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Implementing a technology learning programme in a school for learners with special educational needs: a case study

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This article explores the viability of implementing a technology learning programme in a school for learners with special educational needs. TechnEd (the former RAUTEC), Bernina, the school and the Gauteng Department of Education were involved in the project. The nature of the project required a qualitative, action research approach using group interviewing, observation and narratives to gather data. The action research allowed for evaluation, planning and action after every session. Qualitative data analysis methods were applied. The project had the following educational value for the learners: cognitive, personal and social skill development.

Die implementering van 'n tegnologie-leerprogram in 'n skool vir leerders met spesiale onderwysbehoeftes: 'n gevallestudie

Hierdie artikel ondersoek die lewensvatbaarheid van die implementering van 'n tegnologie-leerprogram in 'n skool vir leerders met spesiale onderwysbehoeftes. TechnEd (die voormalige RAUTEC), Bernina, die skool en die Gauteng Departement van Onderwys was by die projek betrokke. Die aard van die projek het 'n kwalitatiewe aksienavorsingsbenadering genoodsaak wat groeponderhoude, waarneming en narratiewe gebruik om die data te versamel. Die aksienavorsing het evaluering, beplanning en optrede na elke sessie moontlik gemaak. Kwalitatiewe data-ontledingsmetodes is gebruik. Die projek het die volgende opvoedkundige waarde vir die leerders ingehou: kognitiewe, persoonlike en sosiale vaardigheidsontwikkeling.

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Matthews (2003: 96) observes the following with regard to learners in detention: "In a juvenile prison I see the struggles of these youth every day. What seemingly begins as 'learning differences' often advances to chaos, crime and shattered lives behind bars". These learners, who have been incarcerated for a specific transgression, have very few opportunities to turn their school education around. Kollhoff (2002: 11) confirms this: "Correction education represents the last chance many of our students will have to be successful in school. [...] If we are unable to reach these students, there is a high probability that they will return to our juvenile or adult correctional facilities". Learners in detention should be offered intensive learning programmes that will not only excite and keep alive their interest but also accomplish learning gains:[1] "When we provide education to individuals in a correction setting the chance that they will return to the system decreases" (Kollhoff 2002: 11).

This point of departure is also supported in current policy on education. Policy documents state that in respect of reform schools and schools of industry, the Ministry of Education will collaborate with the Ministry of Social Development and the provincial departments of education to ensure that children and youth awaiting trial in these schools are provided with a supportive and effective learning and teaching environment, and that appropriate assessment practices and clear criteria and guidelines for their placement are established (DoE 2001: 27). A range of programmes would be available in reform schools, schools of industry and places of safety. All learners in custody or protective environments would receive education. The Department of Education would provide a range of education services and education-related support, and will work closely with other relevant departments (Justice, Correctional Services, Police, Health, and Welfare) to provide a holistic service (DoE 1997: 57). An inclusive education and training system is organised so that it can

1 A learning programme is guided by the National Curriculum Statement (NCS), and includes content (procedural and conceptual knowledge, as well as skills) and instructional methods (DoE 1992).

provide various levels and kinds of support to learners and teachers (DoE 2001: 6).

Our technological environment is developing at an ever-increasing pace, and the natural world is shrinking (Ankiewicz 2003: 3). According to Ellul (1990: 15) technology is our new environment – in fact, it is the new nature in which we live (Van Schalkwyk 1996: 26-8). Teachers in juvenile correction schools must ask themselves how they are preparing their learners to return to this technological society where technological problem-solving plays a crucial role. A technology learning programme creates a climate for project-based activities and teamwork which encourage learners to ask questions enabling critical and problem-solving skills (Ankiewicz 2003: 18). Learners in LSEN schools generally have made poor choices in the past. Many have found the academic nature of the formal school system difficult, and few have had the opportunity to experience a technology learning programme at school as it was often absent or not available to them. They have not only been left behind, but also been left out. The reality in juvenile correction schools is that learners will ultimately return to society. It should be much more acceptable to society that they return with the skills necessary to succeed (Kollhoff 2002: 11), such as problem-solving skills taught in technology classrooms.

Clearly, the education that needs to be presented within a short period of time under extremely emotional circumstances should achieve lasting learning gains for learners in detention. These learners are now part of a school system that is different, one characterised by concepts such as "resocialization" and "offence cycle". Unfortunately, the classrooms have no windows, no crash gates at the front door, and no razor wire around the playground (Matthews 2003: 96). Because these learners are not interested in learning it is also essential to create a dynamic intervention of which they necessarily will want to be part of and which will promote lasting learning: "They are also given the time and a relatively safe place to practice what they have learned before returning to their communities" (Kollhoff 2002: 12). These learners find it more difficult to learn: "Investigators [...] report some data suggesting that the cognitive progress of delinquents lags behind that of nondelinquents" (Hains & Miller 1980:

22). It is crucial to provide a learning environment that is conducive to learning and that incorporates the necessary scintillating contents and challenges to get these learners learning.

In this kind of learning environment learners should learn to think of different ways to accomplish an objective. Many examples and opportunities should be provided to practise creative skills. Learners should learn how to ask the relevant questions and how to identify an existing problem. Unstructured situations should be provided and, under guidance, learners should be given the opportunity of finding solutions. During the problem-solving process one should restrain from labelling or categorising problems or solutions too quickly (De Swardt 1998: 34-61). The quality of an idea must be evaluated on the basis of its consequences; original and relevant ideas should be rewarded.

Technology education is a powerful tool in the provisioning of such a learning environment, because different types of thinking such as critical and creative thinking, decision-making, problem-solving and design are all recognised as critical aspects of learning and instruction in technology education (Ankiewicz & De Swardt 2002, Jakovljevic 2002). Technology education provides opportunities for learners to practise the subprocesses of complex thinking by means of a variety of learners' tasks and activities (Ankiewicz 2003: 18). "Complex thinking" is an umbrella term for all other subprocesses (creative thinking, critical thinking, decision-making, problem-solving and design) and skills of higher level thinking (Jakovljevic *et al* 2004).

The aim of the project was to investigate the viability of the introduction of a technology learning programme in a LSEN school where learners stay for indefinite periods of time, and to offer guidelines for the introduction of technology education into the school curriculum for learners with special educational needs.[2] The purpose of this article is to report on how learners in detention experienced the technology learning programme.

2 For the purposes of this study, learners with special educational needs are learners who experience barriers to learning and development. These special needs must be addressed to ensure effective learning (DoE 1997: 2).

1. Background

The specific school for learners with special educational needs where the research was done caters for approximately 85 learners, both boys and girls, between the ages of 12 and 17 years (Grades 3 to 11). Learners reside at the school for a period of three to four months while they are waiting for the juvenile court to take a decision on whether they should be placed in a place of safety, in their family's care, in foster care or in a children's home. The majority of these learners have made poor progress at school and have repeated grades because they lack inspiration to learn in hostile surroundings; they are thus frequently absent from school. They suffer from a poor self-image and come from poor, broken families where social problems such as physical and emotional abuse, molestation/sexual harassment, and drug and alcohol abuse occur (Landsberg *et al* 2007: 27-37).

Technology education was never part of the curriculum at this specific school. The technological process that forms the backbone of technology education consists of the following ten stages: problem statement; design brief; investigation; proposal; initial ideas; research; development; planning; making, and evaluation (Ankiewicz *et al* 2000: 128). These stages are to a large extent congruous with the assessment standards that are associated with learning outcome 1 in the National Curriculum Statement (NCS), and are part of the procedural knowledge ("knowing how") of technology education (Van Niekerk *et al* 2010: 195).

A technology learning programme, as part of a pilot project, was implemented for both male and female learners between the ages of 13 and 15. They followed the learning programme for the substrand Textiles as part of the strand Materials and Processing (learning outcome 2, according to the NCS (DoE 2002)). The assessment standards associated with learning outcome 2 are the conceptual knowledge ("knowing that") of technology education. The ten stages of the technological process were used as an explicit organisational framework for the technology learning programme (McCormick *et al* 1994: 7, McCormick 1997: 151, Mawson 2003: 119).

The project was divided into two phases, each phase consisting of two, two-hour sessions. Twenty learners attended the first phase. Learners had to design and make patterns and products using textiles to solve problems or satisfy needs in a real-life context. These textiles were coarse, and learners could paint and glue objects onto the material/fabric. Due to the learners' background, certain safety measures had to be adhered to, for example no scissors were given to learners, and glue, paint and other tools and equipment had to be controlled by the technology teacher.[3]

Based on the recommendations by the technology teacher at the end of the first phase, the group attending the second phase was limited to ten learners, as a large group of 20 learners with this kind of background was not practical. Learners who attended the first phase were not allowed to attend the second phase. One learner, however, enjoyed the first phase so much that he nagged the technology teacher until he was allowed to attend the second phase.

2. Methodology

The research was conducted as a case study, as this allowed for the uniqueness of the situation to be investigated and described. This provides for a holistic approach that is of a qualitative nature. The action research strategy allowed for the systematic gathering of information and making sense of this from the perspective of the participant, the teacher and the learners (Denzin & Lincoln 1994:329). In order to improve the facilitation of technological problem-solving it was necessary to change the instructional strategies by applying the following stages of action research: diagnosing, action planning, action taking, evaluating and specifying learning (Baskerville & Wood-Harper 1996). Action research also values the participants' knowledge, stimulates critical questioning and contributes to better planning and action during the intervention.

3 A technology teacher is a person or facilitator who creates an atmosphere conducive to technology learning. Facilitation is drawing on the ideas, experiences and beliefs of a group so that they arrive at conclusions and decisions that are really their own and enabling them to take responsibility for their learning (Crowther 1995: 414).

The intervention entailed a technology learning programme based on textiles, introduced for LSEN learners in the specific school described in the previous section. In technology education, Textiles is categorised as a substrand of strand 3: Materials and Processing (GDE 1999: 11). Due to the special circumstances of the learners, traditional teaching was substituted with facilitation of learning, and the technology teacher was also required to create a safe, pleasant classroom atmosphere conducive to learning under the previously outlined circumstances.

An observation schedule, based on indicators of creativity in a technology classroom (Vandeleur 1999), was used as an observation guide, and field notes were taken while learners were busy in class. Vandeleur's observation schedule was introduced during the first session of phase one and during both sessions of phase two. The technology teacher made field notes based on her observation and then adapted the presentation accordingly.

Two group interviews were held with learners and one individual interview with the technology teacher in addition to observations of learners' activities and behaviour in the technology classroom. Learners' expectations and experiences of the learning programme were explored by means of open-ended questions during group interviewing before the start of both first sessions and at the end of the second of both phases.

Qualitative data analysis methods were applied (Creswell 1994: 153-60). Guba and Lincoln's model for trustworthiness explains four main aspects of trustworthiness that should be taken into account in qualitative research (Krefting 1991: 214-22). In this study, truth, value and consistency were confirmed by the method of verifying results with the participants. To ensure neutrality (objectivity) researchers participating in this study used recording and analysis of data with time increments due to the fact that action research in this qualitative study implies simultaneous gathering and analysis of data in different time sequences. Applicability cannot be confirmed, because of the uniqueness of the situation. This might be proven in another study.

3. Findings

The following findings were derived based on the expectations of learners, the observation during the intervention, and the interviews:

3.1 Group interviews with learners before the first session of each phase

Although there were different learners in the two groups/phases, both groups expressed similar expectations before the first session of each phase. Learners expected personal gain through participation in the programme. This was evident in the following categories that were derived, related to learners' expectations in both phases:

- A need for enjoyment

Learners wanted to have a pleasant time. In the words of one of them: "we want to have fun ". Enjoyment encourages learning (De Swardt 1998: 38). The fact that learners expected to experience enjoyment could also indicate that they were seeking a reason to be happy. Albrecht (1980: 14-6) describes "happying"as a functional thinking skill. To be happy is a decision and also a strategy to execute the decision. It could indicate a state of mind informing one that one is living effectively according to one's decision. Michalko (1998: 261) indicates that play and creativity have much in common, because when one plays, objects and actions are used in an unusual way. According to him, "an environment of playfulness and humour is highly conducive to creativity". People are more relaxed and less rigid in their thinking and they lose some inhibitions when they play. A group in a playful environment will generate a much wider range of options.

- Knowledge and skills

Learners also wanted to gain knowledge and skills through participation in the project: "I want to learn something"; "to show the world what I have done"; "I want results". This indicates that learners expected to produce something tangible that other people could see. The fact that learners wanted to gain knowledge demonstrates that they are aware that one needs knowledge in order to make progress. Knowledge is dynamic; it is not something static that one person transfers to another. Knowledge is also created each time somebody learns a new concept: "The acquisition of knowledge is an active mental process" (Halpern 1996: 5). Because learners were involved in resource and capability tasks, they developed knowledge about processing of materials as well as developing their psychomotor and cognitive skills (creative, critical and problem-solving skills).

- A need for socialisation and group interaction

Learners also expressed a need for socialisation and group interaction: to "learn how to get along and cooperate". According to Petty (1997: 173-4), the instinct to be respected by others and to have self-esteem like the need to be accepted by a group, as described by Maslow, creates extrinsic motivation which leads to intrinsic motivation. The need to "get along [and] cooperate" (Landsberg *et al* 2007: 102) might have contributed to the learners' motivation. Being with, talking to and observing other people help to generate ideas and provide inspiration and stimulation. Connecting with people as one of the strategies is to "free your creative spirits and find your great ideas" (Ayan 1997: 60).

3.2 Observing learners' activities during the sessions

In general, the observation of all but the first session indicated that the expectations of the learners were met to a large extent. After the first session, which was disorganised and unpleasant for both the technology teacher and the learners, disciplinary measures were introduced by the learners via a teacher. Thereafter everybody adhered to the rules laid down in class, and learners proceeded to quietly designing and working during the ensuing sessions. Learners were focused and proceeded with their work. They seemed to enjoy the sessions. Group interaction, where people communicate and respond to one another, stimulates the structure and role (interpersonal relations); leadership within a group, and group cohesion where people feel they belong and are creating things together. Skill-building, task-building and problem-solution creation are the results of group discussion (Orlich *et al* 1994: 232-5).

The observation results of the three sessions obtained by Vandeleur's (1999) observation schedule are discussed below. Observation of these indicators during the sessions indicated that cognitive development took place. According to Albrecht (1980: 18), "thinking is a skill which you can improve if you want to". The learners' positive approach opened their minds implicitly for learning and thinking.

3.2.1 Direct indicators of creativity

- Development of ideas

Many learners drew hearts or cut hearts out of textile. They could not tell how they arrived at the idea, as the idea-generation stage of the technological process involves creative thinking. This was probably based on the open-ended ideas which the technology teacher shared with them on the first day of phase one. Wakefield (1996: 488) emphasises the importance of open-ended ideas and problems where learners are given the freedom to choose. This provides for greater creativity opportunities (Vandeleur 1999: 30). Learners should go beyond the one-idea outlook; they must pursue more than one idea, and be given freedom of choice in gathering ideas and information (De Swardt 1998: 43, Vandeleur 1999: 28-9). Hugo (Albrecht 1980: 212) states that "having a good idea is a pleasurable experience for anyone – a sort of cerebral high".

Original ideas were represented in very personal designs, with specific personal meaning. One learner painted a Bad Boy sign, "because I love this bad sign". One learner had a "passion ribbon for God"; another one designed a "stop aids campaign"; one learner demonstrated the athletics field next to his home, because he loves his home and the field, and one did a Nike logo because Nike sponsors the kickboxing team to which he belongs. Petty (1997: 16) describes this phase as the "inspiration" phase. According to him, this phase is often associated with a very individual voice. It is an attempt to conjure up deep feelings such as empathy or religion, although approximately 90% of these ideas are normally rejected. On the other hand, a person's simultaneous love for new ideas and reactive fear of them often kill the idea instantly, because the person fears being wrong and laughed at.

Critical thinking was observed to some extent because some learners did careful planning and held discussions with the technology teacher, asking questions, analysing, synthesising, and/or evaluating information in order to make something worthwhile. Halpern (1996: 21) describes critical thinking as "the intimate connection between thinking and feeling". This includes cognitive processes, communication and understanding. Some learners rather hurriedly just went ahead and did whatever came into their minds, without planning or thinking it through "ek doen net wat in my kop kom". In this instance, one would have expected the technology teacher to have guided those learners step-by-step through the ten stages of the technological process (Ankiewicz *et al* 2000: 128). However, due to time constraints this was not possible.

Enjoyment was obvious – they even played music during the sessions. Having fun through play opens up the creative spirit that allows one to see new things, get new insights and make new connections (Ayan 1976: 126). The aesthetics of the product was also important, because they wanted results that they could show to the world. They also complemented one another on their work (De Bono 1984: 19).

- Experimenting

Risk-taking and the cyclical procedure of experimenting followed by evaluating, planning and again experimenting were observed. This was also evident in one learner's comment "begin, weet nie wat om te doen nie, toe doen jy later allerhande dinge". Experimenting was clearly evident even among learners who just dived into the project without planning. Risk-taking and recklessness are often necessary to unlock the self-belief that stimulates creativity in a person (Petty 1997: 62). Experimenting cannot happen without mistakes (Vandeleur 1999: 44). Learners must learn that failure is an important part of life and that success is built upon previous failures (Halpern 1996: 379).

3.2.2 Indirect indicators of creativity

- Persistence

This is probably the one indicator of creativity that was absent to a significant extent in many of the learners. The majority of the learners persisted at the beginning, but after an hour, they became tired and just wanted to finish the product. A few, however, did persist with a great deal of care. Tolerance, willingness to grow and work through obstacles, intrinsic motivation and a preparedness to work for recognition are all necessary in order to be creative (De Swardt 1998: 41, Wakefield 1996: 488). Persistence is a major factor of creative success, and people have to take risks and learn to persevere until they have reached their goal (Ayan 1997: 278).

- Influences

Group interaction, cultural influences as well as values and motivation were evident during the observation of the learners.

The group interaction was good, although learners had to work individually. They helped one another on their individual projects, which was indicative of a cooperative learning group, where there was shared responsibility for each other. Social skills can be developed within such cooperative learning groups (Gunter *et al* 1995:224, Landsberg *et al* 2007: 102). The sharing of ideas, skills and responsibilities within a group contributes to learning (De Swardt 1998: 48-50).

Cultural influences and values were observed all the time and were evident in the products. One learner painted his father sleeping under a tree, the other a soccer field next to the school. People's values and beliefs are embedded in their cultural background. Culture has an influence on everything one does (Gross 1994: 55, Landsberg *et al* 2007: 37).

Motivation is associated with persistence. The learners were free to leave whenever they wanted to, but the majority of the learners were motivated to such an extent that they completed the learning programme. Building self-esteem was observed in some learners who took pride in taking the article home to give to a relative, boyfriend or superintendent at the boarding house. During the interview at the end of the session, one learner commented: "I experienced self-respect". Intrinsic motivation comes from within the person and contributes to self-confidence (Halpern 1996: 378). The learners' freedom to explore and create also enhanced intrinsic motivation and the following six conditions which tend to hamper intrinsic motivation were absent: "constant evaluation; surveillance; reward; competition; restricted choice; extrinsic orientation towards work".

Throughout the technology learning programme learners were involved in resource tasks (short practical activities which engage learners' thinking processes and help them to develop knowledge and skills) and capability tasks (helping learners to develop and demonstrate cognitive, psychomotor and technology-related skills; content (subject matter) knowledge; values and attitudes; and utilise technological problem solving) (Givens & Barlex 2001).

3.3 Group interviews with learners after the sessions

The group interview on the experience of learners in both phases confirmed that expectations were met. Learners confirmed that they thoroughly enjoyed the learning programme: "it was nice"; "lekker om dit te maak"; "die goeters is sharp"; "I had lots of fun ". It is generally accepted that the fascination and enjoyment experienced in the learning situation and in performing a task/project elicit a specific motivation resulting in the required commitment and perseverance by learners to remain involved until final success is ultimately achieved (Petty 1997: 176). Learners, who enjoy being involved in the learning situation, are more susceptible to learning, are more creative and remember the learning experiences better (De Swardt 1998: 38).

Learning took place because learners stated that they had learnt many things such as how to match colours. They felt that they learnt skills and self-respect. One learner showed gratitude by thanking the technology teacher for her input during the learning programme.

Learners compared technology education with other subjects. They had no negative comments on technology education. The following positive comments proved the learners' preference for technology education: "this is more fun"; "elke dag sal ek dit wil doen"; "it is more fun". It is clear from the comments that learners want to do what they enjoy most.

3.4 Interview with the technology teacher after both phases

The technology teacher's first experience was unpleasant, because she could not control the learners: "ek het die kinders totaal onbeheerbaar ervaar". According to her, the following behaviours of learners caused obstacles that affected the presentation of the session: provocative behaviour; jealousy; no respect for one another; rushing through tasks; poor communication with the technology teacher; lack of interest to be creative as many were doing what the person next to them was doing; lack of attention; lack of discipline, and strong manipulative behaviour.

The teacher is regarded as the "conductor" of the "orchestra" in the classroom – the teacher, who could be authoritative, guiding, tolerant, or aggressive creates a specific classroom climate. A positive classroom climate can be recognised in mutual respect and self-respect; trust; high moral values; personal participation by learners; academic and social growth; care; cohesion and renewal. Among the most important factors believed to have an influence on the classroom climate are the teacher, the learners, the educational programme, and discipline and classroom control which is a reflection of the teacher's instructional capabilities. Learners feel safe in an environment in which there are rules and discipline. If learners do not experience security, they cannot concentrate on learning (Abdool 2000: 16).

After the first session of the first phase, learners expressed a need to create the following climate in the class: They wanted each person to respect one another and make the day a pleasant one, also for the technology teacher; learners wanted to learn how to get on as a group; learners laid down rules for using the glue and paint, so that everybody could have the opportunity to use the equipment. This indicates that learners can take responsibility and regulate their environment guided by the technology teacher who possesses instructional skills in teaching a technology learning programme in special schools. Creativity and productivity decline in an environment that is hostile with negative energy and conflict (Ayan 1997: 81).

The follow-up sessions in phases one and two were positive and productive. The technology teacher had a more positive experience of the second group. The reasons for this were the smaller size of the group ("rustiger as die vorige groep, omdat dit 'n kleiner groep is") more personal attention paid to learners, and a different approach ("ek het 'n ander benadering tot hulle gehad") (Gunter *et al* 1995:

245). The technology teacher realised that only one instruction at a time should be given (a step-by-step approach) and that the materials for decoration (paint and articles) should be kept away until they were needed.

The fact that the first group showed their products to the learners in the second group might have better prepared them for what they were to expect. The second group was more susceptible to ideas and utilised more of the technology teacher's ideas. This is an indication that the technology teacher needed to provide work sessions on the development of creative thinking skills where the basic principles of creative thinking are taught.

4. Discussion

In order for LSEN to benefit from such a project, three vital elements need to be combined, supporting one another like the sides of a triangle: the instructional skills of the technology teacher; an appropriate learning programme, and a classroom climate conducive to learning. If the three sides of the triangle are equally strong and supportive of one another, this could have the following educational values for LSEN:

- Cognitive development

When learners are provided with the opportunity to generate ideas, experiment and be creative, the possibility for cognitive development is enhanced:

> Build minds [...] not prisons [...] by infecting them with the desire to know before they can become entangled with cocaine. In lieu of society building prisons to incarcerate its failures of the future, teachers can build minds. If every year a single child could be derailed from a life of crime by each teacher [...] the impact could be tremendous (Marble 1992: 63).

- Personal development

Learners in detention are "hiding behind a shoddy facade of brashness, they have little respect for themselves or anyone else. Their self confidence is remarkably fragile" (Marble 1992: 62-3). Motivation, persistence and improvement in self-image and self-value contribute to the personal development of the learner, and a teaching-learning situation should be such that it promotes these aspects.

- Social skill development

Learners in detention are "depressed and discouraged" (Matthews 2003: 97). Social skill development is possible where both the technology teacher and the learners exhibit positive group interaction, internal group discipline and individual support.

5. Conclusion

Learners' positive experience of the learning programme confirms that cognitive, personal and social skills, with educational value for LSEN, can be developed by means of a technology learning programme. Despite the necessity and need for more research in this regard, for example extending the research to learning programmes for the remaining strands (structures, systems and control) and their associated substrands, the abovementioned research findings already indicate that technology education should be included in the curriculum for LSEN schools.

Technology education in LSEN schools could promote learners' creativity, learning, self-esteem, group interaction and enjoyment. In this particular context, technology education should be presented to very small groups, preferably groups of not more than ten learners.

Bibliography

ABDOOL A D
2000. *Didaktiese riglyne vir die skep van 'n positiewe klaskamerklimaat aan 'n sekondêre skool*. Potchefstroom: PU vir CHO.

ALBRECHT K
1980. *Brain power. Learn to improve your thinking skills*. New York: Prentice Hall Press.

ANKIEWICZ P
2003. Technology education at school: Illusion or reality? Inaugural address, Rand Afrikaans University, Johannesburg, South Africa.

ANKIEWICZ P J & A E DE SWARDT
2002. Aspects to be taken into account when compiling a learning programme to support effective facilitation of technology education. De Jager (ed) 2002: 76-81.

ANKIEWICZ P J, A E DE SWARDT & R STARK
2000: *Technology education. Principles, methods and techniques of technology education, 1*. Johannesburg: Rand Afrikaans University.

AYAN J
1997. *10 ways to free your creative spirit and find your great ideas*. New York: Three Rivers Press.

CRESWELL J N
1994. *Research design: qualitative and quantitative approach*. London: Sage Publication.

CROWTHER J (ed)
1995. *Oxford advanced learner's dictionary*. Oxford: University Press.

DE BONO E
1984. Creativity by design. *Educational Leadership* 42(1): September 1984: 19.

DE JAGER R (ed)
2002. *National conference for technology teachers, Port Natal School, Durban, conference proceedings, 30 September-1 October.* Durban: The Technology Association.

DEPARTMENT OF EDUCATION (DOE)
2001. *Special needs education. Building an inclusive education and training system.Education White Paper 6.* Pretoria: Department of Education.

1997. *Quality education for all. Overcoming barriers to learning and development. Report of the National Commission on Special Needs in Education and Training (NCSNET). National Committee on Education Support Services (NCESS)*. Pretoria: Department of Education.

1992. *Revised national curriculum statement, Grades R-9, (Schools), Policy, Technology*. Pretoria: Department of Education.

DENZIN NK & YS LINCOLN
1994. *Handbook of qualitative research*. London: Sage.

De Swardt A E
1998. Technology education and the development of thinking skills: a case study. Mini-dissertation. Johannesburg: RAU.

Ellul J
1990. *The technological bluff*. Transl by G W Bromiley. Grand Rapids, MI: Eerdmans.

Gauteng Department of Education & Gauteng Institute For Curriculum Development
1999. Draft Progress Map, Technology. Foundation, Intermediate and Senior Phases, Levels 1 to 6. June 1999. Johannesburg: Gauteng Department of Education & Institute for Cirriculum development.

Givens N & D Barlex
2001. The role of published material in curriculum development and implementation for secondary school design and technology in England and Wales. *International Journal of Technology and Design Education* 11(2): 137-61.

Gross E J
1994. *'n Radikale strategie vir gesondheidsvoorligting*. Johannesburg: RAU.

Gunter M A, T H Estes & J Schab
1995. *Instruction: a models approach*. 2nd ed. Bostyn: Allyn & Bacon.

Hains A A & D J Miller
1980. Moral and cognitive development in delinquent and nondelinquent children and adolescents. *The Journal of Genetic Psychology* 137: 21-35.

Halpern D F
1996: *Thought and knowledge: an introduction to critical thinking*. 3rd ed. NJ, Mahwa: Lawrence Erlbaum Associates.

Jakovljevic M
2002. An instructional model for teaching complex thinking through web page design. Unpubl DEd thesis in Technology Education. Faculty of Education, Rand Afrikaans University, Johannesburg.

Jakovljevic M, P Ankiewicz, E de Swardt & E Gross
2004. A synergy between the technological process and a methodology for web design: implications for technological problem solving and design. *International Journal of Technology and Design Education* 14(3): 261-90.

Kollhoff M
2002. Reflections of a Kansas juvenile corrections educator.*The Journal of Correctional Education in the 21st Century: Leave No Child Out* 53(2): 44-95.

KREFTING L
1991. Rigor in qualitative research: the assessment of trustworthiness. *The American Journal of Occupational Therapy* 35(3): 214-22.

LANDSBERG E, D KRUGER & N NEL
2007. *Addressing barriers to learning. A South African perspective*. Pretoria: Van Schaik.

MARBLE G
1992. Plea from a prisoner. *Educational Leadership* 50(4): 61-3.

MATTHEWS S L
2003. Where have all the children gone: a glimpse of students with special needs in the prison classroom. *Juvenile Correctional Education* 54(3): 96-8.

MAWSON B
2003. Beyond 'the design process': an alternative pedagogy for technology education. *International Journal of Technology and Design Education* 13(2): 117-28.

MCCORMICK R
1997. Conceptual and procedural knowledge. *International Journal of Technology and Design Education* 7(1-2): 141-59.

MCCORMICK R, P MURPHY & S HENNESSY
1994. Problem-solving processes in technology education: A pilot study. *International Journal of Technology and Design Education* 4(1): 5-34.

MICHALKO M
1998. *Thinker toys. A handbook of business creativity for the 90's*. Berkeley, CA: Ten Speed Press.

ORLICH D C, R J HARDER, R C CALLAHAN, D P KAUCHAK & H W GIBSON
1994. *Teaching strategies. A guide to better instruction*. Fourth Edition. Toronto: DC Heath and Company.

PETTY G
1997. How to be better at creativity. London: Clays Ltd.

VANDELEUR S M
1999. *Indicators of creativity in a technology class: a case study*. Johannesburg: RAU.

VAN NIEKERK E, P ANKIEWICZ & E DE SWARDT
2010. A process-based assessment framework for technology education: a case study. *International Journal of Technology and Design Education* 20(2): 191-215.

VAN SCHALKWYK P
1996. Opvattinge oor tegnologie by leerlinge en onderwysers. Filosofie van die Opvoedkunde. Ongepubl. PhD proefskrif. Potchefstroom, PU vir CHO.

WAKEFIELD J F
1996. *Educational psychology – learning to be a problem solver*. Boston: Houghton Mifflin.