

# **TECHNOLOGY EDUCATION IN SOUTH AFRICA SINCE 1998: A SHIFT FROM TRADITIONAL EVALUATION TO A PROCESS-BASED ASSESSMENT FRAMEWORK**

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**ABSTRACT:** Changes in the educational approach in South Africa from the traditional to the new outcomes-based education (OBE) approach required educators to make adjustments, especially concerning the shift away from traditional evaluation to using OBE-assessments which made specific demands on educators. However, limited information is available in literature on an assessment framework for technology education, which confirms the need for establishing a well-structured framework to assess learners. The purpose of this paper is to establish a process-based assessment framework to assess learners in technology education in a meaningful and responsible manner. Two research questions were formulated: What are the implications of OBE for assessment in general? What are the aspects of a process-based assessment framework for technology education? A case study as a form of quantitative action research was undertaken. Three Grade 7 learners and an educator at a parallel medium primary school were involved in the case study. For the purpose of the research project, information obtained from a capability task was used. The research only focused on the initial idea generation stage (stage five) of the technological process, as well as creative and critical thinking (as thinking sub-processes) in a Grade 7 technology education class in South Africa. Observation and semi-structured interviews were used as data-collection methods. The validity and reliability of the study were ensured by means of triangulation. Three main categories (findings) were identified as aspects of a process-based assessment framework: outcomes, content and assessment methodology. Further subcategories were identified within each of these main categories. This framework can assist educators to make a shift from traditional evaluation to OBE assessment.

**Key words:** Technology education; assessment; assessment framework; outcomes; content; assessment methodology

## INTRODUCTION

*Broad educational approach*

With the implementation of *Curriculum 2005* (based on the principles and premises of OBE) in 1998, technology education became a reality in South Africa. As one of the eight learning areas in *Curriculum 2005* Technology has its own field of knowledge, skills and values with unique characteristics and links with the other learning areas (Department of Education 2002, pp. 5,10; Department of Education 1997, p. 10).

All decisions pertaining to planning, teaching and assessment in OBE are determined by four principles, namely: the outcomes educators want learners to achieve, the content used by educators to help the learners to achieve the outcomes, the process educators employ to assist the learners in achieving the outcomes and the assessment of the learners (Killen 2000, pp. vii, xiv-xv). The discussion of the shift from traditional evaluation to a process-based assessment framework for technology education will be structured around three of these principles: the outcomes, the content and the assessment of learners.

Outcomes are divided into two subcategories: specific outcomes (what learners should be able to do in the context of technology education at the end of a learning experience, RSA 1997, p. 89) and unit outcomes (what the learners can demonstrate regarding a specific aspect of technology education). Before the start of any assessment of the learners, the facilitator has to identify the outcomes to be assessed (Compton & Harwood 2003, pp. 10-11). As outcomes cannot be achieved in a vacuum, learning content is seen as the tool for learners to achieve the stated outcomes (Killen 2000, p. xiv).

The content of technology must include conceptual knowledge (“knowing that”) of technology as artefact, as well as procedural knowledge (“knowing how”) on the design and making of such artefacts (Glaser 1984; in McCormick 1997, p. 149). Although conceptual knowledge (“knowing that”) and procedural knowledge (“knowing how”) can be distinguished in technology, they can never be separated (McCormick 1997, pp. 143,145; Ropohl 1997, p. 69; Ryle 1949, pp. 28-32). Conceptual knowledge relates to the links between knowledge items. If a learner can identify these links, it can be said that the learner has conceptual understanding (McCormick 1997, p. 143). De Vries distinguishes four types of conceptual knowledge (“knowing that”) relevant to the development of technological artefacts. These are knowledge of the artefact’s physical nature, knowledge of its functional nature, knowledge of the relationship between its physical and functional nature and process knowledge (De Vries 2003c, p. 84; Broens & De Vries 2003, pp. 5-6; De Vries 2003b, p. 2; de Vries 2003a pp. 13-14). Procedural knowledge (“knowing how”) is frequently referred to as tacit, personal or implicit knowledge. Technological procedural

knowledge (“knowing how”) is not associated with technical skills but with thinking processes and skills (McCormick 1997, p. 144). It is general practice in technology education to present the procedural knowledge (“knowing how”) of technology in a stage-oriented format in models (Johnsey 1995, pp. 200, 202-205; Jones 1997, pp. 83-96; GDE & GICD 1999, pp. ii-xxii; Ankiewicz, De Swart & Stark 2000, pp. 127-129). Most models are represented as a linear process, assuming that the process proceeds in a particular sequence (Johnsey 1995, pp. 202-205; Mawson 2003, p. 118). In South Africa the technological process itself consists of ten procedural stages through which the learner needs to work. These stages are:

- Stage 1: Problem statement (brief description of the problem or need in short, descriptive sentences).
- Stage 2: Design brief (brief description of planning for solving the problem or to meet the need).
- Stage 3: Investigation (collection of information concerning the problem or need).
- Stage 4: Proposal (written exposition of what needs to be done or designed to solve the identified problem or meet the need).
- Stage 5: Initial idea generation (various ideas are generated and analysed, and the best idea is selected).
- Stage 6: Research (solving specific problems concerning the selected idea).
- Stage 7: Developing the selected idea to a final idea (adding further detail to the selected idea).
- Stage 8: Planning (planning how the product will be made).
- Stage 9: Making the product.
- Stage 10: Evaluation of the final product based on stated criteria (Ankiewicz, et al., 2000, 128).

#### *Implications of OBE for assessment*

All the changes in national and provincial policies caused a shift away from traditional ways of evaluation to an assessment which made certain demands on educators.

#### *a) Educators have to shift their focus from being solely responsible for evaluation affording learners the opportunity for self- and peer assessment*

Traditionally the educator was seen as the source of knowledge and therefore the only one able to evaluate learners’ work (Geyser 2000, p. 54; Le Grange & Reddy 2000, pp. 9, 19). Meaningful assessment in outcomes-based assessment relies on a good relationship between the educator and the learners, and therefore both educator and learners should be involved in assessment (Compton

& Harwood 2003, p. 7; Le Grange & Reddy 2000, p. 19). The opportunity for the educator to assess learners' work while they are busy with it should be created (Owen-Jackson 2002, p. 209). Opportunities for learners for self-assessment should be created for them to understand the needs of the learning community of which they are part. In this way learners take responsibility for their own learning. The peer group must also be involved in the assessment process by providing learners with the opportunity to assess one another's work (Ankiewicz & De Swardt 2001, p. 98; Le Grange & Reddy 2000, p. 19; Geysers 2000, p. 55; Williams & Williams 1996, p. 192; Mawson 2003, p. 124; Brown, Race & Smith 1997, p. 112).

*b) Educators are accustomed to awarding marks for tests and examinations taken by learners and promoting them on the basis of these marks. Making the shift from traditional evaluation to assessing learners' gradual progression is proving to be difficult*

Before the implementation of outcomes-based assessment educators mainly made use of paper-and-pencil assessment to test learners' textbook-based knowledge. One individual learner was compared to another individual and promotion decisions were based on results from tests and examinations which were calculated to a final result in numerical terms (Geysers 2000, p. 54; Pretorius 1998, p. 84). It turned out to be quite difficult for educators to turn away from this traditional way of awarding marks and making judgements according to the marks allocated to formative assessment (performed during the lesson) of learners' performance. Based on formative assessment it is possible for educators to continually determine whether learners are working towards successfully achieving the stated outcomes, make the required adjustments to instructional strategies and ensure that obstacles can be removed in time for successful learning to occur (Ankiewicz & De Swardt 2001, pp. 96-97; Le Grange & Reddy 2000, pp. 4-5; Williams & Williams 1996, p. 188; Benbow & Mably 2002, p. 201; Moreland & Jones 2000, p. 285; Clemson & Clemson, 1991, p. 35).

*c) Educators have to shift from traditional tests and examinations to using other assessment instruments*

As the major emphasis in traditional evaluation was on individual evaluation, the results of single tests and examinations were used for promotional decisions. In contrast with this approach assessment in outcomes-based education is based on using different assessment instruments. The assessment instrument used by educators and learners should provide meaningful feedback with regard to teaching and learning. It should provide every learner with an equal chance to demonstrate that success has been achieved (Pretorius 1998, p. 84).

The use of observation sheets enables the educator to record whether the stated outcomes have been achieved successfully. While learners are working, the educator should concentrate on specific aspects and make notes on the observation sheets (Clemson & Clemson 1991, pp. 50-51,65; Van der Horst & McDonald 1997, p. 191; Altrichter, Posch & Somekh 1993, pp. 10-11; Habeshaw, Gibbs & Habeshaw 1993, pp. 33-36). Rubrics consist of observable criteria indicating which aspects will be assessed and on what level each aspect will be assessed. They can be used to assess particular skills demonstrated, as well as products made by learners (Department of Education 2002, pp. 18-21; Kubiszyn & Borich 2000, pp. 169-170). Questions and answers as an assessment instrument must consist of a series of relevant questions on a particular topic, providing learners with the opportunity to formulate their own answers (Department of Education 2002, p. 11; Owen-Jackson 2002, pp. 255-260). A portfolio as an assessment instrument should contain a representative variety of examples of a learner's work, including homework, models, posters, the educator's grading of the completed work, descriptions of the learner's achievements, test marks and material collected by the learner according to specified criteria. Portfolios should provide learners with opportunities to supply evidence that specific skills have been mastered (Ankiewicz & De Swardt 2001, pp. 101-103; Geysers 2000, p.66; Le Grange & Reddy 2000, pp. 23-24; Benbow & Mably 2002, p. 206; Kubiszyn & Borich 2000, pp. 181-182). A project as assessment instrument should be undertaken by the individual or in groups over a period of time. Information must be collected, analysed and a report must be written. A project must serve as a demonstration of knowledge, skills, creativity and initiative as determined by the assessment criteria (Ankiewicz & De Swardt 2001, pp. 101-103; Pretorius 1998, p. 87; Benbow & Mably 2002, p. 205; Habeshaw et al. 1993, p. 125).

*d) Educators have to make the shift from the traditional scoring method to using other 'grading methods'*

Educators have to make a shift from the traditional scoring method in terms of numerical values to make judgements about learners' competence to collecting and interpreting evidence of learners' achievements and giving feedback by using descriptive statements on what the learners have achieved (Ankiewicz & De Swardt 2001, p. 94; Geysers 2000, p. 54). Rubrics could successfully be used in outcomes-based assessment. Rubrics must consist of specific pre-established performance criteria on how to assess learners' performance. The set of criteria should describe which outcomes are being assessed. The descriptions of levels of quality of performance should guide learners to the desired level of performance (Department of Education 2002, pp. 18-23). National codes of assessment are used to report on a learner's achievement. The sliding scale ranges as follows:

- 4 (70% and more) – exceeded the requirements

- 3 (50%-69%) – satisfied the requirements
- 2 (40%-49%) – partially satisfied the requirements
- 1 (0%-39%) – not yet satisfied the requirements (Department of Education, 2002, p. 24).

## PROBLEM STATEMENT AND PURPOSE

As one of the eight learning areas in outcomes-based education, learners' competence in technology education should be assessed in a meaningful and responsible manner requiring that more than just the end-product be assessed. In the opinion of Moreland and Jones (2000, p. 283) the fact that the focus is not on the essential aspects of technology education is one of the biggest problems concerning assessment in technology education. Educators regard assessment in technology education as a difficult task as a result of a deficiency in fundamental knowledge in technology education (Moreland & Jones 2000, pp. 299-300). This shortage of knowledge in technology education was confirmed by the initial research by Compton and Harwood (2003, pp. 2-26). They mention that educators experience problems in developing programmes in technology education that support learners' learning and provide them with the opportunity to excel due to their deficient knowledge. Moreland and Jones (2000, pp. 297-303) furthermore comment that educators are unable to indicate precisely which technological outcomes are related to a specific task. They just strive to achieve broad outcomes. Consequently educators emphasise the completed product and mainly focus on assessing the learner's final attempt (summative assessment). Educators' lack of adequate knowledge therefore leads them to emphasise aspects other than the technological process (procedural knowledge) and technological concepts (conceptual knowledge) during assessment, and therefore do not select the appropriate learning outcomes. The result is that educators focus on specific activities rather than on specific outcomes.

Kent and Towse (1997, p. 168) mention that proper feedback to learners is a dilemma and that uncertainties with regard to the content cannot be eliminated immediately. The emphasis is still on the final mark awarded for a project. In this regard Mavrommatis (1997, p. 382) states that educators mainly use assessment to classify a learner at the end of a project. Too much emphasis is placed on capability tasks (summative assessment) because technology education is regarded as designing, making and testing. Educators assume that learners will integrate information from other learning areas themselves without specifically creating a resource task or case study task for them to do so (Moreland & Jones 2000, pp. 291-302).

According to Moreland and Jones (2000, p. 286) the gap between the present knowledge and skills (conceptual knowledge) of the learner and the outcome to be achieved is never successfully

bridged. If the educator is aware of the existence of this gap, then knowledge and skills (conceptual knowledge) can be broadened to successfully achieve the set objective. In other words, content and teaching methodology should be used to achieve outcomes.

At present only one reference to an assessment framework for technology education could be located: “*The Technology Assessment Framework (TAF)*” used in New Zealand. This assessment framework was developed in order to assess learners whose technology literacy had improved by developing knowledge and skills (conceptual knowledge) and their application in practice (procedural knowledge). Opportunities are created for analysing and criticising own and others’ work, i.e. opportunities for self-assessment and peer group assessment (Compton & Harwood 2003, p. 1-24).

Although directives and guidelines concerning assessment in technology education are provided, the need for a process-based assessment framework in technology education exists because responsible assessment in technology education is essential to ensure that high-quality learning, teaching and assessment take place and that every learner gets an optimal and fair chance to master the stated outcomes (Van Niekerk 2002, pp. 8-9). However, only limited guidelines for an assessment framework for technology education could be found in the literature regarding assessment in technology education. Therefore, the purpose of this paper is to establish a process-based assessment framework to assess learners in technology education in a meaningful and responsible manner. In order to devise a process-based assessment framework for technology education it is essential to identify the outcomes as well as the knowledge (conceptual and procedural knowledge) that create opportunities for assessing the intended outcomes. Attention should simultaneously be paid to the relevant thinking sub-processes and associated skills to be mastered.

The research questions addressed in the paper are:

1. *What demands does OBE make on educators when requiring a shift from traditional evaluation to assessment?*
2. *What are the aspects of a process-based assessment framework for technology education in order to assist educators to make a shift from traditional evaluation to OBE assessment?*

## RESEARCH DESIGN

A case study as form of qualitative action research was undertaken (Merriam 1998, p. 10). Observation and semi-structured interviews were used as data-collection methods. The researcher

was the primary instrument in the collection of data as the researcher functioned as participative observer and facilitated and monitored the project (Mouton & Marias 1992, p. 92). Recurring themes were revealed and conclusions were arrived at. Categories and subcategories were derived from the comparisons (Merriam 1998, pp. 164,179).

For reasons of geography, logistics and convenience the research project was placed in a parallel medium primary school in South Africa. The participants in the intervention were 33 Afrikaans speaking grade 7 learners (16 girls and 17 boys) with an average age of 13 years. The school is situated in a higher socio-economic suburban area. The parents of the learners mainly follow professional careers and have a positive attitude towards the school. Although the school as such has adequate equipment, the technology classroom is ill-equipped with ordinary laboratory desks, chairs and a few tools. Learners are motivated and positive towards technology education. The project relied on learners' goodwill to provide the materials and tools for the project. Within the case study action research was undertaken. As the focus of the assessment in this study was, *inter alia*, on learners' application of creative and critical thinking, as part of the purposive sampling three grade 7 learners (average age 13 years, one boy and two girls) from the same heterogeneous class, who were able to apply creative and critical thinking, were identified to be part of the case study. The three learners who were involved in the semi-structured interviews and observation were selected according to the following criteria:

- The researcher's prior acquaintance with the creative and critical thinking skills of the three learners. The learners had been in the researcher's class for two years;
- Neethling's (1998) brain profile to confirm that the learners used creative and critical thinking strategies;
- A questionnaire composed by the researcher, based on behavioural criteria developed from Neethling's (1998) brain profile for creative thinking, completed by the learners' parents.

The learners worked on a real-life project, namely that 12-13 year old learners (grade 7) lack the time to eat a nutritious breakfast before school and the learners were required to generate ideas for a breakfast substitute in the form of a snack that could provide for the nutritional needs of a grade 7 learner (capability task). For the purpose of this study the focus only fell on the initial idea generation stage (stage 5) of the technological process, creative and critical thinking (as thinking sub-processes) and a capability task. While performing the capability task learners were observed by the educator and researcher. The educator assessed learners by applying the provided assessment rubrics. Each learner received a self-assessment rubric, as well as group assessment rubrics. Semi-structured interviews (conducted in Afrikaans, the mother tongue of the respondents

and one of the eleven official languages of South Africa), as well as follow-up semi-structured interviews were conducted by the researcher with the educator and with the three learners. Audio-recordings were made of all the semi-structured interviews which were then transcribed and analysed.

In this study validity and reliability were obtained by:

- Triangulation of data sources. The educator and learners were used as data sources.
- Triangulation of methods by using observation and semi-structured interviews with the three learners and the educator.
- Member checks were done. The emerging findings were discussed with the educator and the three learners and they had the opportunity to confirm that the data had been correctly interpreted by the researcher (Mouton & Marais 1992, p. 92; Krathwohl 1993, pp. 238-239; Leedy 1997, p. 169).

## FINDINGS

From the observation and semi-structured interviews three main categories with subcategories emerged as aspects of an assessment framework: outcomes, content and assessment methodology.

### *Outcomes as first aspect of a process-based assessment framework*

Outcomes should be linked to the philosophy of technology with its four aspects (ontology, epistemology, methodology and teleology; Ankiewicz 2003, p. 17). Outcomes cannot be achieved in a vacuum and therefore the learning content (as included in the epistemology and methodology) is the tool for learners to achieve the outcomes. Outcomes as main category are divided into two subcategories: specific outcomes (what learners should be able to do at the end of a learning experience (RSA 1997, p. 89)) and unit outcomes (what the learners can demonstrate regarding the initial idea generation stage, as well as how creative and critical thinking in the context of technology education have been applied).

The following responses from the educator support the importance of outcomes as an aspect of an assessment framework:

Specific outcomes:        *“The specific outcomes to be achieved were indicated clearly at the beginning of the project...”*  
    *“... the learners could experience the problem through the stated outcomes ...”*

Unit outcomes: *“The unit outcomes were indicated on the different rubrics ... understood what had to be done ...”*  
*“ I really liked it that the unit outcomes were specifically directed at the learners...”*

*Content as second aspect of a process-based assessment framework*

Content as an aspect of an assessment framework is the second main category. Content implies knowledge which is divided into conceptual knowledge and procedural knowledge (McCormick 1997, p. 143; Ropohl 1997, p. 69; Ryle 1949, pp. 28-32). An assessment framework should create the opportunity for assessing the extent to which the learners acquired both conceptual and procedural knowledge, which are used as a vehicle to achieve the outcomes (Ankiewicz 2003, p. 17). Conceptual knowledge (knowledge of the physical nature, knowledge of the functional nature, knowledge of the relationship between the physical and functional nature and process knowledge) as the learners' understanding of what a snack as a substitute breakfast must comply with, was assessed informally. The following responses supports the use of conceptual knowledge:

Physical nature: *“Is it wise to put so much chocolate in your snack”*

*“... a lot of breakfast cereals have got honey as an ingredient ...”*

Functional nature: *“... remember that it must substitute for breakfast .. I forgot about that”*

Relationship between physical and functional nature:

*“... chocolate can maybe give you too much energy if you eat it early in the morning*

*and it might not be good for your health...”*

*“... so it must be nutritious ...”*

Process knowledge: *“... maybe I must rather use honey to mix all the ingredients together ... instead of chocolate ...”*

Physical nature: *“... a lot of breakfast cereals have got honey as an ingredient ...”*

Procedural knowledge as tacit, personal or implicit knowledge (McCormick 1997, p. 144) encompasses the procedural stages of the technological process and thinking sub-processes as subcategories (Ankiewicz et al. 2000, pp. 122, 127-134). Aspects of creative and critical thinking (thinking as sub-process) were observed. Learners considered as many solutions to the problem as possible and risks were taken because ideas were combined to form new ideas. Learners had to represent various ideas for a snack as a breakfast substitute as free-hand sketches with captions. Determination and perseverance to further develop ideas were necessary. Learners started with an idea and modified it until they were satisfied with their effort. Some of the learners even went back

to the original idea after it had been completed and again made some changes. The critical thinking of learners became evident from the comparison of possible solutions to the problem, weighing the advantages and disadvantages of each idea. Learners were willing to expand their existing knowledge with new information and thus insight was acquired, enabling them to motivate the choice of a specific solution. The knowledge the learners acquired through the resource tasks and the case study tasks were used to complete the capability task. The learners worked enthusiastically on their ideas. They were motivated to generate the best idea.

During the semi-structured interview with the educator the following comments highlighted procedural knowledge (procedural stages of the technological process and thinking sub-processes) as part of content:

Stages of the technological process: *“They worked according to a procedure ... not just putting a few thoughts together and hoping to solve the problem ...”*

Thinking sub-processes: *“...they had the chance to create ... they had the chance to really formulate their thoughts ... to apply the technological knowledge, their skills ... applying their skills to create something new ...”*

Stages of the technological process: *“ I could follow them through the different stages ... assessing their work during each stage ...”*

#### *Assessment methodology as a third aspect of a process-based assessment framework*

Assessment methodology as an aspect of an assessment framework is the third main category. The following subcategories can be distinguished: context in which the assessment occurs, type of assessment (including the persons involved, the time when assessment occurred and the way of assessment), assessment techniques and assessment instruments (Van Niekerk 2002, p. 42).

##### a. Context in which the assessment occurs

The context in which assessment occurs is determined by the specific learner task (resource task, capability task and case study task) performed individually or in groups and by the procedural stages of the technological process. In this study the learners were provided with the opportunity to perform a capability task by applying factual knowledge and basic skills (conceptual knowledge) acquired through the resource tasks and case study tasks to solve the given problem themselves. Initially the learners worked individually and then in groups of three. The following comments support the importance of individual and group work as part of the context:

Individual work: *“I had my own ideas ... I made the drawings myself ... I enjoyed it to work on my own ...”*

Group work: *“It’s also enjoyable in a group where you do not need to make everything on your own – you get extra help ...”*

#### b. Type of assessment

The type of assessment depends on the persons involved (educator, learner, peer group), the time when assessment occurs (diagnostic, formative, summative) and the type of assessment (formal, informal). After completing the capability task the learners assessed themselves by using the self-assessment rubric and in this way took responsibility for their own learning (Ankiewicz & De Swardt 2001, p. 98; Le Grange & Reddy 2000, p. 19; Geysler 2000, p. 55; Williams & Williams 1996, p. 192). The learners were continually conversing with one another and critically discussed and assessed one another’s ideas. If a learner’s ideas did not meet the requirements, the other learners provided criticism and also assessed one another’s work on the group assessment rubric (Le Grange & Reddy 2000, p. 19; Geysler 2000, p. 55; Mawson 2003, p. 124; Brown et al. 1997, p. 112). While the learners were engaged in the capability task, the educator periodically conversed with the learners, assessing their work to ensure that they were busy with the given task and that they understood what they were doing and also indicating to what extent each learner had successfully achieved the stated outcomes on the rubric (Owen-Jackson 2002, p. 209). The following quotations highlight the importance of different persons involved in assessment:

Self assessment: *“What I really liked was that they had to assess themselves and they themselves had to decide how they had fared in the assessment ...”*  
*“I assessed myself on what I felt I had done ...”*

Peer group assessment: *“... we assessed each other and I think we were quite fair in our assessment...”*  
*“... you were in their group and then they do know what you had done and then you would be assessed for it ...”*

Educator assessment: *“... I read through the unit outcomes before I started to assess the learners while they were busy doing their work ... knew what I was looking for ...”*

Assessment occurred continuously (formative assessment), as well as after the completion of a particular task or activity (summative assessment, Ankiewicz & De Swardt 2001, pp. 96-97; Benbow & Mably 2002, p. 201; Department of Education 2002, p. 5). The educator confirmed the importance of formative and summative assessment:

Formative assessment: *“We were busy with assessment the whole time ... it was continuous ...”*

*“I liked it because you could immediately help the learner when you saw that they were doing something wrong...”*

Summative assessment: *“... after the learners had finished their activity ... we all talked together, discussing and assessing the learners’ work ...”*

Although this study mainly focused on formal assessment planned in advance (Ankiewicz & De Swardt, 2001, p. 99) and based on specific assessment rubrics, the researcher also observed that the educator moved between the learners and informally assessed them on the spur of the moment. Problems were thus identified and addressed. The educator made the following comments on formal and informal assessment:

Formal assessment: *“... was very clear to me, very well planned and ... I knew what to do ... there was something of that ...”*

Informal assessment: *“... and it was enjoyable to informally make notes every now and then ... and then casually observe the learners ... if a learner made a mistake I could immediately help the learner ...”*

#### d. Assessment techniques

While the learners were busy with the capability task, the educator observed the learners to determine whether particular skills related to the given task could be demonstrated, in other words, whether the stated unit outcomes were achieved in the presence of the educator (Van der Horst & McDonald 1997, p. 191; Altrichter et al. 1993, pp. 10-11; Habeshaw et al. 1993, pp. 33-36). The learners had the opportunity to orally demonstrate their knowledge and skills (conceptual knowledge) used to solve the problem (Friederich-Nel, De Jager, Joubert & Nel 2003, p. 49, 54; Naicker 1999, p. 95). The following responses emphasise the use of different assessment techniques:

Observation: *“... made a lot of sense to me ... many more of their own characteristics ... come out .... observe what they do ... get to know them better ... make notes ...”*

Oral response: (The question related to an explanation for the chosen idea)

*“My idea? I think it is the best ... I am going to make an energy bar as breakfast substitute. I am going to use muesli because most of the energy bars I tasted have muesli as an ingredient ... I’ll use syrup or honey to mix al the*

*ingredients together ... definitely not too much chocolate because it isn't good for you ...”*

Written responses in the form of freehand sketches as an assessment technique was used as the learners were busy generating different ideas to solve the problem (Figure 1).

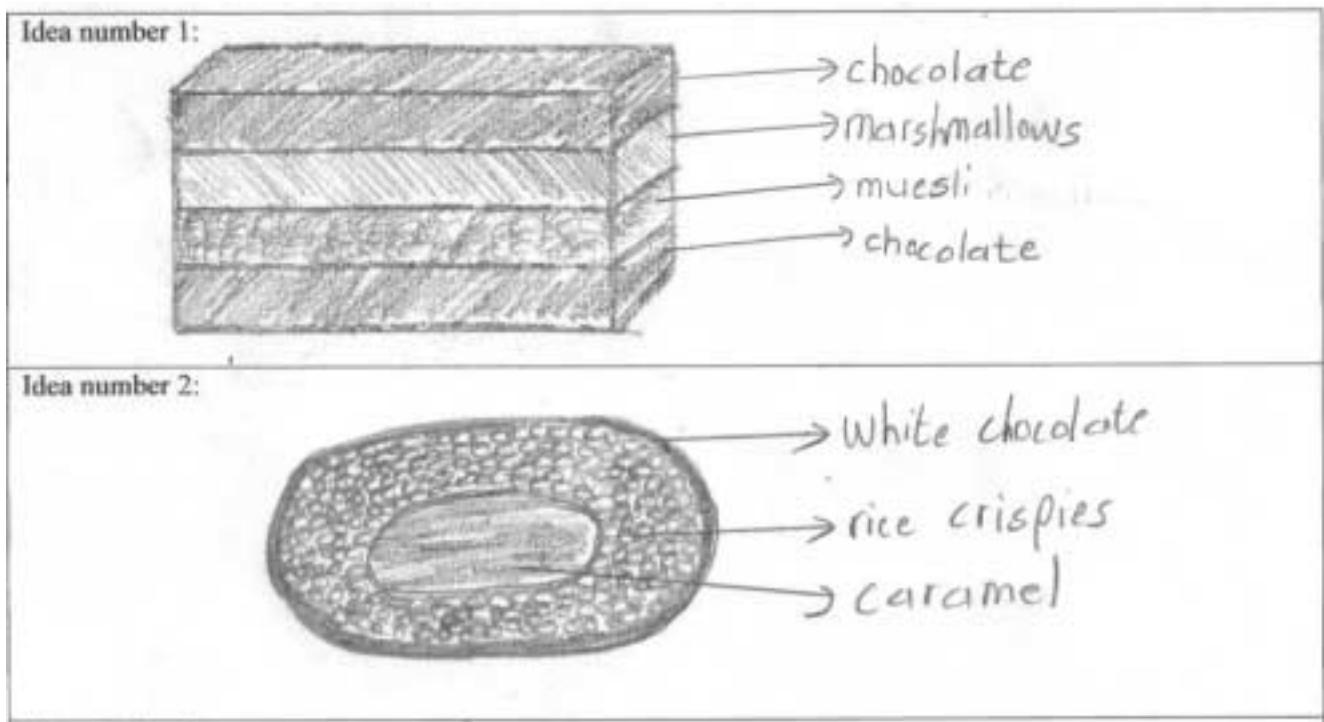


Figure 1: Written responses as assessment technique

#### e. Assessment instruments

Before the onset of the capability task the educator provided each learner with assessment rubrics. On each assessment rubric a numeric value (four point scale description) was indicated to assess each learner's performance (Department of Education 2002, pp. 18-21; Kubiszyn & Borich 2000, pp. 169,170). Before the rubrics were completed the educator explained each rubric to the learners.

During the semi-structured interview and follow-up semi-structured interview the educator and learners made the following comments on the value and usefulness of the assessment rubric as assessment instrument:

Rubrics: *“... then I really liked the assessment rubric. The rubric helped me a lot because I could keep up with what was asked all the time ... it is very easy to use ...”.*

*“... it said exactly you had to look at that thing ... if you look at it, you understand it ...”*

*“... easy way to assess others in the group ...”*

*“... I liked it when I could complete it for myself ...”*

### *An assessment framework for technology education*

Based on the interconnections between the main categories and subcategories a process-based assessment framework for technology education (Figure 1) can be compiled for meaningful and effective assessment. The assessment framework consists of three aspects: outcomes, content and assessment methodology. These aspects are entwined with the philosophy of technology. Though this framework is not a final model, it ought to be developed through further research.

When planning assessment for a particular learning program the educator considers outcomes (1) to be achieved by the learner as a starting-point. The outcomes of a learning programme are divided into specific outcomes (1a) and unit outcomes (1b). Secondly, the educator needs to take the selected content (2) into account, because content serves as vehicle for the learners to achieve the unit outcomes and consequently the specific outcomes. Content implies knowledge (2a) and knowledge is subdivided into conceptual knowledge (2b) and procedural knowledge (2c). Conceptual knowledge comprises of what a learner understands about a certain aspect. Procedural knowledge is further divided into the procedural stages of the technological process (2c-i) and the thinking sub-processes (2c-ii). The specific procedural stages (2c-i) during which assessment will occur should be taken into account, as well as the dominant thinking sub-processes (2c-ii) within the particular stage. Thirdly, the educator should apply the assessment methodology (3). The assessment methodology consists of four aspects: context (3a), type of assessment (3b), assessment techniques (3c) and assessment instruments (3d). When considering the context (3a), the educator should pay attention to the type of learner task (3a-i) to be performed, be it a resource, case study or capability task. The educator should also consider during which procedural stage of the technological process (3a-ii) the learner task should be done and whether it will be done individually or as group work (3a-iii). Taking the context (3a) into account, the educator decides on the type of assessment (3b) based on the persons (3b-i) involved (educator, learner, peer group), the time (3b-ii) of assessment (diagnostic, formative, summative) and the method (3b-iii) of assessment (formal or informal). The assessment techniques (3c) should then be taken into consideration, as well as the assessment instruments (3d). The assessment techniques imply observation, oral assessment and written assessment. Rubrics can be used as assessment instruments. If the unit outcomes are not achieved, the educator plans to repeat the content or select different content for the particular learning programme. The assessment methodology is once again applied. The cycle

is repeated until every learner has achieved the unit outcomes and consequently the specific outcomes.

Although only one of the ten stages was involved in the empirical study, from which the assessment framework was derived, it could also, as a generic assessment framework, be applied to the other procedural stages as part of the rational problem-solving paradigm. It has to be utilised with minor adjustments to accommodate the unique outcomes, content (conceptual and procedural knowledge) and learner- and educator activities associated with the specific stage. This application to the other procedural stages of the technological process also deserves further in-depth study.

(Figure 2)

## DISCUSSION

In order for educators to make a shift from traditional evaluation to OBE assessment the educator must be aware of the following demands it will make: assessment is no longer the sole responsibility of the educator because self- and peer assessment comes into play; assessment does not consist of marks and tests alone, but also requires a report on the gradual progression of learners; assessment requires the educators to use different instruments to indicate the gradual progression of learners and not a once-off test or examination; assessment relies heavily upon grading and not scoring (Research question 1).

The focus of a process-based assessment framework falls on the essential aspects of technology education, namely the outcomes, content and the assessment methodology. An assessment framework based on this can assist the educator to make the shift from traditional evaluation to OBE assessment. The framework can therefore be used, when the educator plans assessment, to ensure that all three aspects of technology education are included. A clear framework ensures that assessment in technology education offers high quality learning, teaching and assessment and that each learner is given the opportunity to achieve the stated outcomes. Outcomes (first aspect of a process-based assessment framework) are identified, as well as the procedural stages of the technological process which creates the opportunity to assess the stated outcomes. By means of content (second aspect of a process-based assessment framework) attention is given to conceptual knowledge (“knowing that”), as well as procedural knowledge (“knowing how”) through the applicable thinking sub-processes and the attendant skills to be mastered. Assessment methodology (third aspect of a process-based assessment framework) ensures that different learner tasks are used

during the technological process for the learners to be given the opportunity to use their knowledge and skills and to thus prove that the stated outcomes are achieved. Assessment is continually (formative assessment) done formally and informally while the educator and the learners are actively involved in assessment. By using different assessment techniques and assessment instruments each learner is given the opportunity to be successful in the achievement of the stated outcomes. Content and assessment methodology are thus used to achieve the outcomes.

A process-based assessment framework prevents the educator from merely focusing on the design process during assessment. A process approach therefore substitutes a product approach and the emphasis does not fall on the end product alone. Everything the learners do during the completion of the learner tasks, as well as during all ten stages of the technological process, is important for assessment.

A process-based assessment framework makes provision for formative as well as summative assessment. The educator can continuously assess whether the learners achieve the stated outcomes. Constant feedback can be given to learners and correction can be made betimes if learners' factual knowledge of basic skills of a specific technological aspect is not correct. As a result learners are motivated to complete the task at hand. Learners are actively involved in assessment through formal and informal peer group assessment and self-assessment. The use of different assessment techniques and different assessment instruments creates the opportunity for each learner to successfully achieve the outcomes (Research question 2).

## CONCLUSION

The purpose of this paper was to briefly discuss demands OBE makes on educators when they are required to make a shift from traditional evaluation to assessment. In order to assist educators an assessment framework was developed to assess learners in technology education in a meaningful and responsible manner. An assessment framework was developed from the research findings and information gained from the literature. This framework consists of three aspects: outcomes, content and assessment methodology. The framework can therefore be used when the educator plans assessment to ensure that all three aspects of technology education are included and in this way it helps the educator to make the shift from traditional evaluation to assessment. Although this framework only focuses on one stage of the technological process, it can be utilised with minor adjustments as guidelines for assessment in other stages of the technological process, and should therefore be researched further.

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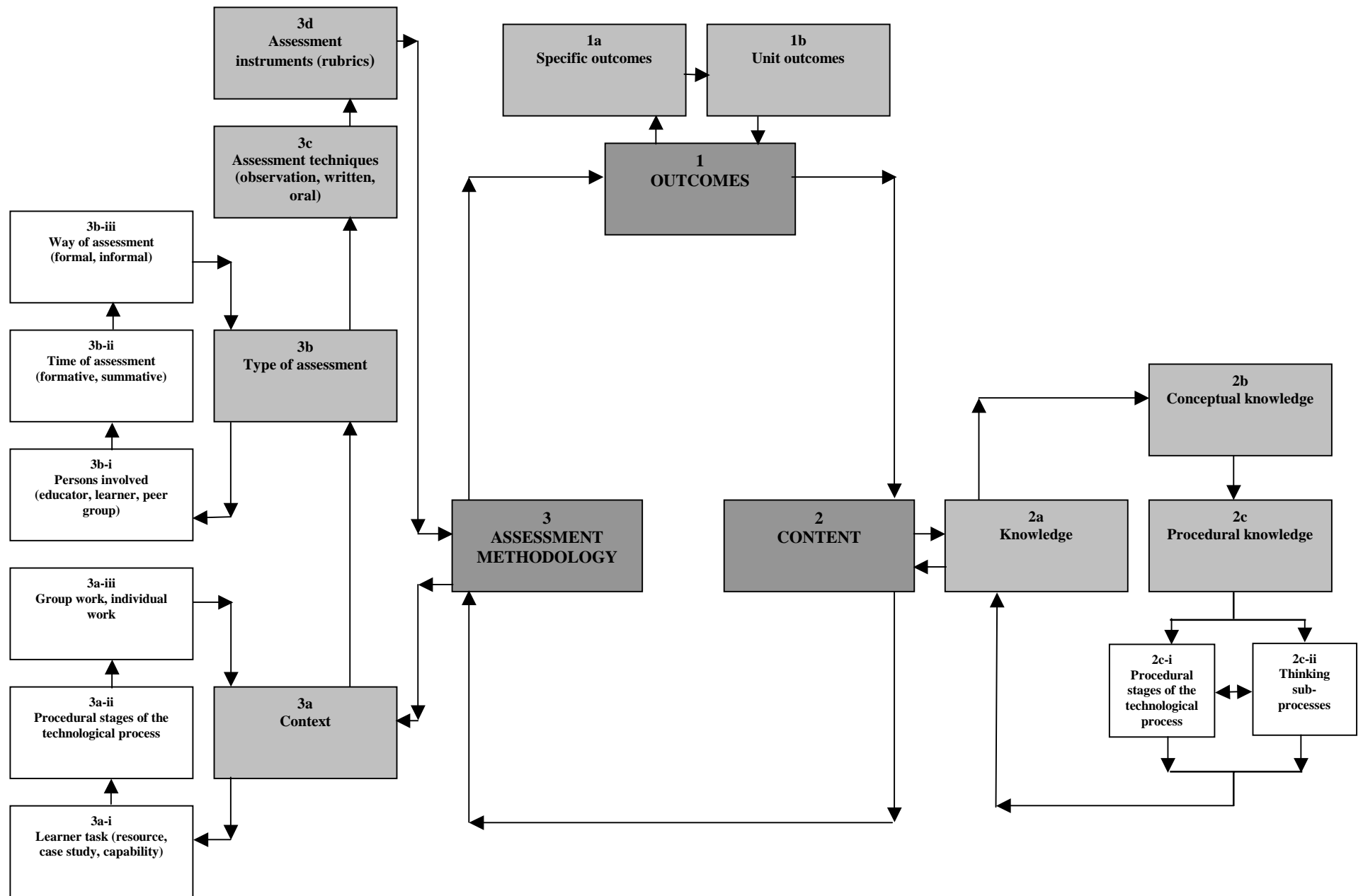


Figure 2: A process based assessment framework for technology education

