TEACHER PERSPECTIVES ON THE IMPLEMENTATION OF THE NATIONAL CURRICULUM STATEMENT (NCS) IN TECHNOLOGY

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Abstract
This paper reports on a research project that investigates the implementation of Technology in the Senior Phase (Grade 7, 8 & 9) classrooms in public schools in the Gauteng Province. The purpose of the research project was to identify and analyse implementation 'issues' technology teachers have, and to gather information related to their perspectives on the principles underpinning the National Curriculum Statement (NCS), their pedagogical content knowledge (PCK) and pedagogy used in respect of the NCS (Technology) curriculum. One hundred and twenty three (123) technology teachers from all districts in Gauteng participated in the project. Participants anonymously completed a two-part questionnaire. Selected descriptive and inferential statistics (involving exploratory factor analyses) were utilised to identify main factors that probably contributed to the measured findings. Results showed that the majority of teachers came from Township areas where schools are under-resourced and problems with teaching technology are experienced. In striving to address the matter constructively a number of recommendations were made.

Keywords: Technology teacher perceptions, implemented or enacted technology curriculum

1.1 INTRODUCTION

Technology as a new separate learning area was introduced to the South African education scene in 1998 with the introduction of Curriculum 2005. Limited time was given by the National Department of Education for the implementation of the new curriculum and because of that there was very little time to adequately educate or train technology teachers. Teachers were expected to implement technology in schools without being appropriately trained with regard to content and/or instructional methodology. Because of the discontinuation of industrial arts subjects, qualified and competent teachers in subjects, such as Home Economics, Woodwork, Metalwork and Industrial Arts, were generally assigned the responsibility of implementing and teaching technology. These teachers were confused by the introduction of technology education, because they were accustomed to traditional instructional methodology in the manipulation of materials and the use of technology within the context of their traditional subjects. Teachers were not sure how to approach lesson planning in the new learning area, they were unsure of what to teach learners in class and how to facilitate and assess what they have taught (Engelbrecht, Ankiewicz & De Swardt, 2007; Van Niekerk, Ankiewicz & De Swardt, 2010). Although Departments of

Education did provide some initial training, the training focused more on generic concepts within Outcomes Based Education (OBE) than on technology-specific content with the result that the majority of the teachers did not find it very useful (Chisholm, 2000; Engelbrecht, Ankiewicz & De Swardt, 2005; 2006). What the teachers really needed was the necessary knowledge, skills and values to effectively teach technology in schools in the South African context.

According to De Vries (2005, p.149) there is no other subject that relates to technology education and thus it would be difficult for a technology teacher without formal technology training to base his/her teaching and learning strategies on approaches from other subjects (Pool, Reitsma & Mentz, E, 2013). The implication of this is that teachers who teach with limited subject knowledge will only focus on areas of knowledge which are familiar to them and which will influence their level of teaching (Pool et al., 2013).

A number of South African researchers found that technology teachers in South Africa are ill-equipped regarding the necessary knowledge to teach the themes associated with technology (Ankiewicz, 2003, p. 17; Reddy, Ankiewicz, De Swart & Gross, 2003, p. 29; Potgieter, 2004, p. 210). The Bernstein report (2011, p. 4) emphasised that many of the current practicing teachers in mathematics, science and technology were not teaching effectively. She further stressed that one of the reasons was because they were poorly trained.

For a teacher to be successful in teaching technology he/she should have technological competencies which include subject knowledge, pedagogical subject knowledge, subject skills and pedagogical subject skills (Jones & Moreland, 2004, p. 123).

Technological knowledge can be divided into conceptual knowledge, 'knowing that' and procedural knowledge, 'knowing how' (McCormick, 1997, p. 143). McCormick (1997, p. 143) explains that conceptual knowledge is not simply factual knowledge, it is about relationships among 'items' of knowledge and includes ideas which are necessary when thinking about technological activity. Procedural knowledge is about 'know how to do it' and within the technological context may include concepts like design, modelling, problem solving, system approaches, project planning, quality assurance and optimisation. When teaching and learning technology these two types of knowledge cannot be separated (McCormick, 1997, p. 145; Ankiewicz, 2013, p. 9).

In the South African context it is expected that the technology teachers should demonstrate in-depth technological knowledge regarding the understanding of knowledge associated with the following Learning Outcomes (LO's) (DoE, 2002, p. 5):

LO1 technological processes and skills (including the technological problem solving process);

LO2 technological knowledge and understanding (including structures, processing, systems and control); and

LO3 the interrelationship between technology, society and the environment.

Subject specific pedagogical content knowledge (PCK) is important because the teacher must be able to convert specific content of Technology into knowledge that is meaningful for learners (Pool et al., 2013), thus teachers with no training in Technology Education will not have the necessary PCK to teach technology.

In 2009 the Gauteng Department of Education (GDE) commissioned the Department of Science and Technology Education at the University of Johannesburg to investigate teachers' current status of teaching Technology in the Senior Phase (Grade 7, 8 & 9) in the province. During that time 11 years have elapsed since the introduction of the NCS and the purpose of the study was to establish the difficulties teachers still have with the teaching of Technology.

1.1.1 Problem statement

The GDE is not sure what the academic stance is regarding the teaching of technology in public schools in the province. The researchers are of the opinion that most development programmes offered to technology teachers or their initial teachers' training did not prepare them to teach technology effectively.

The **specific research questions that guide this study**, are:

- What are the problems that Technology teachers experience in adhering to the requirements and implementation of the National Curriculum Statement (NCS)?
- What are teachers' understanding of the NCS and its topics?
- How are teachers implementing the technology curriculum in the classroom? Are the methodologies used to teach the topics appropriate and relevant?
- What recommendations can be provided to overcome some of the problems associated with teaching the mandated technology component?

1.1.2 Aim and objectives of the research study

The aim of the research project was to identify and analyse implementation 'issues' technology teachers have, and to gather information related to their perspectives on the principles underpinning the NCS, their pedagogical content knowledge (PCK) and pedagogy used in respect of the NCS (Technology) curriculum. The objective for this paper will be to identify the problems that Technology teachers experience in adhering to the requirements and implementation of the NCS.

1.2 RESEARCH DESIGN AND METHODOLOGY

The sample selection for this research project was based on convenience sampling (Merriam, 1998, p. 63) as it includes 123 teachers from public schools situated mainly in Township areas in Gauteng Province and who were all enrolled for the Advanced Certificate in Education (ACE), sponsored by the GDE, at the University of Johannesburg. The research design was quantitative in nature and a survey was utilised to collect the data. Section A of the structured questionnaire contained the independent variables where respondents had to provide certain background as well as biographic information. The perceptions of teachers regarding the topics in the NCS, teaching strategies used, their technological knowledge and understanding of topics, their planning and preparation, and their use of hands-on activities in the NCS all formed the dependent variables. To facilitate the gathering of data on the dependent variables (personal and school details, topics in the NCS, planning and preparation in technology education, hands-on activities in technology and indigenous knowledge in technology) the items were included in sections A to E in the structured questionnaire. In each instance the respondents were asked to respond on a Likert type scale. The reliability of the various sections of the questionnaire was tested using the Alpha Cronbach reliability coefficient and the construct validity was ascertained using the process of factor analysis (PCA with varimax rotation). This analysis will be explained more fully under the inferential analysis of the data. SPSS 20 was used to provide a descriptive analysis of the sample utilised in this research.

1.2.1 Descriptive analysis of the data

The majority of teachers sampled namely 94 or 76.4% were teaching in Township schools. Although this is not representative of the schools in Gauteng it was more in line with the areas where problems with teaching technology are experienced namely in under-resourced schools such as those found in Townships. Sixty eight (68) or 55.7% of the respondents indicated that they teach at “no fee schools” and as such they probably belong to schools classified as quintile 1, 2 or 3 schools. Quintile 1, 2 and 3 schools do receive a higher resource allocation from the provincial government but they are prohibited from charging school fees (SA, 2011) and this would probably have a negative influence on any additional resources being allocated to the teaching of Technology. This data also correlates with the data that most respondents were from Township schools. Of the 123 respondents involved in the sample 82 (66.7%) indicated that they were currently teaching technology. The majority was thus presently involved in implementing the Technology curriculum and the assumption was made that the other 33.3% were at some stage involved in teaching technology or wanted to study further to supplement their existing specialisations.

Technology is a relatively recent addition to the school curriculum in South Africa and hence one would not expect many teachers to have more than 10 years of experience in teaching Technology. However, this sample had 56.1% of teachers who had less than five years of experience. This could be indicated that the incoming newly qualified teachers are being used to teach Technology but as the age of the teachers was not asked it was not possible to determine if this assumption was correct. It could also be that schools are using any teachers who were in “surplus” in certain areas to teach Technology. 48% of the respondents were previously involved in professional development in Technology. Almost 65% of the teachers (in the sample) involved in the implementation of the Technology curriculum had no recognized academic qualification in Technology teaching. Only eight (8) teachers had a degree qualification in Technology. These figures support the research initiated by the Department of Labour (Mda & Erasmus, 2008, p. 54) who expressed a concern about the issue of critical skills in Mathematics, Science and Technology. Furthermore this research indicated that “In terms of the MST area, if very few learners learn and pass these subjects at high school, study MST at Higher Education institutions, and pursue careers in these fields, then we will not be able to meet targets of required skills and contributions to the economy through natural scientists.”

With respect to the availability of resources for teaching Technology the original four categories provided were collapsed to three namely no resources, poorly resourced and adequately to well resourced. It is a major concern that only 23.8% of respondents in the sample indicated that their schools were adequately to well resourced with respect to teaching Technology. Again this finding corresponds to that of Township schools. This lack of resources was further corroborated as almost 88% of the sample indicated that their school did not have a Technology laboratory or workshop in their school.

The data collected also indicated that 94.3% of the learners attending the schools in the sample had English as the primary medium of instruction. Item 10 asked respondents what percentage of their Technology learners had an African language as their mother tongue and 52.6% had indicated that more than 80% of their learners had an African language as their mother tongue. Mda and Erasmus (2008, p. 56) in their research project indicated that “A significant number of African teachers in South Africa cannot express themselves in the language of learning, which is usually English, even though their schooling and tertiary education may have been through the medium of English. The language weakness is not at the level of sophisticated linguistic styles, or use of colloquial language in formal writing, but the lack of basic English language skills as in correct usage of tense, agreement between the noun and the verb, and construction of a proper sentence. The poor language skills extend to a lack of reading skills, which make studying for a senior degree very difficult as this usually entails a great deal of reading. It can be assumed, therefore, that the same teachers do not read in their fields, or enrich their teaching by reading extra texts”. Thus this finding by these researchers taken together with the statistics of this sample probably also indicates a significant language problem in the teaching of Technology.

Furthermore 67 (54.5%) respondents indicated that they had more than 40 learners per class which exceeds the recommended norm of 40 for primary schools and 35 for secondary schools.

A cross tabulation between location of school and number of learners per class indicates that 54 (80.6%) of the 67 respondents who reported having more than 40 learners per class came from Township schools. Township schools seem to be vastly under-resourced with a prohibitive number of learners per classroom and under such conditions the implementation of the Technology curriculum seems to be a difficult if not impossible task. A bar graph of the average numbers per class taught is provided in figure 1

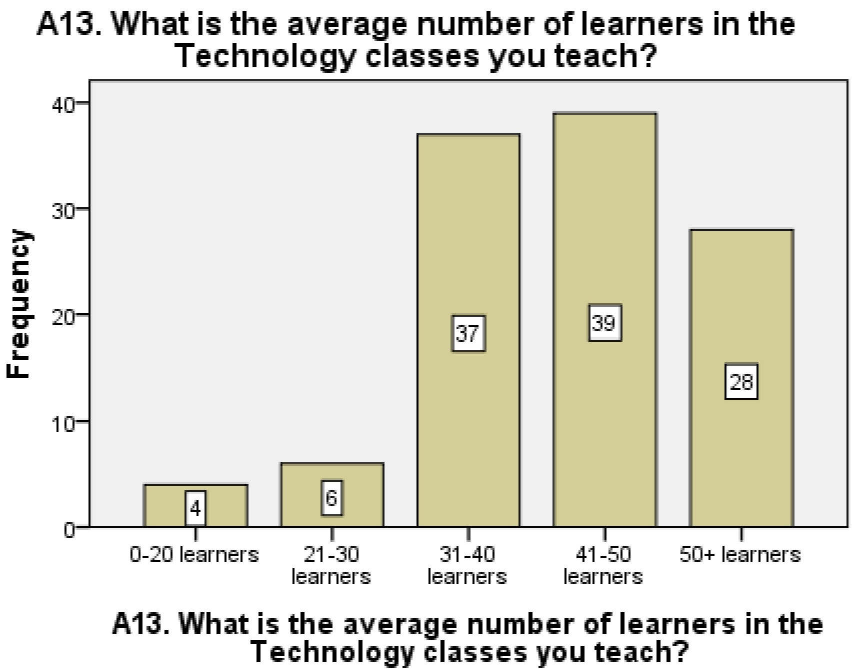

Figure1: A bar graph indicating the average learners in Technology classes in the sample

The descriptive analysis of sample clearly indicates that Township schools have significant contextual problems and that these will have an influence on the perceptions of the teachers tasked with teaching technology at these schools.

1.2.2 Inferential analysis of the data

The questionnaire used to facilitate the gathering of data has been added as Annexure A.
Items B1-B12 in Section B of the questionnaire related *to topics in the Technology curriculum* and were operationalized by asking respondents to respond on a scale where 1 indicated strongly agree and 5 was uncertain. Unfortunately this scale had to be recoded as the uncertain option should have had a value of 3. Thus 1 remained as strongly disagree, 2 remained as disagree, 3 became 4 as it was agree, 4 then became strongly agree at 5 and the uncertain took on a value of 3. The factor analytic procedure (PCA) indicated that items BR5, BR9, BR10 (where R indicates that the scale was reversed) should be removed from the procedure as their KMO (Kaiser-Meyer-Olkin) values were < 0.5. The nine remaining items had a KMO value of 0.73 and a Bartlett's

sphericity of p = 0.000 indicating that these items could be grouped into factors. The first-order procedure produced three (3) factors. The Monte Carlo parallel analysis which compares the size of the eigenvalues with those obtained from a randomly generated data set of the same size indicated that two components should be retained (Pallant, 2007, p. 183). However, Item BR12_inv. had a communality value of <0.20 and was also removed

A second-order procedure resulted in one second-order factor whose reliability was increased on removing B4R. The Cronbach coefficient for the remaining seven items was 0.701 and it explained 61.9% of the variance present. It was named *perceptions of technological competence regarding the technology curriculum.*

The factor loadings were all above 0.40 indicating that all items were important to this factor. The mean score of 3.85 indicates that the respondents tended towards agreeing with the items in this factor. One would expect this as self-confidence is related to the competence one has in teaching technology however a higher mean would have been preferable. The data distribution for *perceptions of technological competence regarding the technology curriculum (FB2)* is given in figure 1.

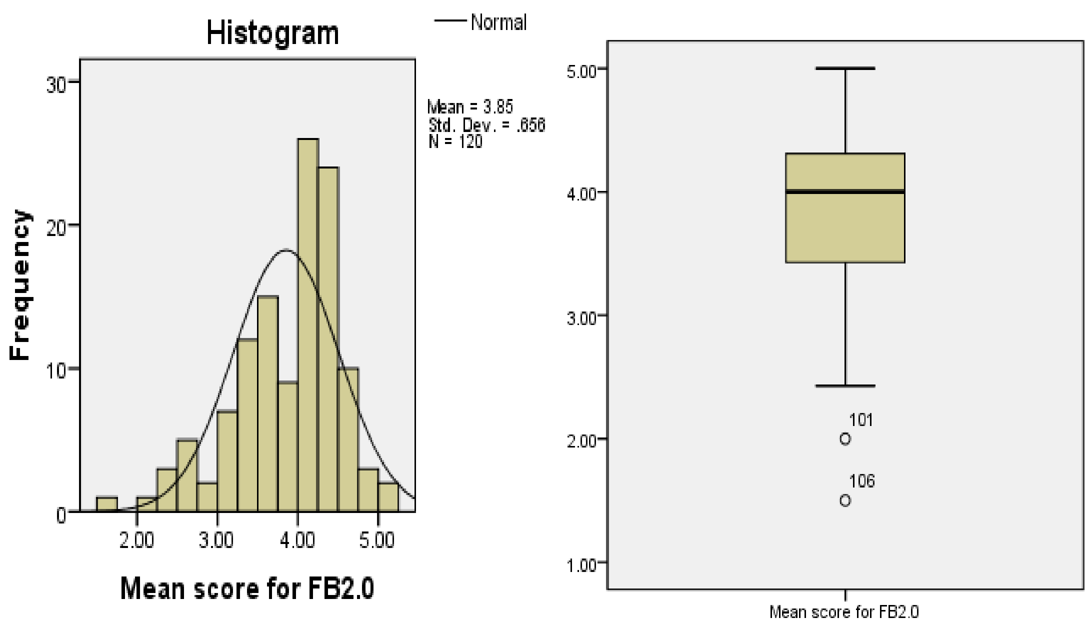

Figure 1: A histogram and box-plot of the factor perceptions of technological competence regarding the technology curriculum (FB2)

The box plot indicates that respondents 101 and 106 were outliers. The mean scores of these outliers varied from 1.50 to 2.00 and hence both of these respondents indicated disagreement with the factor perceptions of technological competence (FB2). Both of these outliers were at Township schools, had between 0-5 years teaching experience, had no suitable qualification to teach technology and both had 80% or more learners who had an African language as mother tongue. *This possibly indicates the importance of a suitable qualification in technology as it will* *influence perceptions of their competence in teaching technology*. However as the distribution of the data was normal parametric statistical tests could be utilised to test for any significant associations between this dependent variable and the independent variables in Section A of the questionnaire.

Significance of differences between independent groups for perceptions of technological competence regarding the technology curriculum (FB2.0)

In order to determine possible associations between this dependent variable and some of the independent variables present in the questionnaire namely A1, A2, A3, A9 and A12.1 to 12.3 were recoded to form two groups. Statistically significant differences could only be found between the independent groups present in Item A3 namely "Do you currently teach Technology?"

Two independent groups

When comparing the factor means of two independent groups one can use the Student t-test or the independent t-test. SPSS20.0 uses Levene's test to test the assumption of homogeneity of variances. In the Levene test if p > 0.05 then one assumes equal variances between the two independent groups and if p < 0.5 then one assumes that the variances are not equal (Runyon, Coleman & Pittenger, 2000).

Hypotheses for these groups could be:

Ho- There is statistically no significant difference between the factor means of the two technology groups (the group who currently teaches technology and the group who currently does not teach technology) regarding the factor perceptions of technological competence regarding the technology curriculum (FB2.0)

Ha - There is a statistically significant difference between the factor means of the two technology groups (the group who currently teaches technology and the group who currently does not teach technology) regarding the factor perceptions of technological competence regarding the technology curriculum (FB2.0)

The data indicated that those respondents who were currently involved in teaching technology obtained a higher mean regarding their perceptions of being technologically competent regarding the current technology curriculum than those who were not currently teaching technology ($\overline{X}_{Yes} = 3.95; \overline{X}_{No} = 3.64; p = 0.017; r = 0.22$). The null hypothesis (Ho) cannot be accepted as p<0.05. The respondents currently teaching technology tend to agree more strongly with FB2 than those not teaching technology as they have more positive perceptions and hence perceptions with respect to their competence in teaching technology. Having sureness about one's capability improves one's self-concept and provides one with confidence to attempt things which appear daunting to others (Meyer, Moore & Viljoen, 1997).

The non-parametric equivalent of the t-test is the Mann-Whitney U-test where ranking the data is used gave a similar result.

Three or more independent groups with respect to FB2.0

Only those groups where statistically significant differences were found will be discussed. The hypotheses for the availability of resources for teaching technology (A8) could be stated as follows:

HoA - There is statistically no significant difference between the factor means of the three groups (In terms of the availability of resources) regarding their perceptions of technological competence regarding the technology curriculum (FB2.0)
HaA - There is a statistically significant difference between the factor means of the three groups (In terms of the availability of resources) regarding their perceptions of technological competence regarding the technology curriculum (FB2.0)

The parametric test used for three or more groups at the univariate level was the Analysis of Variance (ANOVA) test. Should a statistically significant difference be found between the three groups tested together then a post-hoc tests could be used to find pair-wise differences. The only independent grouping that revealed statistically significant differences was A8 which asked the respondents how they would describe their school in terms of the availability of resources for teaching technology. The three groupings used were: (1) no resources available (2) poorly resourced (3) adequately to well resourced.

The data indicated that respondents who have no resources available for teaching technology agree to a statistically significantly smaller extent with perceptions of technological competence regarding the current curriculum (FB2.0) than do those who believe that they are poorly resourced. The ANOVA results were: (. $(X_{None} = 3.52; \overline{X}_{Poor} = 3.98; \overline{X}_{Adequate} = 3.89; p + 0.008; r = 0.20)$. When compared pair-wise, the Dunnett T3 test revealed that the statistically significant difference was between the poorly resourced and respondents who had no resources available. The effect size was small (r = 0.2). The use of non-parametric statistical procedures gave similar results. A cross-tabulation between A8 (Resources) and A1 (School location) indicated that 69 respondents (56.6%) who belonged to

Township schools had the perception that they belonged to poorly resourced schools while only 24 (19.7%) of the respondents who belonged to Township schools had the perception that they had no resources. It appears that those teachers from similar contextual conditions such as Township schools have significantly different perceptions about their self-assurance capabilities regarding the teaching of technology. Even if poorly resourced these teachers still have positive perceptions regarding their competence with respect to teaching the present topics in technology. It is thus possible that even if only a few resources for teaching technology are available that it can make a difference in perceptions. However, there was no difference between the adequately resourced schools and the others indicating that variables other than resources, such as attitude and commitment towards teaching technology, could also play a role in the perceptions factor.

Items B_13 to B_21 used a different scale that attempted to obtain the frequency with which the respondents made use of various teaching strategies to assist them in their teaching task. The scale had polar opposites of 1 (Never) and 5 (Very often) and a separate factor analytic procedure was conducted on these items. On removal of items B13, B16, B17 and B18 because of low MSA values (<0.5) the five (5) remaining items had a KMO value 0.59 with a Bartlett's value of 0.000 indicating that factor analysis could produce useable factors. The five items resulted in two first-order factors namely *readily available basic resources and sophisticate resources*. A second-order factor analysis indicated that these five items would form one factor but with a reliability coefficient of <0.5. On removal of items B_14, B_15 and B_20 only two items remained. However, the reliability of this second-order factor increased to a more acceptable 0.73. It was named *readily available basic resources*. The mean score of 3.26 indicated that respondents had the perception that they sometimes make use of colleagues for assistance regarding the topics present in the Technology curriculum. This is a readily available basic resource and it seems strange that teachers do not make use of assistance from colleagues more often. This mean score of 3.26 could probably only be judged against the mean scores of the other eight items which refer to resources that are *not readily available*. Item B_14 (I make use of the Internet to get ideas on teaching Technology) had the lowest mean score and the highest standard deviation. The mean score of 2.31 for this Item indicates that respondents seldom make use of the Internet to get ideas on teaching Technology. A histogram indicated that the distribution of the data was negatively skew. A cross-tabulation between Item B14 and Item A1 (location of school) indicated that 35 (83.3%) of the 42 teachers who indicated that they never use the Internet, came from Township schools. These teachers thus probably do not make use of Internet facilities as they are not available in Township schools. However, the reasonably high standard deviation indicates that there was some variation in the answers.

The Item with the highest mean score was B_20 which asked respondents about the need to consult numerous textbooks in order to prepare lessons. The mean score of 3.79 indicated that the respondents had the perception that they often have to consult numerous textbooks. This perception is probably due to the expectation that is present in the various policies related to teacher job descriptions. Teachers are likely to provide an inflated value of this and the perceptions of significant others such as learners, parents and school management is likely to be lower.

Items B13 to B21 hence proved problematical from a factor analytic point of view. Only two items were found to be correlated sufficiently in order to group together and produce a factor with a reliability coefficient > 0.7. These two items formed what was named readily available basic resources.

Significance of differences between independent groups regarding using readily available basic resources FB2_0 (B19 and B21)

Item A4 which asked respondents about their years of teaching experience in Technology originally had four categories. The groups were collapsed to three and tested using an Analysis of Variance or ANOVA. The results were:
$(\overline{X}_{0-5yrs.} = 3.39; \overline{X}_{6-10yrs.} = 2.83; \overline{X}_{11+yrs.} = 3.43; p = 0.02; r = 27)$. Teachers with less than five years of teaching Technology had a statistically significantly higher mean score regarding use of colleagues as readily available basic resource when it comes to asking for assistance on topics in the Technology curriculum than do teachers with between 6 to 10 years experience. The youngest group with the least experience was probably trained regarding the present curriculum topics and they were also technologically competent. It is difficult to reason why the group with 6 to 10 years of teaching experience had the lowest factor mean score however they would be those teachers who started teaching around the introduction of Curriculum 2005 and were concerned with Outcomes Based Education (OBE) and asking younger colleagues for assistance may reflect poorly on their own competence.

SECTION B_2 with items B_1 to B14 were all related to the content knowledge of topics specified in the syllabus for technology and were operationalized using an equal interval scale where 1 was excellent and 4 was very poor. The items were subjected to two consecutive factor analytic procedures. The first-order analysis had a KMO of 0.836 and Bartlett's sphericity value of 0.000. Four first-order factors were formed but a Monte Carlo PCA for parallel analysis suggested that only two factors are involved with these items. When the two first-order factors were subjected to another factor analytic procedure one factor only resulted which was named *knowledge and understanding of topics in Technology.*

The mean factor score of 2.16 indicated that the respondents believed that their content knowledge of the topics in the technology syllabus was good. It seems logical that the knowledge and understanding one has of the topics present in the Technology curriculum will correlate with one's training and involvement in teaching Technology.

Significance of differences between independent groups regarding knowledge and understanding of topics in the Technology curriculum (Items B_1 to B_14)

Item A3 asked respondents whether they were presently teaching technology and hence the yes or no answers provided two independent groups which could be tested using t-tests ($X_{Yes} = 2.08; \overline{X}_{No} = 2.34; p = 0.002; r = 0.29$). The data indicated that both groups believed that their content knowledge and understanding to teach the topics listed are good, but as expected, those that are currently teaching technology believed this to a greater extent than those who are not currently teaching Technology. The Mann-Whitney U-test for non-parametric procedures produced a similar result. Thus respondents currently teaching technology have a more positive perception regarding their knowledge and understanding of the topics in the present technology curriculum.

Significance of differences between the years of experience in teaching technology (rA4) groups regarding their knowledge and understanding of topics in the Technology curriculum

The ANOVA test gave the following results:
($\overline{X}_{0-5Yrs} = 3.39; \overline{X}_{6-10Yrs} = 2.83; \overline{X}_{11+Yrs} = 3.43$). Respondents with 6 to 10 years of teaching technology experience had the perception that they had good knowledge and understanding of the topics in the present technology curriculum. It is possible that those respondents with 0-5 years of teaching technology are still unsure whilst those with more than 11 years of teaching experience find the new topics more difficult to become acquainted with.

Section C of the questionnaire probed the perceptions of teachers regarding aspects related to planning and preparation involved in technology education. Questions C1 to C18 were operationalized using a five-point scale where 1 indicated strongly agree and 5 indicated uncertainty. All the items were recoded so that the 5 for uncertain became 3. On subjecting the items to a factor analytic procedure the two factors resulting both had reliability coefficients way below the recommended value of 0.7. The factor analytic procedure was not able to produce any reliable factors regarding this section of the questionnaire. When the items were analysed independently it was found that Item C10R (Any lesson plan should always have an outcome) and Item C17R (It is important to use more than one textbook in planning lessons both had a mean score of 4.56. Respondents' thus agreed that lesson plans should have an outcome and more than one textbook when should be used when planning for a lesson. These high means are expected as it is probably departmental and school policy that lessons should have an outcome and more than one textbook when planning a lesson is advisable. At the other end of the spectrum of mean scores the lowest score was achieved by Item C5 which asked whether "a teacher who has taught for over 10 years should not have to write a lesson plan". The mean score of 1.83 indicates disagreement with this item.

Thus when it comes to lesson preparation the respondents answered strictly according to the Departmental expectations as found in the South African Schools Act and the Personnel Administrative Measures mandates.

Items C19-C34 was concerned with ways of ensuring effective lesson planning. The factor analytic procedure (PCA) performed on the items C19 to C34 anchored by never (1) and very often (5) had a KMO of 0.802 and Bartlett's sphericity of p=0.000. However, C19 was removed as it had a KMO < 0.5 and the KMO value increased to 0.824 for 15 items with Bartlett's sphericity p=0.000. The factor analytic procedure produced four first-order factors but the Monte Carlo parallel analysis indicated that one factor was sufficient. The Cronbach Alpha coefficient was 0.854 for the 14 items and both the Kolmogorov-Smirnov and the Shapiro-Wilk values were greater than 0.05. Hence the assumption of normality for these 14 items was met.

Significance of differences between independent groups for planning and preparation in technology education (FC_2.0)

When testing for significant differences between two independent groups no statistically significant differences could be found between any of the independent groupings. The mean scores of all groups indicated that they had the perceptions that they sometimes to often involve themselves with the items posed relating to planning and preparation in technology education. Similarly when testing for statistically significant differences between three of more groups no significant differences could be found with respect to the planning and preparation in technology education. However all groups indicated a perception that they often engage in the activities of planning and preparation in respect to technology education.

Items D1 to D23 asked respondents their theoretical perceptions regarding the use of hand-on activities in technology education. The items were operationalized by a scale with 1 indicating strong agreement with the item and 5 indicating uncertainty regarding the item. The scale was changed as uncertain would be better represented by a value of 3. A PCA factor analytic procedure indicated that items D2R, D4R, D19R, D20R, D3R, D14R, D16R and D5R had MSA values <0.6 and were removed from the analysis. The KMO value was 0.742 and Bartlett's sphericity had a p<0.0005 indicating that factor analysis would produce fewer factors. Four first-order factors resulted but the Monte Carlo Parallel analysis suggested that two factors would be sufficient. A second-order analysis resulted in one factor only with an Alpha reliability coefficient of 0.78 and which explained 74.0% of the variance present.

The factor had a mean score of 3.92 which indicated that most of the respondents agreed with the theoretical foundations behind the hands-on activities involved in the teaching of Technology. There were two outliers with low scores and both were from Township schools with no formal qualification for teaching technology and neither of them is presently involved in its teaching. Item D6R had the highest mean score and respondents agreed that "technology is about solving problems for human needs". Item D23R had the lowest mean score and respondents were unsure whether "technology was a complex social activity where men and women of all ethnic and national backgrounds participate in technology and its applications". Given the fact that the sample was mostly applicable to Township schools it is realistic to assume that these respondents do not yet see that all men and women of all ethnic backgrounds participate in technology applications.

No statistically significant differences could be found between any of the independent groupings. With respect to hands-on activities in Technology all groups agreed with the items in the factor. Practical work in technology education goes hand in hand with experiential learning and hence technology education cannot proceed without the necessary hands-on experiences. As this factor involved the idealized situation where respondents were asked to give their perceptions of the theoretical value of a hands-on experience the factor was named theoretical perceptions of hands-on activities in teaching Technology. In contrast the teachers' actual or real hands-on experience was probed by items D_24 to D_46.

A factor analytic procedure showed a KMO of 0.626 and Bartlett's sphericity of p=0.000. Items D_33, D_35, D_37, D_43 and D_44 had KMO values <0.5 and were removed from the procedure. The resulting KMO for the 18 remaining items was 0.721 with p=0.000. Four first-order factors resulted but the Monte Carlo parallel analysis pointed to one factor only which explained 46.32% of the variance . The second-order analysis had a KMO of 0.621 and on removal of item D_46 a Cronbach Alpha reliability of 0.781 for the 17 items. The factor was named *perceptions of actual or real hands-on activities in teaching Technology.*

The distribution of data was negatively skew with a mean score of 3.02 indicating that the respondents were sometimes involved with the hands-on activities shown in the items. The box plot indicates that respondents 67 and 88 are seldom concerned with hands-on activities. Both respondents indicated that they have no qualification in technology education. The mean score was smaller than its theoretical counterpart (Item D1-D23). As it was the same respondents who completed the items one could use a paired samples t-test. The results of the paired t-test were $t(116) = 20.61; p<0.0005; r=0.88$. The effect size or practical significance is thus large and probably indicates the ease of saying something versus the actual modeling of that which you espouse. Also it may indicate that although teachers understand the theoretical implications of hands-on activities they may not be able to do this in practice either because it involves a great amount of preparation or the technological resources are not available   The differences in factor mean scores could be investigated using non-parametric statistical procedures.

Significance of differences between independent groups for perceptions of actual or real hands-on activities in teaching Technology (FD_2.0)

For two independent groups no statistically significant differences could be found between any of the groupings. Most groups of respondents indicated that they were sometimes involved with group hands-on activities of items D24 to D46. Likewise no significant differences could be found when testing for three or more independent groups.

1.3 IMPLICATIONS OF THE FINDINGS

One finding that seems to feature in almost all statistical analyses conducted is that it is always harder to implement some programme than to design it. When the Technology curriculum was designed it was done by persons who are considered to be experts in Technology education. These persons are often associated with the Department of Higher education who work at the macro-level of the education system. The implementation of the curriculum, however, takes place at the micro-level of the system and occurs via teachers. Thus an implementation gap between the expectations as ideal value and perceptions as the real value is often present. This research also indicated an important implication gap in that the expectations as set out in the mandated curriculum could be considered to be the ideal. The perceptions of teachers as the real value were often found to be lower than the expected value. This gives rise to the implementation gap between "the expected and the perceived" and this gap needs to be eliminated via effective continuing professional teacher development (CPTD) programmes and workshops for teachers involved in teaching technology. Familiarity with the practical aspects of Technology teaching is essential as it will give such teachers the self-confidence needed to include all forms of practical work into their teaching. The selection of teachers with a positive attitude and commitment towards the importance of Technology in the curriculum is a management strategy that school leaders need to be aware of. Hence school leadership should not just allocate teachers to the teaching of Technology because they have a shortage of teachers who are suitably qualified in Technology education. Before any teacher is allocated or undergoes in-service training in Technology education his/her aptitude, attitude and commitment should first be determined.

Any CPTD programme developed for Technology teachers should always consider the context of the situation and if English is used as the medium of instruction attention needs to be given to explanations that are as clear and simple as possible. Practical examples taken from the context of the school will assist with understanding some of the concepts involved in Technology as will practical training in the use of the internet. The availability of adequate resources as well as their use in practice is essential in teaching Technology. Any workshops involving Technology education should allow participants to actually experience the value of a hands-on experience as this will provide them with the confidence to also include in their day-to-day teaching. The internet is also something that all teachers should have access to and practical training in its effective use is essential. The policy of class size needs to be seriously considered where practical work is part-and-parcel of the subject being taught and school leadership needs to keep the class sizes down to manageable numbers especially in Township schools.

1.4 CONCLUSION

For technology education to survive in the public school sector will depend to a large extent on the provision of the necessary resources, facilities and proper CPTD programmes to ensure that effective teaching and learning in technology take place as intended by the curriculum. To meet the challenges experienced by most teachers in technology education a cooperative effort between the Department of Education, Higher Education Institutions and the private sector will be necessary.

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ANNEXURE A: Questionnaire for Technology teachers

Section A deals with personal and school details

Section B

The following items relate to the ***topics*** in the Technology curriculum.

Mark your response by crossing the number you think is most appropriate.

		STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	UNCERTAIN
1	I feel competent at teaching Technology	1	2	3	4	5
2	I did have exposure to most of the topics through my previous studies.	1	2	3	4	5
3	I understand most of the content applicable to Technology	1	2	3	4	5
4	The Department of Education provided effective training in Technology	1	2	3	4	5
5	I need more training in Technology	1	2	3	4	5
6	My previous teacher education studies prepared me well for Technology	1	2	3	4	5
7	The topics covered in Technology are relevant to the learners	1	2	3	4	5
8	I am familiar with facilitating hands-on activities	1	2	3	4	5
9	Hands-on activities are an extra burden on Technology teachers	1	2	3	4	5
10	I see no reason in doing hands-on activities if a topic is covered in theory.	1	2	3	4	5
11	I enjoy teaching Technology	1	2	3	4	5
12	There are topics with concepts which are difficult for me to understand	1	2	3	4	5
		NEVER	**SELDOM**	**SOMETIMES**	**OFTEN**	**VERY OFTEN**
13	My subject advisor/facilitator offers me suggestions on how to teach Technology	1	2	3	4	5
14	I make use of the internet to get ideas on teaching Technology.	1	2	3	4	5
15	I have the necessary tools, material and teaching aids to do hands-on activities	1	2	3	4	5
16	The prescribed textbooks cover all the topics adequately	1	2	3	4	5
17	I spend more time in planning hands-on activities compared to planning theory lessons.	1	2	3	4	5
18	My learners find Technology interesting	1	2	3	4	5
19	I ask my colleagues to help me with topics unknown to me	1	2	3	4	5
20	I need to consult numerous textbooks to prepare lessons	1	2	3	4	5
21	I have discussions with my colleague/s on how to teach topics that are difficult to me	1	2	3	4	5

You now need to rate your content knowledge of the following topics by using the equal interval scale provided:
1 = excellent, meaning I am very knowledgeable on this topic
2 = good, meaning I have sufficient knowledge to teach this topic
3 = poor, meaning I have some knowledge but it is inadequate to teach these topics
4 = very poor, meaning I have serious knowledge gaps in this topic and need to improve on this
Mark your choice by making a cross in the appropriate block
My technological knowledge and understanding of the following topics is….

	TOPIC	EXCELLENT	GOOD	POOR	VERY POOR
1	The technological process	1	2	3	4
2	Graphic communication	1	2	3	4
3	The use of tools and materials to make products	1	2	3	4
4	Structures	1	2	3	4
5	Processing: Resistant materials	1	2	3	4
6	Processing: Textiles	1	2	3	4
7	Processing: Food	1	2	3	4
8	Systems and control: Mechanical	1	2	3	4
9	Systems and control: Pneumatics	1	2	3	4
10	Systems and control: Hydraulics	1	2	3	4
11	Systems and control: Electrical	1	2	3	4
12	Indigenous Technology and Culture	1	2	3	4
13	Impact of Technology	1	2	3	4
14	Bias in Technology	1	2	3	4

Section C

The following items relate to your ***planning and preparation in Technology Education.***
Mark your response by placing a cross in the appropriate block.

		STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	UNCERTAIN
1	Writing a lesson plan is useful in helping me think about the lesson I will teach	1	2	3	4	5
2	Only novice teachers should write lesson plans	1	2	3	4	5
3	When I am planning my lessons I find it useful to have discussions with my colleagues	1	2	3	4	5
4	It is okay for teachers to deviate from their written lesson plans	1	2	3	4	5
5	If a teacher has taught for over 10 years he/she should not have to write a lesson plan	1	2	3	4	5
6	Due to the newness of the curriculum all teachers should write lesson plans	1	2	3	4	5
7	The curriculum documents from the Department of Education is useful in telling me about the depth at which I must teach a topic	1	2	3	4	5
8	I wish I could use a simpler grid to plan my lessons	1	2	3	4	5
9	Teachers should be allowed to design their own lesson plan grids according to their own needs	1	2	3	4	5
10	Any lesson plan should always have a learning outcome	1	2	3	4	5
11	I wish I had more time available to plan my lessons	1	2	3	4	5
12	When planning a lesson, it is necessary to have an assessment task in mind	1	2	3	4	5
13	I only write a lesson plan because it is checked by somebody	1	2	3	4	5
14	Due to the new curriculum, teachers should plan for more hands-on activities in their teaching	1	2	3	4	5
15	I feel isolated when planning my lessons	1	2	3	4	5
16	Lessons need to be planned so that learners are involved in some activity	1	2	3	4	5
17	It is important to use more than one textbook in planning lessons	1	2	3	4	5
18	The National Curriculum Statement is written in language which is easy to understand	1	2	3	4	5
		NEVER	SELDOM	SOMETIMES	OFTEN	VERY OFTEN
19	I find that I now spend more time planning for my lessons compared to the previous curriculum	1	2	3	4	5
20	I write a lesson plan	1	2	3	4	5
21	I plan my lessons so that learners from different ethnic backgrounds are considered	1	2	3	4	5
22	When planning my lesson, I deliberately search for challenging questions to ask my learners	1	2	3	4	5
23	I make use of the internet to get ideas on how to teach a topic	1	2	3	4	5
24	I follow a lesson plan grid which I received when I attended a Department of Education training workshop	1	2	3	4	5
25	I consult a variety of textbooks in planning my lessons	1	2	3	4	5
26	My lesson plan acts as a guide when I am teaching	1	2	3	4	5
27	When I plan my lessons I think about how my learners can be actively involved in the lesson	1	2	3	4	5
28	When planning my lesson, I consider a variety of questions at different levels of thinking to ask learners during the lesson	1	2	3	4	5
29	I use one textbook in planning my lessons	1	2	3	4	5
30	Learning Area Assessment Standards help me in developing appropriate assessment tasks for my learners	1	2	3	4	5
31	When planning to teach a certain topic I ask a teacher of another learning area whether he/she is teaching something similar in his/her learning area	1	2	3	4	5
32	When planning my lessons I look for examples which relate to the life experiences of my learners	1	2	3	4	5
33	I exchange ideas with colleagues on how best to teach a topic	1	2	3	4	5
34	The curriculum documents in Technology guide me in my lesson planning	1	2	3	4	5

Section D

The following items relate to **hands-on activities** in Technology.
Mark your chosen response by placing a cross in the appropriate block.

		STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	UNCERTAIN
1	I look forward to lessons where hands-on activities are included	1	2	3	4	5
2	Hands-on activities take up too much of my teaching time	1	2	3	4	5
3	It is difficult to maintain control of learners during hands-on activities	1	2	3	4	5
4	Technological knowledge is a well-organized collection of facts	1	2	3	4	5
5	Hands-on activities serve no purpose if learners do not obtain appropriate results	1	2	3	4	5
6	Technology is about solving problems for human needs	1	2	3	4	5
7	I prefer my learners to *design* their own solutions	1	2	3	4	5
8	I have much expertise doing technological problem solving	1	2	3	4	5
9	Technological problem solving helps my learners to develop technological process skills	1	2	3	4	5
10	My head of department supports the way in which hands-on activities are done in my class	1	2	3	4	5
11	The purpose of doing technological problem solving is to apply conceptual knowledge	1	2	3	4	5
12	I feel confident teaching lessons where learners do technological problem solving	1	2	3	4	5
13	For learners to do hands-on activities, the teacher needs to give clear guidelines and/or demonstrations on what to do	1	2	3	4	5
14	Hands-on activities are difficult to manage	1	2	3	4	5
15	My learners derive more benefit from doing a hands-on activity themselves than only observing me demonstrating it to them	1	2	3	4	5
16	Technological knowledge is stable and unchanging	1	2	3	4	5
17	My learners are capable of solving their own technological problems	1	2	3	4	5
18	When making a proposal for a possible solution to a technological problem learners have to consider the information collected during the investigation stage	1	2	3	4	5
19	Sometimes I am unclear on how to formulate a proposal for a solution to a technological problem	1	2	3	4	5
20	My learners are quite competent at doing technological investigation with little guidance from me	1	2	3	4	5
21	The management of my school could do more to support me in implementing hands-on activities	1	2	3	4	5
22	Most learners are capable of formulating a proposal for a solution to a technological problem	1	2	3	4	5
23	Technology is a complex social activity where men and women of all ethnic and national backgrounds participate in technology and its applications	1	2	3	4	5
		NEVER	SELDOM	SOMETIM ES	OFTEN	VERY OFTEN
24	My learners enjoy hands-on activities	1	2	3	4	5
25	I try hands-on activities myself when preparing for the lesson	1	2	3	4	5
26	My learners do technological problem solving	1	2	3	4	5
27	My learners know how to identify specifications for a solution to a technological problem	1	2	3	4	5
28	My learners use hands-on activities as an opportunity to engage in casual chat on something unrelated to technology	1	2	3	4	5
29	My learners follow my workshop rules	1	2	3	4	5
30	I borrow tools and material from other schools	1	2	3	4	5
31	The lesson time allocated is adequate for my learners to do hands-on activities	1	2	3	4	5
32	I do practical demonstrations	1	2	3	4	5
33	My learners take a lot of time to settle down before starting with the hands-on activities	1	2	3	4	5
34	I give learners a worksheet with instructions to follow when they do hands-on activities	1	2	3	4	5
35	I have discipline problems during hands-on activities	1	2	3	4	5
36	My learners *apply* the technological process (Note: Investigate, design, make, evaluate and communicate solutions to a technological problem)	1	2	3	4	5
37	When I need tools and material the management of my school makes funds available for the purchase of these	1	2	3	4	5
38	I give learners the solutions to a technological problem rather than asking them to solve it themselves	1	2	3	4	5

39	My learners are willing to come and complete hands-on activities during the lunch break or after school	1	2	3	4	5
40	With the new curriculum, I now include more hands-on activities in my teaching	1	2	3	4	5
41	I give my learners hands-on activities to do at home	1	2	3	4	5
42	I have learners working in groups during hands-on activities	1	2	3	4	5
43	If my learners need more time to complete hands-on activities, another teacher grants me the extra time from his/her lesson	1	2	3	4	5
44	The length of the lesson makes it difficult for my learners to do hands-on activities in class	1	2	3	4	5
45	My learners are well behaved when they are doing hands-on activities	1	2	3	4	5
46	It is more effective for the teacher to explain a concept rather than having learners gain understanding of the concept through hands-on activities	1	2	3	4	5

Section E

The following items relate to ***indigenous knowledge*** in Technology. Indigenous knowledge systems (IKS) in the South African context refers to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. For example, there exists indigenous knowledge on the medicinal use of plants by cultural groups. *Mark your response by placing a cross in the appropriate block.*

		STRONGLY DISAGREE	DISAGREE	AGREE	STRONGLY AGREE	UNCERTAIN
1	The indigenous knowledge of people needs to be recognized	1	2	3	4	5
2	Indigenous knowledge can be related to some of the topics I teach	1	2	3	4	5
3	My learners are willing to talk about their customs and traditions	1	2	3	4	5
4	Discussions on indigenous knowledge take up too much time	1	2	3	4	5
5	By referring to indigenous knowledge technology becomes more relevant to my learners	1	2	3	4	5
6	My learners are willing to relate their customs and traditions to the concept being taught	1	2	3	4	5
7	Indigenous knowledge that my learners possess interferes with the learning of technology	1	2	3	4	5
8	I welcome any new views on technology phenomena	1	2	3	4	5
9	Learners do not understand technological concepts because they want to cling to their indigenous knowledge	1	2	3	4	5
10	The term technology encompasses all manmade phenomena	1	2	3	4	5
11	People from all cultures contribute to technological knowledge	1	2	3	4	5
12	I prefer my learners not to have any existing beliefs when I introduce a new concept	1	2	3	4	5
13	Learners points of view must be respected	1	2	3	4	5
14	Technology is an integral part of social and cultural traditions	1	2	3	4	5
15	The importance of indigenous knowledge is exaggerated	1	2	3	4	5
16	There is little connection between indigenous knowledge and western technology	1	2	3	4	5
17	Ideas for technology research come from indigenous knowledge	1	2	3	4	5
18	I understand what is meant by indigenous knowledge	1	2	3	4	5
19	Indigenous knowledge is often in conflict with western science	1	2	3	4	5
20	I have sufficient knowledge on indigenous knowledge systems to incorporate this into my lessons	1	2	3	4	5