technology educator the information in the facilitator guide is very helpful. The example answers help me a great deal with my marking”

“It empowers the learner and educator to a great extent and meets an urgent need within education by providing a vast amount of useful material”

CONCLUSION

Technology education is still in its infancy and because teachers are forced to teach technology education without any worthwhile training, the import of this paper is that it is essential to structure ESM in such a way that the guidelines will discourage educators from slipping into traditional forms of instruction so that they will make the shift to OBE.

The purpose of this paper was to illustrate how approaches to learning should be translated into approaches of instruction through appropriate instructional strategies in order to realise the shift from a traditional to an OBE approach of instruction (Research question 1).

Technological knowledge (encompassing conceptual and procedural knowledge) opens the door for instructional approaches related to both behaviourist and constructivist learning theories. This forces the educator in technology education to design learning programmes for learners in such a way that they will gradually become more constructivist in nature, in order to establish increased self-reliance and the opportunity for complex thought and construction of meaning in learners. Through the application of appropriate instructional strategies, ordered according to a continuum, the learner can accept increasing control and responsibility for learning. The nature of the content (conceptual and procedural knowledge) and the learner tasks will be the indicators for the choice of an instructional approach and strategy followed by the educator (Research question 2).

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