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*Piet Ankiewicz, Fatima Adam, Estelle de Swardt & Elna Gross*

# The facilitation of critical thinking in a Technology Education classroom

## Summary

The teacher's role in facilitating learning and thinking in Technology Education classrooms is crucial to creating an environment conducive to the promotion and development of thinking. The aim of this study was to determine how teacher facilitation can promote and develop thinking in Technology Education lessons. A single case study using a qualitative research approach with convenience sampling and involving grade eight Technology Education learners was used to conduct the study. Data collection was by means of direct non-participant observation of both teacher-learner and learner-learner interaction. Transcripts of video tapes, audio tapes, field notes and instructional aids were analysed and recommendations for the facilitation of co-operative learning and critical thinking in the Technology Education classroom were made.

## Die fasilitering van kritiese denke in 'n Tegnologie-onderwysklaskamer

Die rol van die onderwyser in die fasilitering van leer en denke in Tegnologie-onderwysklaskamers is noodsaaklik ten einde 'n omgewing te skep wat bevorderlik is vir denkontwikkeling. Die doel van hierdie studie is om vas te stel hoe fasilitering deur 'n onderwyser denke tydens 'n tegnologie-onderwysles kan bevorder en ontwikkel. Die navorsingsbenadering is kwalitatief van aard en daar is van gerieflikheidsteekproeftrekking gebruik gemaak in 'n enkel gevallestudie. Tegnologie-onderwysleerders van graad agt is betrek. Data-insameling het geskied deur middel van direkte nie-deelnemende observasie van beide onderwyser-leerder- en leerder-leerder-interaksie. Transkripsies van video-opnames, oudiobande, veldnotas en onderrighulpmiddels is geanaliseer en aanbevelings vir die fasilitering van koöperatiewe leer en kritiese denke in die tegnologie-onderwysklaskamer word gemaak.

*Prof P J Ankiewicz, Ms F Adam, Dr A E de Swardt, Dept of Curriculum Studies, Rand Afrikaans University, P O Box 524, Auckland Park 2006; E-mail: pja@edcur.rau.ac.za, aeds@edcur.rau.ac.za; Dr E J Gross, P O Box 1787, Cresta 2118; E-mail: hhg@icon.co.za*

The emergence of a technologically based society has made serious demands upon the education sector to produce highly skilled and innovative individuals (Mullar 1992: 18; Paul & Wilson 1994: 3). Technological changes require citizens to be able to deal effectively with an ever-changing context, to find solutions to unfamiliar problems in their workplaces, and to participate effectively in the day-to-day decisions affecting their lives (Jones 1997: 242).

These pressures have resulted in a number of international attempts to reform and redevelop the school curriculum (Potgieter 1994: 12). The inclusion of Technology Education as a subject in the school curriculum in many countries constitutes one such attempt (Layton 1995: 92). Technology Education is viewed as having the potential to develop the higher-order thinking required to solve the complex technological problems facing people today (Layton 1988: 15; Sterry & Savage 1990: 26; DeLuca 1992: 26; Potgieter 1994: 12).

South Africa is no different from countries across the globe in its need for informed citizens able to deal with a complex, ever-changing context and participate in the development of a growing democracy (ANC 1994: 83). The country needs an education system that produces independent, critical thinkers who are able to question, weigh evidence, make informed judgements and accept the incomplete nature of knowledge (RSA 1995: 22). The implementation of Technology Education in the school curriculum forms part of this innovation (HEDCOM 1996: 2).

The vision for Technology Education is to produce creative, adaptable, critically thinking, autonomous, entrepreneurial and employable citizens (HEDCOM 1996: 1). Technology Education is defined in the HEDCOM Technology Education project as being concerned with promoting the capability of learners to use, evaluate and design appropriate technological solutions to problems. Knowledge, skills and an understanding of the impact of technology on the individual and society are involved. This includes the effective use of technological products and systems, the ability to evaluate technological products from functional, economic, environmental, ethical, social and aesthetic points of view, and the ability to design appropriate products to specifications set by learners, teachers or others (HEDCOM 1996).

Technology Education follows a technological design process (an approach to solving problems comprising design, manufacture and evaluation), and is cross curricular, based on real-life contexts, and value-laden (HEDCOM 1996: 12). In addition, Technology Education attempts to integrate thinking and action in the solution of problems (HEDCOM 1996: 15). It is argued that this combination of features of Technology Education provides an environment conducive to the development of the kind of thinking required by the complex society in which we live (Layton 1988: 14). However, these key features also pose a serious challenge to effective implementation of Technology Education.

In particular, the attempt to integrate thinking and action by encouraging the hand and mind to work together offers a challenge to the implementation of Technology Education in schools. Depending on how Technology Education is taught, it can either promote the desired thinking skills or be reduced to the craft subject from which it originated. If it is taught as a subject in which artefacts are made and the product is the most crucial outcome, the thinking outcomes can be lost (Zuga 1997: 207). The higher order thinking which the subject has the potential to stimulate can be overwhelmed by other, more practical or technical outcomes (Zuga 1997: 207). Zuga (1997: 210) suggests that the disjuncture between practical and theoretical knowledge that has pervaded the field, as well as the teaching practice of "one correct answer", seems to be alive in the minds of teachers, and to influence what is delivered in Technology Education classrooms.

This makes the call for innovative teaching approaches to Technology Education a significant one. In order to promote and develop the desired thinking skills, Technology Education requires different epistemological and methodological approaches to learning and teaching (Waks 1994: 44). Technology Education promotes and supports the social construction of knowledge (Waks 1994: 44; HEDCOM 1996: 1). The need for new approaches has led to a different role for teachers: that of facilitators of learning (HEDCOM 1996: 11).

A Technology Education teacher is required to act as a diagnostician, mediator and facilitator in order to support and promote opportunities for thought (Perold 1995: 11). The *Collins English Dictionary* defines "facilitate" as "make easy" and "help progress of". Extrapola-

ting from this broad definition, the researcher defines facilitation as meaning the general way in which teachers react, respond, guide, probe and interact with learners in the context of teaching, learning, knowledge acquisition and application.

Knowing when to provide learners with support and what the nature of that support should be is crucial to skilled facilitation. Knowing when to give learners the answers, when to provide a clue, or when to probe creates an environment of risk and security, which is regarded as essential to critical thinking (Roussouw & Lamprecht 1995: 5). The continuum of direct instruction and autonomous invention must be determined by the teacher according to the tasks which learners attempt (Perkins 1986: 8).

The teacher's role in facilitating learning and thinking in Technology Education classrooms is crucial to creating an environment conducive to the promotion and development of thinking. It is therefore essential to investigate and examine the teacher's role as facilitator and obtain greater clarity on the nature of that role in influencing the development of thought.

## 1. Problem statement

The relationship between critical thinking and Technology Education has been acknowledged by policy makers and practitioners alike (Potgieter 1994: 10; Ankiewicz 1995: 254). Ankiewicz (1995: 254) suggests that the "ultimate criteria for the evaluation of the effect and relevance of Technology Education are the degree of critical thinking it generates". However, this area is not yet fully understood and how teachers implement thinking in Technology Education has not been well researched (Zuga 1997: 208). Against this background, the research question was formulated as follows: How can the teacher facilitate the promotion and development of thinking in Technology Education classrooms?

## 2. Aim of the study

The aim of this case study was to determine how teacher facilitation in a specific technology classroom influenced the critical thinking of learners and, on the basis of this case, to formulate guidelines for teachers on how to promote critical thinking in similar classrooms.

## 3. Research strategy and methods

The single case study employed a qualitative research approach and associated methods. A single case study was selected as most appropriate for investigating a contemporary real-life phenomenon (Yin 1984: 23). Qualitative approaches are well suited to non-positivist, subjective conceptions of reality which acknowledge that complex human behaviour cannot be explained in purely scientific terms (Cohen & Manion 1994: 6).

### 3.1 Population sampling

The study involved a grade eight Technology Education class at a multicultural English-medium public school in the feeder area of the Rand Afrikaans University. The class comprised 35 learners, of whom 18 were female. The learners are disadvantaged, as the school is in a cosmopolitan inner-city area. Overpopulation, crime and drug trafficking are common in the area.

Convenience sampling was the ideal method because the school was close to the researcher's place of employment and it was therefore relatively inexpensive. Cohen & Manion (1980: 88) suggest that convenience sampling is often used when dealing with captive audiences such as teachers and learners.

### 3.2 Data collection

In accordance with the principles of data collection outlined by Yin (1984: 95), data were collected by means of:

- direct non-participant observation of both teacher-learner as well as learner-learner interaction,
- recordings on audio tape and video, and
- the assessment of instructional aids.

## 3.3 Data analysis

The transcripts of audio tapes, fieldnotes and instructional aids were analysed using Kerlinger's approach (Kerlinger 1986: 479). Data were organised into categories and themes and corroborated by an independent coder. The video tapes were analyzed first by the researcher and then independently by two specialists in Technology Education.

## 3.4 Reliability

The following contributed to the reliability of the study (Krefting 1991: 214-22):

- the utilisation of various sources of data collection, for instance tape/video recordings, field notes and instructional aids, and
- the use of an independent coder for data analysis to corroborate the researcher's categorisation of data.

# 4. Results

From the data analysis, deficient facilitation of capability tasks was identified as the main problem area, with the following two subcategories:

- facilitation non-conducive to co-operative learning (in both teacher-learner interaction and learner-learner interaction), and
- non-refined questioning technique in attempting to facilitate thinking (formulation, frequency, nature and structure of questions).

## 4.1 Deficient facilitation of capability tasks

### 4.1.1 Facilitation non-conducive to co-operative learning

Co-operative learning is supported by current theories of learning and development (Johnson *et al* 1994: 14/15). Kutnick & Rogers (1994: 2) endorse the social constructivist theorists Piaget and Vygotsky, who suggest that learners learn better in a social context and as members of a group. Social interaction is seen as raising human thinking and problem solving to a higher level (Resnick 1987: 41; Johnson & Johnson 1991: 57). This is strongly supported by classroom research confirming its superiority over other learning ap-

proaches (Johnson *et al* 1994: 16). Technology Education in particular promotes the use of co-operative learning to develop thinking (HEDCOM 1996: 15).

Co-operative learning involves the use of a methodological tool which encourages learners to work together to solve problems. This is different from traditional chalk-and-talk methods and requires an understanding of how learners behave in groups as well as the role of the teacher in ensuring effective group processes.

- *Teacher-learner interaction*

It is evident from the data that the teacher's design of the group task and support of the group process affected learner outputs.

In this study the teacher did not play an effective role in promoting successful outcomes of learner group activity. At the outset the teacher did not design the task to suit the nature of group work ("May I have your attention, now you are working as a group. What I would like to do is to choose maybe three people in the group, and let those three people do some sketches or three designs that you have in mind. From those three you choose the best one"). Secondly, the teacher misjudged the learners' level of pre-knowledge and this impacted negatively on the quality of discussion at the group level ("Now, we know this background, we know why we have to pack food"). Thirdly, the teacher did not play an active role in facilitating the promotion of thinking in group work by probing, challenging and supporting ("Write in your notebooks later. First read the worksheet; you are given the answers in here, all things are in here"). The teacher promoted closed one-word responses through his intervention ("Do you understand?").

Teachers can improve the effectiveness of group work by designing the task appropriately, reinforcing the various group process skills and providing facilitation in which insight into the group process is evident (Kutnick & Rogers 1994: 40).

Kutnick and Rogers's review of studies concerning classroom groups found that the existence of groupings did not necessarily mean that teachers co-ordinated their assignment of learning tasks to suit the group approach. They suggest that while small groups may be the predominant seating pattern, class work is often assigned to individuals

(Kutnick & Rogers 1994: 3). To be co-operative, a group task must be designed to promote a clear positive interdependence: members must promote each other's learning and success face-to-face and hold each other personally and individually accountable for a fair share of the work (Johnson & Johnson 1992: 35).

Teacher functions, such as checking for understanding and elaboration, are vital to high quality learning but are often absent or inadequate in classrooms (Johnson *et al* 1994: 40). Teachers should not leave learners to conduct independent group work without support. If learners are not allowed to emerge from their dependence on teachers, cognitive development in small groups is unlikely to be effective (Kutnick & Rogers 1994: 29).

Facilitating the group process and not allowing group work to take place without key strategic interventions by the teacher is a key factor. The study raises concerns about the classroom practice that causes learners to model themselves on other learners who manifest various inaccuracies (Fearn 1972: 108). Vygotsky's zone of proximal development, which refers to "the distance between the actual development as determined by independent problem-solving and the level of potential development possible with adult guidance or a more capable peer", needs to be considered when attempting to facilitate thinking among learners in groups (Kutnick & Rogers 1994: 5). The idea that learners learn better from each other as peers should be explored in greater detail if the potential for peer-to-peer learning is to be maximised rather than becoming a hindrance to quality learning.

- *Learner-learner interaction*

The observation of learner behaviour in groups is concerned with the relationships and interactions among learners as they work together to solve problems (Johnson *et al* 1994: 26). The study showed that learners did not have the necessary skills or competency to conduct effective group work and that this often directly or indirectly impeded learning and thinking ("You can't say nothing all the time"; "He is bored"; "Sipho, man, you must listen to what we are talking about"; "I'm trying to, but no-one's listening").

Learners lacked communication and listening skills, since they all spoke at once and did not respond to each others' inputs. In this stu-

dy, because the classroom comprised multi-lingual learners, communication also occurred in different languages without rules for translation ("The learners all talk simultaneously, in African languages".). They were unable to deal effectively with controversy. In addition, the group dynamics resulted in a failure to mobilise learners' participation effectively and in domination by one individual who provided inadequate and inaccurate information. Finally, the evidence showed that most of the group discussion resulted in off-task activity or activity of a low cognitive order. Learners did not have clarity about the tasks which they were to perform. It was clear from the evidence that group work did not of itself promote or develop higher-order learning or thinking ("Ke batla lenyalo / I want marriage; Uya ibukela igeneration / Do you watch 'Generations'?").

The literature supports the finding that certain group process skills are indispensable to the successful implementation of group work (Johnson *et al* 1994: 65). The first and most crucial element of the group process is the ability to communicate effectively (Johnson & Johnson 1991: 100). Sending and receiving messages and language issues are important. Inextricably linked to the ability to communicate are other group process skills such as the ability to listen to others, waiting for one's turn to speak and respecting others' opinions. If these behaviours are not modelled in groups, their absence is likely to lessen the positive effects of group work (Kutnick & Rogers 1994: 29). Research also indicates that controversy can be very useful in the teaching of thinking. However, if it is not well used it can actually impede learning and teaching (Johnson & Johnson 1991: 100).

The literature also supports the finding that certain group dynamics, such as group domination by a member who provides inadequate and inaccurate information readily accepted by the group, inhibits higher-order thinking and reasoning (Fearn 1972: 102).

The literature supports the finding that where learners were not appropriately prepared to conduct group work effectively, the work performed is largely off-task (unrelated to the academic work they are supposed to be doing) and of a low cognitive order (Ashman & Conway 1993: 24; Kutnick & Rogers 1994: 16).

All the above literature and evidence points to a possible relationship between group process skills and effective group work. Co-

operative learning requires more of learners than simply to sit in groups. Successful co-operative learning is indicated by the quality of learner behaviour and activity within groups and is in turn dependent on the learners' ability to conduct effective group work (Kutnick & Rogers 1994: 29). In order for co-operative learning to result in higher-order learning and thinking, learners need a certain competence in group process skills (Henak 1990-1992: 2).

### 4.1.2 Non-refined questioning technique in attempting to facilitate thinking

The study of the use of questioning as a technique in facilitating thinking is concerned with exploring the extent to which questioning can be used for the possible promotion and development of thinking.

Many advocate the use of questioning techniques to promote reasoning and thinking skills in classrooms (Resnick 1987: 42). However, it is accepted that different questioning techniques can result in different learning outcomes (Palmer 1972: 130; Raths *et al* 1986: 173; Linsey 1988: 59) and that questioning does not necessarily promote thought (Udall & Daniel 1991: 59).

In order to understand and measure teacher behaviour in terms of questioning techniques, Palmer (1972: 175) suggests the following indicators:

- the number of questions asked and the rate of questioning (the near absence of questions and, on the other hand, too rapid questioning eliciting only one-word answers, both indicate weakness);
- the cognitive level of questions posed (too many questions demanding the recall of information and too few eliciting evaluation and hypothetical analysis would suggest low-order thinking);
- *The teacher's questioning style*

When teachers act as facilitators, they give direction, support, ask probing questions, give learners time to think (waiting time), clarify and explain any ambiguity (Bellanca & Forgarty 1993: 13). The term "questioning style" refers to a teacher's manner of facilitating questions.

The questioning style used by the teacher in this study was closed-ended, requiring one-word responses from learners. The teacher did

not give learners time to think and often answered questions himself, after failing to elicit a response on the first attempt.

Analysis of the teacher's role in facilitating thinking by means of questioning showed that the outcomes of questions were influenced by the teacher's style of questioning. In thinking classrooms, the teacher facilitates and encourages learners to challenge, to ponder and to take risks (Udall & Daniels 1991: 17). These teachers are mindful decision-makers who take the time to dig deeply into carefully selected key ideas, elicit thinking responses from all learners and ask probing questions (Raths *et al* 1986: 3; Udall & Daniels 1991: 167; Ashman & Conway 1993: 28; Bellance & Fogarty 1993: 10). Evidence from the data indicates that the questioning style used by the teacher did not result in higher-order thinking. Instead, the teacher's style promoted closed-ended, one-word responses.

The difficulty in this instance is making appropriate decisions about when and how to probe in order to produce thinking outcomes. Probing should encourage openness and involve learners in the thinking act rather than simply in finding the right answer. Raths *et al* (1986: 165/170) suggest that probes which bring closure, ask for one correct answer and are based on information retrieval hinder higher-order thinking. The evidence of the study correlated with the research in showing that teachers do not give learners sufficient time to respond to questions, that waiting time increases the quality of responses, and that teachers often answer questions themselves (Gall 1989: 115). Some of the pedagogical strategies that could be adopted to assist in the design of a thoughtful classroom include listening and waiting for responses (silence) (Barell 1991: 73). Rowe asserts that when teachers learn how to extend their silences, they will that learner responses reflect more inferential thinking (Barell 1991: 91).

Barell (1991: 91) suggests that many teachers ask "Are there any questions?" and that this is followed by silence. He therefore suggests that this approach is not useful, not a good strategy for obtaining feedback.

- *The frequency, nature and structure of questions formulated by teacher*

"Frequency" refers to the number of questions formulated by the teacher in the facilitation process. The data indicate that the number of questions asked by the teacher was small in relation to the number of lessons and the number of interactions that took place.

The nature of questions relates to their cognitive level. Analysis of the data showed that most questions required only low-level recall and were closed-ended ("Which one is this one? Which chemical? We are looking at specifying this chemical. What is found here?"). A high proportion of questions were administrative or organisational. Very few questions demanded higher-order thinking or reasoning.

"Structure" refers to the manner in which the teacher formulates questions. Evidence from the data indicates that the questions formulated by the teacher were fragmentary and poorly structured. Most contained too much information in one transaction, which was confusing for learners ("What the name of the product is, the name of the thing is in here, what is found in here?"). According to Palmer (1972: 175), the structure and frequency of questions are indicative of their use to promote learning and thinking. Questions which are poorly structured result in lower-order learning and thinking.

Correlating with the findings of the study, the literature shows that most questions asked in classrooms are lower-order questions involving information recall and simple comprehension (Kerry 1982: 5; Gall 1989: 114). Learners are not involved in addressing thought-provoking questions (McTighe & Lyman 1989: 174) but instead focus on closed-ended questions that seldom invite thought (Kerry 1982: 5). In fact, many questions have been found to be counter-productive to the teaching of thinking (Raths *et al* 1986: 168).

Previous studies also show that a large proportion of teacher questions focus on mundane administration rather than on concepts (Kerry 1982: 5). This often uses teaching time inefficiently and leads learners to model certain negative behaviour, as they see questioning in terms of administration (Raths *et al* 1986: 170).

# 5. Recommendations

## 5.1 Recommendations on facilitating capability tasks

### 5.1.1 Providing facilitation conducive to co-operative learning

In theory, co-operative learning approaches seem far superior to other approaches, but they require careful planning and facilitation if they are to result in thinking outcomes. The following recommendations are made to facilitate co-operative learning.

Success in co-operative learning requires careful design of activities, strategic intervention by teachers and the possession of a basic set of group process skills by learners. Together, these factors maximise the effectiveness of group approaches. Teacher-learner interaction is particularly important. Teachers should pay careful attention to the dynamics of the group, and to the level and range of group discussion, as well as making continuous interventions to improve the quality and structure of discussions.

Teachers need to understand which activities will be best served by group work and which will not. Teachers should have the skills to make appropriate choices about methodologies in relation to the task and the learners. Teachers must design tasks appropriately to maximise the effects of group work. Group work ought not to be viewed as a new panacea to be universally applied, but rather as one of many tools for the promotion of learning and thinking.

Teachers should see themselves as active participants in the group process. They should set group objectives and assess how well these are being met. If teachers do not define clear objectives it is difficult to assess the benefits of group work for their learners.

A key component of the group process is the issue of language as a group dynamic. The teacher needs to discuss a range of language policy issues with learners and establish an approach for dealing with the issues of multilingualism in the classroom. The teacher should promote the acceptance and validation of all languages and learners should be allowed to use any languages which they feel will assist their learning. However, the teacher should also emphasise the need to ensure that group members understand one another and develop mechanisms of support.

Learner-learner interaction contributes to the dynamics of group interaction. If the teacher listens carefully to the substance of the group interaction, it will be possible to diagnose conceptual difficulties and to assess what group skills learners do or do not possess. The teacher will also be able to determine whether group work is in fact resulting in the desired outcomes; if not, why not, and whether this is corrigible or not. The teacher also needs to be informed about the group dynamics in terms of dominant members or learners not listening to or respecting one another's opinion.

The teacher needs to accept that power dynamics relating to race, gender and class may surface as group members interact. Such issues need to be dealt with in ways that promote democratic participation and learning.

### 5.1.2 Refining the questioning technique of the teacher in an attempt to facilitate thinking skills

The key attribute required to facilitate thinking is skill in making appropriate choices about when, how and why to intervene. This requires the teacher to listen constantly for opportunities as interaction occurs among learners or between learners and the teacher. This approach requires intensive planning as well as the ability to think on one's feet. A combination of intensive planning and real flexibility is required to facilitate thinking effectively.

Teachers should be trained to match the aims and objectives of their lessons with strategies for achieving them. Teacher development programmes and curriculum advocates should provide concrete support for teachers in terms of developing strategies to promote thinking as well as means of assessing various strategic options. The teacher should set out thinking objectives for each component of the lesson or the design cycle. This can be done by using Bloom's or other taxonomies to distinguish the levels of thinking required by learners.

Teachers can apply methodological tools such as questioning techniques, controversy, and co-operative learning to challenge learners' perceptions and conceptions. Whatever methods are selected, the teacher must promote open-ended approaches, ask probing questions and allow learners time to think (Bellanca & Fogarty 1993: 13).

Activities which can be introduced include reflective approaches to learning and teaching, where teachers ask themselves what level of thinking they intend to promote and how they intend to do so, and finally assess whether they have achieved this objective. Teachers should be conscious of the range and nature of the questions they ask, and the nature of the learner responses these questions elicit. This calls for metacognitive strategies.

Teachers should demand reasons for all learner activities and choices, no matter how obvious these may seem. They should also promote learner reflection so that metacognitive strategies become fundamental to the classroom culture for learners as well.

Learners should be taught to defend their choices but at the same time to be open to other perspectives. Decisions that are not well-informed or argued need to be refined with the assistance of the teacher. Teachers should also be cautioned against advantaging native speakers of English in facilitating discussion and debate.

## 5.2 Implications of findings for curriculum implementation, teacher training and research in South Africa

The use of co-operative learning must be explored further in terms of its implementation within the South African context of large, multilingual, poorly-resourced classes. More information is required on how, when and why co-operative learning best promotes learning and thinking. Without such research, an already disadvantaged cohort of learners will be further disadvantaged.

The implementation of Technology Education as a cross-curricular approach requires an understanding of certain mathematical, scientific and environmental knowledge and skills. The recent implementation of Curriculum 2005 has left teachers grappling with issues of outcomes-based learning, assessment and the accompanying methodologies. This is further complicated by the introduction of a new learning area, Technology, for which there are very few trained teachers. In view of this, the introduction of cross-curricular approaches must proceed with caution. If teachers do not have knowledge of the specialised fields, they will neglect the mathematical and scientific knowledge required for technological problem-solving. Ignoring the cross-curricular require-

ment of Technology Education would reduce it to a craft-like approach and defeat the aim for which it was developed: critical thinking.

The aim of using the hand and the mind together in Technology Education and Curriculum 2005 cannot be successfully implemented if higher-order thinking is overwhelmed by more technical, practical outcomes. This would amount to the handiwork approach, which emphasises the hand over the mind and does not promote higher-order thinking.

The use and interpretation of the constructivist approach has implications for the ways in which teachers view their role and for the promotion and development of critical thinking in classrooms. The concept of a passive role for the teacher may have arisen out of an extreme interpretation of the constructivist approach. But if learners are expected to engage actively with one another, while the teacher plays a passive role, lower-order rote learning and much off-task deliberation is likely to result. The teacher's role should be active in order to facilitate higher-order thinking by means of co-operative learning, questioning techniques or other methodological tools. These should be included in teacher training.

## 6. Conclusion

Learning should be shaped by the needs of the society in which it is based. It is evident that in our technological age society requires competent critical thinkers able to solve a range of complex technological and other problems. While it is clear that Technology Education is well placed to promote and develop thinking skills, this must not be assumed to occur in learners merely because they produce technological products. It has been argued that Technology Education will, and can, promote a thinking environment. In contrast, the research results show that Technology Education classrooms can just as easily be non-thinking environments.

The key to ensuring that Technology Education achieves its aims and objectives lies in the appropriate and adequate preparation of teachers. Teacher facilitation of the learning process has the potential to bridge the gap between what Technology Education aims to achieve and the shortcomings of the case study.

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