Learning activities in the *Technology* subject to engage learners in the senior phase of schooling

Donald M. Makhubele & Sibongile Simelane-Mnisi

Tshwane University of Technology
Pretoria, South Africa

ABSTRACT: The aim of this study was to investigate the activities carried out in the subject *Technology* to engage learners in the senior phase of schooling. The sample comprised 32 learners from Cottondale Circuit in Mpumalanga Province, South Africa. The qualitative case study method was used. Observations and interviews were used to collect data. Atlas.ti was applied to analyse qualitative data. The findings showed that learners were engaged in theoretical aspects of the subject and group activity to complete the practical projects. The results revealed that all learners were engaged in practical work or MiniPAT which involved individual and group work. Furthermore, practical work or MiniPAT was completed quarterly. It is recommended that teachers engage learners in inquiry-based hands-on activities to encourage the development of collaboration and problem-solving skills.

INTRODUCTION

The Technology subject influences learners' daily lives, and certainly, it plays a major role in developing learners' positive and negative attitudes toward it [1]. In order to instil the right attitude and technological know-how of the subject, essential learning activities are required for practical skills [2]. However, it is pointed out that learners perceived the Technology subject as difficult, problematic, demanding and challenging [3]. This perception leads to inadequate performance among learners.

To overcome this perception, it was critical in this study to create a conducive learning environment with learning activities that promote and increase students learning that relates to reflective decision-making, argumentation and engagement [4]. The most effective strategies for learning practical skills are demonstration methods, enquiry, project and assignment methods [5].

The significant issues to teach Technology to learners was to provide learners with the opportunity to learn problem-solving using the design process, practical skills, knowledge and the application of knowledge [6]. This would be achieved through practical projects using a variety of technological skills relating to investigating, designing, decision-making, evaluating and communicating (IDMEC) [6]. These skills are meant to accommodate various learning preferences and learners' approach to learning.

Research shows that it is essential that teachers create technology activities that cause learners to construct and interact with learning [7]. In this regard, it was crucial in this study that learners be engaged in various learning activities to enhance their understanding of the subject. Investigating learners' activities was motivated by the study conducted by Horton that emphasised a learning model combined with practice [8]. This author was inspired by the Chinese proverb that says: *I hear and I forget, I see and I remember, I do and I understand*. This proverb assisted the teachers in this study to create various activities in short practical assessment tasks (MiniPAT).

The MiniPAT makes up the main formal assessment of a learner's skills and knowledge application during each term. Ankiewicz states that the MiniPAT introduces procedural knowledge associated with technological problem-solving [9]. It may be an assignment covering aspects of the design process or it may be a full capability task covering all aspects of the design process that include investigating, design, make, evaluate and communicate [6]. Research results by Gumbo indicated that teachers and learners tend to struggle in this area. Most teachers viewed the MiniPAT as a monster, and they did not know what to do about it [10].

The purpose of this study was to examine the learning activities used in the Technology subject to engage learners in the senior phase. To identify the learning activities used in the Technology MiniPAT, observations were conducted at

two schools. Furthermore, individual semi-structured interviews were conducted with learners, to understand their opinions about the activities they used in both theory and practicals.

RESEARCH QUESTION

The main research question explored in this study was: *What are the learning activities used by learners in Technology*?

METHOD

To address the research question, a qualitative case study was used. The qualitative case study enables exploration of a phenomenon within its context using a variety of data sources [11]. The intention of using the qualitative case study was to explore learning activities used in Technology through a variety of lenses, which allows for multiple facets of the phenomenon to be revealed and understood. Hence, observations and individual semi-structured interviews were employed. Furthermore, the descriptive case study was the appropriate type of case study for this investigation, because it describes a phenomenon and the real-life context in which it occurred [12].

Participants

The participants were 32 senior phase learners from eight high schools from Cottondale Circuit, Mpumalanga Province in South Africa. Senior phase comprises of grade 7, 8 and 9 students. For the purpose of this study, grade 8 and 9 learners were involved. Purposive sampling was used to select the participants who were knowledgeable about the phenomenon [13].

Data Collection

This study was performed in May and June 2018. Data were collected by means of observation and individual semi-structured interviews. Two schools were observed by the researchers to identify the learning activities used to engage learners in class. The non-participatory observation was used, because it allowed the researchers to observe rather than take part in the lesson [2]. The typical questions were: *What are the activities used to engage learners in Technology in class*? *How do learners interact and engage during the class*? Secondly, the individual semi-structured interviews were conducted also to determine the learning activities used in the MiniPAT. Typical questions were: *Do you participate in Technology activities in class*? *Explain, do you do practical work (MiniPAT) in the Technology workshop*?

Data Analysis

Data were analysed by means of Atlas.ti. Two primary documents were uploaded on the hermeneutic unit called the FAT Technology project. From these documents, 296 codes were created. The codes were then grouped into five networks relating to:

1) participation in class or the MiniPAT;
2) practical work or the MiniPAT;
3) number of practical exercises;
4) duration of practical work;
5) duration of the Technology test.

These networks were then clustered into a theme called *learning activities* to make an in-depth understanding of the analysis.

FINDINGS AND DISCUSSION

Participation in Class or the MiniPAT

With regard to participating in class or the MiniPAT, the findings revealed that learners' participation in Technology lessons plays an important role in determining the level of performance in the subject. Therefore, each learner was expected to take part in all Technology activities in class including the MiniPAT. Figure 1 shows the conceptual network of learners' participation in class.

The findings revealed that learners participated in Technology activities in class or the MiniPAT. In this case, Nothando said: *Yes, we are given classwork and homework*. Dineo also indicated that: *Yes, the teacher asked us a question on what we learned throughout the day and then we answer*. Mandisa further mentioned that: *Yes, we answered questions and wrote during classwork*. Melvin revealed that he participated, because he wanted to know Technology.

They were given assignments and even the MiniPAT. It may be observed from the findings that classwork, homework, question and answer, and assignments were mostly the learning activities used. This finding is supported by Mnisi that classwork promotes active learning, whereby learners are afforded an opportunity to actively participate by doing in the class and not only by listening passively [14]. Classwork improves learners' understanding of information [14]. Mtshali argued that critical thinking allows learners to come up with a creative solution to a problem [15].

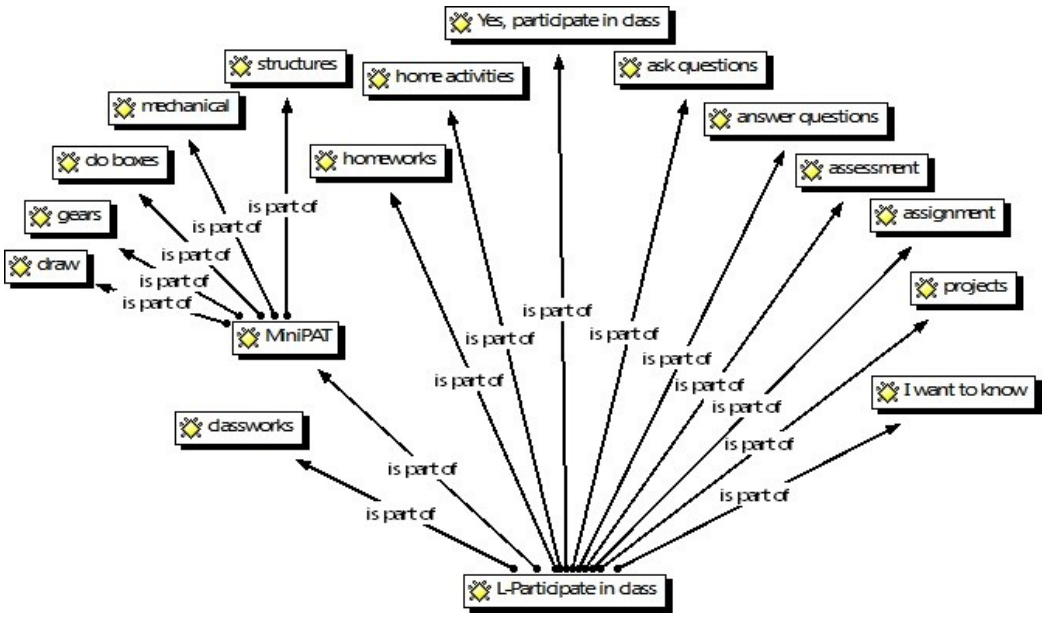

Figure 1: The conceptual network of learners' participation in class.

Practical Work or the MiniPAT

It was found that practical work or the MiniPAT was completed quarterly, meaning that learners were given practical work to complete. The practical work covers the work done during the quarter (theory) and it forms 70% of the work in Technology. It involves individual and group work. There are technological or design processes to be followed when executing practical work (MiniPAT). Figure 2 shows the conceptual network of practical work (MiniPAT) used in the Technology subject.

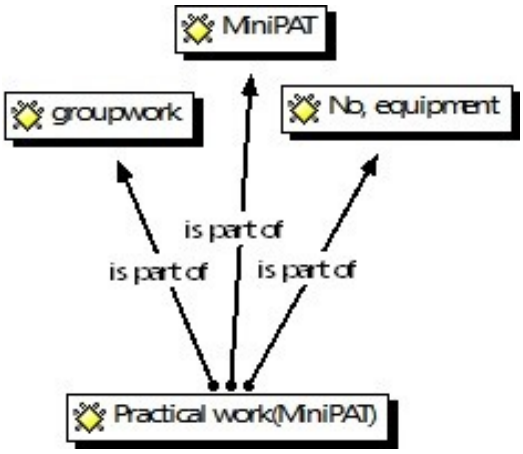

Figure 2: The conceptual network of practical work (MiniPAT) used in the Technology subject.

The findings revealed that learners were engaged in practical work or the MiniPAT in Technology. Here, Bopelo agreed with Vutivi who indicated that: *Yes, we do practicals in the form of a MiniPAT and also in groups.* This finding is supported by Mngunikazi, where group activity was also promoted to complete the Technology task [16]. It is evident from a study by Filipowski et al that group work is an effective strategy to employ in practical work as it assists learners to participate in complex workshop activities [17]. Group work promotes teamwork. The findings further revealed that the MiniPAT was done at the end of each quarter.

It may be argued that though individual and group work activities were promoted, but learners have had difficulty in completing the MiniPAT with understanding. It is stated that in the MiniPAT learners complete their task by applying the design process (IDMEC) [18].

It was also found that learners struggled to do the MiniPAT, because of the lack of equipment. In this instance, Lerato mentioned that they agreed that they: …*did the MiniPAT,* but also said: …*there was a lack of available equipment.* Both Tinyiko and Tendani revealed that: *In the MiniPAT we do it in class we do not have the workshop or laboratory to do practicals.* Tendani said: *We do the MiniPAT but the teacher explains theory because they do not have the material to show us gears and others.* The literature revealed that it is critical to have appropriate facilities and equipment to effectively implement Technology in secondary school [19].

Number of Practical Exercises

Concerning the number of practical exercises, it was crucial to obtain this data from the learners in order to solve the challenges encountered with the learning of Technology. Furthermore, practical work to be completed in Technology were clearly stipulated in the subject policy. The Technology content to be taught in grade 8 covers the following concepts: term 1 impact of technology processing, term 2 mechanical systems, term 3 control, and term 4 electrical systems and control [6]. Figure 3 shows the conceptual network of practical exercises used in the Technology subject.

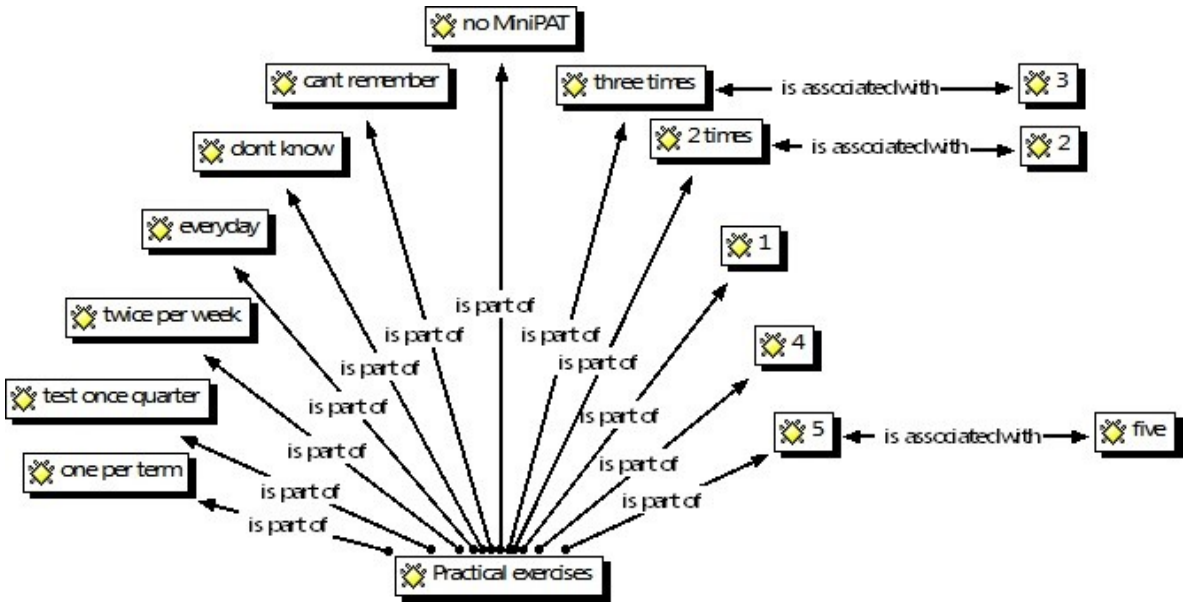

Figure 3: The conceptual network of practical exercises used in the Technology subject.

The Technology content for grade 9 covers structures in term 1, mechanical systems and control in term 2, electric/electrical systems in term 3 and in term 4 processing [6]. The aim of these topics was to ensure that learners are aware of the interrelationship between technology, society and the environment [6].

The findings revealed that most of the learners indicated that they were given practical work. In this regard, participants differed as Thembi and Thabo opined that it happened once a term, whereas Surprise said twice a term and Thabang said five times a term. It may be argued that through practical projects completed in a term using a variety of technological skills relating to investigating, designing, decision-making, evaluating and communicating, the aim was to enhance the learners' skills and accommodate various learning preferences [6].

Duration of Practical Work

With regard to the duration of practical work, it was found in this study that learners frequently were engaged in Technology activities, which among others include practical work that covers a large scope of Technology as a subject. Learners complete practical work at different times. Figure 4 indicates the conceptual network of practical work (MiniPAT) time used in the Technology subject.

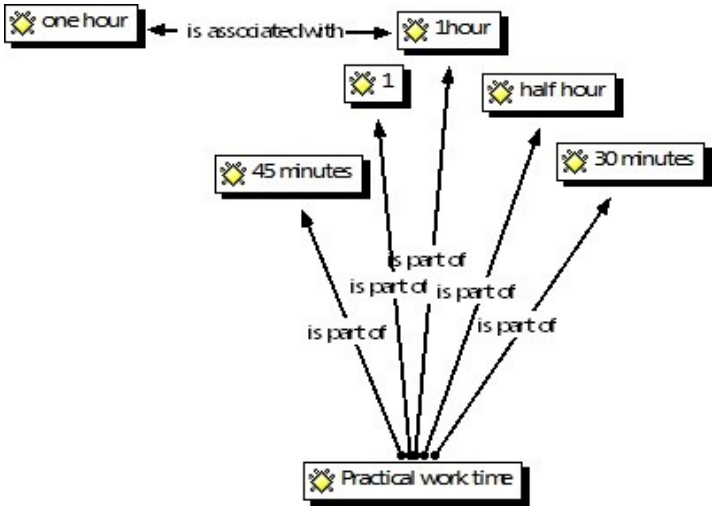

Figure 4: The conceptual network of practical work (MiniPAT) time used in the Technology subject.

The findings revealed that the time needed to complete tasks varied between the learners. For example, Zandile indicated that: …*it took an hour to complete the practical work.* Pleasure mentioned that: …*it took one hour and 30 minutes to do the practical work depending on the topic*. Lerato further said that: …*it took more than one hour to do practical work.* Hope indicated that: …*practical work, took 45 minutes*.

The implementation time of the Technology subject in the senior phase is clearly stated in the Technology curriculum [20]. It is stated that the allocated teaching time for Technology must be two hours per week. As this subject involves practical work, 60 minutes of the two hours should be one continuous period for practical work, e.g. one double period comprising two periods of 30 minutes. Schools using alternative period lengths or a cycle system, must ensure that all subjects obtain their correct time allocation and that sufficient time is allocated for practical sessions [6].

Duration of Technology Test

In terms of duration of the Technology test, it was also critical in this study to know the assessments that were conducted to check if learners had mastered the content. It was crucial that the form of evaluation for the Technology subject was clearly defined. Figure 5 shows the duration of the Technology tests.

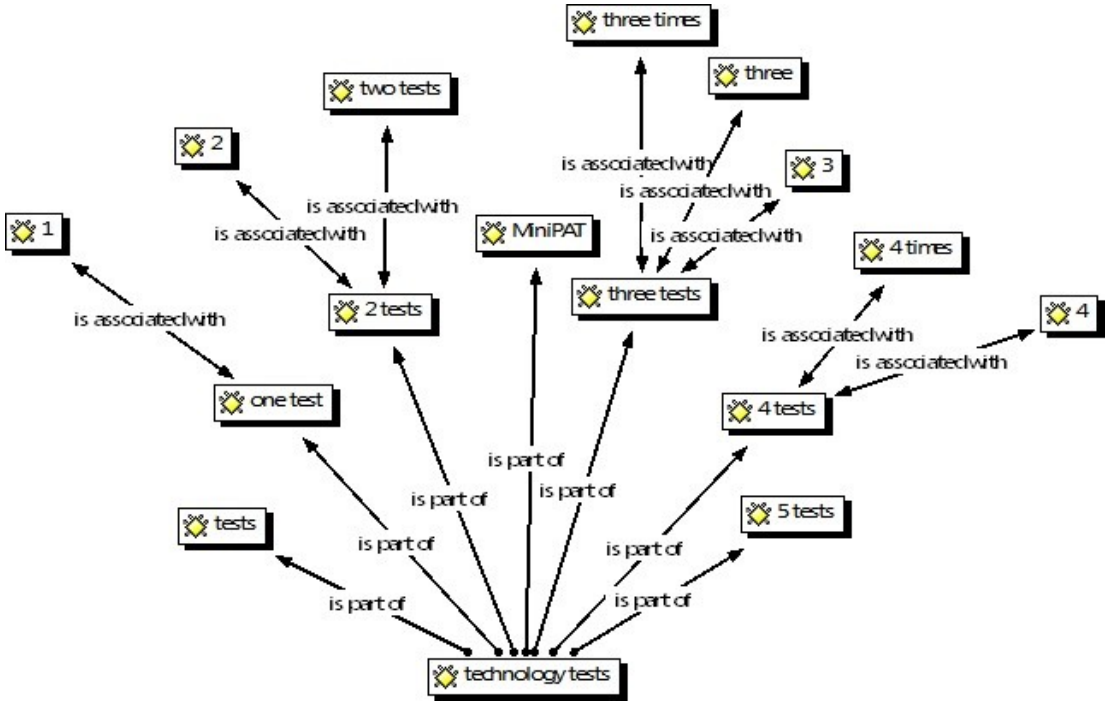

Figure 5: The network relating to the duration of the Technology tests.

The findings revealed that learners were given the Technology tests as part of learning activities. This is confirmed by Nsuku and Trinity who replied in the affirmative and said: *Yes, they did tests four times per term*. Nyiko mentioned: *Yes, one test per term*, whereas Melvin indicated: …*four tests and two MiniPAT per term.* Tsakani agreed and said: *Yes, they were given three tests per term*.

Technology assessment guidelines stated clearly that the assessment tasks should be appropriate for the age and grade of the learners being assessed [21]. However, it was found in this study that the assessment methods that were used in the subject, such as tests and examinations, needed improvement. Literature shows various types of assessments the teacher can select when assessing learners in Technology, such as demonstration brainstorming/mind mapping, practical, presentation, panel discussion, model making/plans/design, research project, project work, exhibition, investigation, etc [16].

CONCLUSIONS

In conclusion, to infuse positive attitude and technological knowledge to learners, it is critical to employ learning activities that will require learners to actively engage in practicals or the MiniPAT. Creating such activities might reduce the problems usually encountered in Technology. Furthermore, activities identified in this study might provide solutions to teachers who still struggle to teach the MiniPAT.

It may be observed in this study, that a variety of learning activities were required to enable the students to perform or practice in order to improve their learning. This might be achieved when learners are given the opportunity to construct, engage and interact with the learning content. Limited activities were utilised by the learners, such as classwork, homework, group work and learners asking questions.

Not all the activities that are essential to promote participation and engagement to enhance technology skills were utilised even the assessment strategies were limited to tests and the MiniPAT. Even though learners in this study were engaged in practical work, it was completed at different times. The MiniPAT is the main formal assessment used in the Technology subject and it was executed once per term.

RECOMMENDATIONS

It is critical that the teacher uses various assessment types in assessing the learners' knowledge, skills and values in order to improve the performance of the learners. It is recommended that a learner-centred approach be used, because it allows the learner to be actively involved in the subject. Technology is a valuable subject that promotes 21st Century skills, it allows learners to participate in the skills required in the 4th Industrial Revolution. Above all, Technology contributes to the economic growth of the country. Further research could be conducted using the mixed method with a wider scope of participants and learners' relevant biographical data revealed.

REFERENCES

1. Šuligoj, V. and Ferk Savec, S., The relationship of students' attitudes to technology and their creative ability. *World Trans. on Engng. and Technol. Educ.*, 16, **3**, 243-248 (2018).
2. Makhubele, D.M., Factors Affecting Learners' Performance in the Senior Phase Technology Subject at Selected Schools in Cottondale Circuit. Tshwane University of Technology, South Africa: Pretoria (2019).
3. Ugochukwu, C.N., Elisha, N.E. and Emmanuel, E.I., Factors Affecting Students' Performance on Basic Technology Junior Secondary School Certificate Examination. Nigeria: Ebonyi State University (2014).
4. Purzer, S., Engineering Approaches to Problem Solving and Design in Secondary School Science: Teachers as Design Coaches. Washington DC: Purdue University (2017).
5. Joseph, A.O. and Godstime, T.C., Strategies of effective teaching and learning practical skills in technical and vocational training programmes in Nigeria. *Inter. J. of Scientific Research Engng. and Technol*., 5, **12**, 598-603 (2016).
6. Department of Basic Education, DBE, National Curriculum Statement Grade R-12. Pretoria: Government Printers (2011).
7. Makhubele, D.M., Simelane-Mnisi, S. and Makgato, M., Teaching and learning for technology in South African rural high schools. *World Trans. on Engng. and Technol. Educ.*, 17, **3**, 266-271 (2019).
8. Horton, B., I hear and I forget, I see and I remember, I do and I understand - putting learning models into practice. *Planet*, 3, **1**, 12-14 (2001).
9. Ankiewicz, P. Technology education in South Africa since the new dispensation in 1994: an analysis of curriculum documents and a meta-synthesis of scholarly work. *Inter. J. of Technol. and Design Educ.*, 1-33, (2020).
10. Gumbo, M. Professional development of technology teachers: does their training meet their needs? *Perspectives in Educ.*, 38, **1**, 58-71 (2020).
11. Baxter, P. and Jack, S., Qualitative case study methodology: study design and implementation for novice researchers. *The Qualitative Report*, 13, **4**, 544-559 (2008).
12. Yin, R.K., *Case Study Research: Design and Methods.* (3rd Edn), Thousand Oaks, CA: Sage (2003).
13. Cohen, L., Manion, L. and Morrisson, K., *Research Methods in Education.* (5th Edn), London: Routledge Falmer: Taylor and Francis Group (2002).
14. Mnisi, S., Exploring a Teaching Strategy Using Clicker Mobile Technology for Active Learning in Undergraduate Mathematics Classes. Doctoral Thesis. Tshwane University of Technology, Pretoria (2015).
15. Mtshali, T.I., Critical thinking skills for Civil Technology practical assessment tasks (PATs). *World Trans. on Engng. and Technol. Educ.*, 18, **2**, 237-241 (2020).
16. Mngunikazi, P.S., Grade Nine Technology Teachers' Understanding and Practice of Assessment in Technology: a Case Study in a District of Escourt. South Africa: University of KwaZulu-Natal (2014).
17. Filipowski, S., Nessel M. and Romaniak, K., Improving student competence through workshops. *World Trans. on Engng. and Technol. Educ.*, 17, **4**, 483-489 (2019).
18. Mokoena, M.M., Problem-based Teaching and Learning in Senior Phase Technology Education in Thabo-Mafutsanyana District, QwaQwa. South Africa: University of South Africa (2014).
19. Hamilton, C. and Middleton, H., Implementing technology education in a high school: a case study. In: Middleton, H., Pavlova, M. and Roubuck, D., Learning in Technology Education: Challenges for the 21st Century. *Proc. 2nd Biennial Inter. Conf. on Technol. Educ. Research*, 152-160 (2015).
20. Department of Basic Education, DBE, Revised National Curriculum Statement R-9 (Schools). Pretoria: Department of Education (2002).
21. Department of Basic Education, DBE, Assessment Guideline, National Curriculum Statement Assessment Guidelines for General Education and Training (Intermediate and Senior Phases) Technology. Pretoria: Department of Education (2011).