South African Journal of Education

Vol 25(4)273–278

Development and validation of the Science Teacher Inventory of Needs for Limpopo province (STIN-LP)

Rüdiger Laugksch, Angeline Rakumako, Tsalane Manyelo and **Daniel Mabye**
laugksch@humanities.uct.ac.za

The development and validation of an instrument for establishing the perceived INSET needs of teachers of Mathematics, Physical Science, and Biology in Limpopo province, South Africa, and their pertinent demographic details are described. The instrument was modified from the Science Teacher Inventory of Needs (STIN-3) developed by previous workers. STIN-3 was adapted for use in the educational context of Limpopo province in collaboration with important stakeholders in Mathematics, Physical Science, and Biology education at the provincial and national level. The stakeholders commented on the appropriateness or otherwise of items, suggested additional items, and assessed the clarity of items and instructions for completing the questionnaire. An English Second Language expert inspected the instrument to make its language demands appropriate for the target audience. The resulting Science Teacher Inventory of Needs for Limpopo Province (STIN-LP) was pilot-tested on 132 teachers in the subjects and modified accordingly. The final STIN-LP has good alignment with the Norms and Standards for Educators and consists of 95 items: 47 items describing INSET needs in 7 different categories, 26 demographic items, 14 items describing teachers' problems, and 8 items assessing the frequency of use of particular teaching strategies.

Keywords: biology teachers, in-service education and training (INSET), Limpopo (Northern Province), mathematics teachers, needs assessment, physical science teachers, surveys, teacher characteristics, test construction

Introduction

The South African government's new National Curriculum Statement for Grades 10 to 12 (Department of Education, 2003a) — in line with its earlier White Paper on Science and Technology (Department of Arts, Culture, Science and Technology, 1996) — makes it clear that adequate skills and knowledge of mathematics and the physical / life sciences are believed to be a vital component of successful contemporary life and socio-economic development. Yet, if the number of candidates who write the Senior Certificate examination is taken as an indication of the number of Grade 12 learners who take mathematics and science subjects in school (as opposed to merely [re]writing the examination), enrolments in key current school subjects like Mathematics, Physical Science, and Biology have decreased by 29%, 27%, and 45%, respectively, between 1999 and 2003 in Limpopo province (Department of Education, 2000; 2001; 2003b). Moreover, although pass rates in the Senior Certificate examinations for these subjects have increased over the same period, the pass rates for learners from Limpopo province are consistently the lowest — or, in the case of Biology, the second lowest — provincial results in the country (Department of Education, 2000; 2001; 2003b). It is therefore apparent that the poor state of mathematics and science education in the Limpopo Province demands a meaningful response.

Among the many factors that influence achievement in mathematics and the natural sciences, the role of teachers' pedagogical knowledge and skills in their subject area is acknowledged to be a key factor. Teachers' craft knowledge — that is, knowledge and beliefs regarding pedagogy, students, subject matter and curriculum (Van Driel, Verloop & De Vos, 1998) — is related to teacher effectiveness (Darling-Hammond, 2000; Hill, Rowan & Ball, 2005). Moreover, there is overriding evidence that teacher quality in terms of teacher preparation and qualification strongly influence students' level of achievement (Darling-Hammond, 2000; Darling-Hammond, Berry & Thoreson, 2001; Goldhaber & Brewer, 2000). However, it is widely recognised that, for historical reasons, the training of Mathematics, Physical Science, and Biology teachers in rural areas such as Limpopo province is of variable, but largely inadequate, quality (Arnott, Kubeka, Rice & Hall, 1997; Mailula, 1995; Ngoepe, 1995). An important initial response to the inadequate state of mathematics and science education in Limpopo province must therefore include the establishment of effective, widely available in-service teacher education and training programmes (INSET).

The effectiveness and the success of INSET programmes in general depend on at least two factors. First, efficient and effective planning of INSET activities on a provincial level requires that planners have at their disposal accurate demographic information of relevant subject teachers in the Province. The current Limpopo Department of Education was established in 1996 through the merging of seven different departments of the apartheid era (*viz.* education departments from the former Venda, Lebowa and Gazankulu, the former Department of Education and Training, the Department of Education and Culture, the House of Representatives, the Department of Education and Culture, the House of Delegates and the former Transvaal Education Department) (Lee & Glover, 1995: Addendum F). The teacher database in these departments was of varying quality and reliability, and these databases are therefore not useful in providing current information applicable to the entire Limpopo province. Although so-called 'snap surveys' are now conducted annually by the Limpopo Department of Education, these surveys do not ask for comprehensive information on teachers' demographic details (MA Seopa, pers. comm.). Also, data of the first survey that did ask for such detailed information as part of the Annual Schools Survey in 2003 are unlikely to be available soon (MA Seopa, pers. comm.). Therefore, accurate and reliable detailed demographic information on mathematics and science teachers for the whole province is, for all intents and purposes, still not widely available.

The second factor influencing the effectiveness and success of INSET programmes is the need for such activities to address expressly the perceived INSET needs of teachers (Zurub & Rubba, 1983). Lubben (1994) argues that INSET activities are usually structured on the basis of the observations of INSET providers and the requests of educational administrators, without consulting teachers to identify their priority INSET needs. When teachers are not consulted about their work environments, and planners assume that they know what is best for teachers, teacher morale suffers, INSET programmes are poorly attended, and achievement is scarcely influenced (Mecca & Klindienst, cited by Baird & Rowsey, 1989). However, Baird, Easterday, Rowsey and Smith (1993) maintain that INSET programmes based on the expressed needs of teachers yield more positive responses from teachers. Smith and Haley (cited by Easterday & Smith, 1992) add that such programmes can also boost workshop attendance rather than programmes which are not applicable to teachers' classroom needs. Indeed, the above sentiments were also echoed by teachers, INSET providers, department of education officials, and academics attending the 1995 Conference on Science, Mathematics and Technology Education Policy in Limpopo province (Lee & Glover, 1995).

Underway in Limpopo province is a study addressing the above two factors related to the effectiveness and success of INSET programmes in Mathematics, Physical Science, and Biology. This will be achieved by a) determining timeous, reliable, up-to-date demographic information of these subject teachers; b) determining the perceived

INSET needs of these teachers; and c) investigating possible associations between INSET needs and demographic variables. In this study, a 'mixed-method' research methodology (e.g. Tashakkori & Teddlie, 2003) will be followed. First, a survey employing a questionnaire will be used, as surveys are efficient and cost-effective ways of obtaining information from a large number of individuals and can ensure anonymity (McMillan & Schumacher, 1993). Second, interviews with relevant subject teacher focus groups will be carried out in order to cross-validate the information from the completed questionnaire. In this article we describe the adaptation, development, and validation of the instrument (i.e. questionnaire) to be used in the survey-processes in which standard practices recommended by, for example, Cohen, Manion and Morrison (2000) and McMillan and Schumacher (1993), were followed.

Survey instrument

The survey instrument was developed from the Science Teacher Inventory of Needs (STIN-3) of Baird, Prather, Finson and Oliver (1994) which, in turn, evolved from the original STIN developed by Zurub and Rubba (1983). STIN was purposely chosen because it was developed specifically to assess perceived needs of mathematics and science teachers in developing countries to provide the necessary data for the planning of effective INSET activities (Zurub & Rubba, 1983). STIN has been successfully used in a number of developing countries such as, for example, Malaysia, Jordan, and Lebanon (Abu Bakar, Rubba, Tomera & Zurub, 1988: Jbeily & Barufaldi, 1985), as well as in a number of studies investigating INSET needs of rural and urban mathematics and science teachers in the United States (Rubba, 1981; Baird & Rowsey, 1989; Baird *et al*., 1993; 1994.)

The original STIN

The original STIN was developed and validated using empirical and quantitative techniques (Abu Bakar & Rubba, 1985; Zurub & Rubba, 1983), and contained 76 items organised into seven categories of teachers' needs: 1) specifying objectives for instruction, 2) diagnosing and evaluating learning, 3) planning instruction, 4) delivering instruction, 5) managing instruction, 5) administering instructional facilities and equipment, and 7) improving personal competence. Each item in the questionnaire consists of a statement describing a task that a teacher may be called upon to perform, followed by a five-point scale to indicate the level of need (i.e. A = not familiar, B = no need, C = little need, D = moderate need, and E = great need) (Zurub & Rubba, 1983). STIN allowed open-ended responses to each item and additional spaces were provided for teachers to write in needs not listed on the questionnaire.

STIN was last revised in 1994, and the resulting STIN-3 of Baird *et al*. (1994) contained a total of 100 items, divided into four sections. The first 52 items assess needs in the above seven categories and offer response options as described above. These items are followed by 26 others that use forced-choice options to determine demographic information about teachers and their schools. The next nine items assess frequency of use of teaching strategies, offering a response ranging from "never use" to "weekly use." Finally, 13 items describe problems that may confront teachers, using a five-point response option from "not a significant problem" to "a serious problem" (Baird *et al*., 1994). In order to allow for machine scoring, open-ended response options were eliminated. A blank page at the end of the questionnaire was provided for teachers to write down needs not included in STIN-3.

Initial modifications to STIN-3

The STIN-3 instrument was adapted and modified for use in the educational context of South Africa and Limpopo province in a number of ways, and was called the Science Teacher Inventory of Needs for Limpopo Province (STIN-LP). Firstly, because individual teachers may offer one, two, or all three subjects, there is some degree of 'overlap' between teachers of Mathematics, Physical Science, and Biology. Consequently, an instrument appropriate for all three school subjects needed to be developed, but in which individual respondents have to choose the perspective from which one subject they complete the questionnaire. In this process, the criterion of the subject in which the respondent teaches the most number of periods per week was used. STIN-3 was modified to accommodate this requirement. Secondly, general instructions were rephrased to be appropriate for relevant subject teachers in Limpopo province. For example, the instruction "In responding to this item you are asked to use a #2 pencil to bubble in the one letter that best designates the degree to which you feel a need for help with that task" was changed to "In responding to this item, you are asked to shade in on the answer sheet the one letter that best describes the degree to which you feel a need for help with that task". Thirdly, terms not used in South Africa were replaced with more appropriate ones with which teachers would be familiar (e.g. "certification" was replaced by "qualification", "miles" by "kilometres", etc.). Fourthly, items not relevant to Limpopo province educational context were removed (e.g. "What is the average per-pupil expenditure in your district?"). The questionnaire was then edited for clarity.

As the majority of teachers in Limpopo province are English Second Language speakers (Sepedi being the dominant language spoken) (Statistics South Africa, 2003), particular attention was paid to simplifying the instructions and items without losing their essential meaning. This was done so that the language demand of the items would not be a limiting factor in the teachers' understanding of the questionnaire thus compromising its reliability. In this regard, strategies consisted of providing clarifying examples in brackets, e.g. "Select commercially prepared teaching materials (e.g. textbooks, charts, models, etc.)" and underlining key ideas, e.g. "Develop lesson plans, (i.e. learning activities) which integrate Mathematics/Physical Science/ Biology with other subjects". Lastly, in order to focus teachers' attention, instructions for each section were written in bold and / or italics, and particularly important instructions were also printed in red.

Validation by stakeholders

Although the original STIN was found to be reliable and valid in other countries, its use in a different educational context demanded that its validity be determined with respect to this new context (i.e. Limpopo province). In other words, the INSET needs mentioned in the instrument have to reflect important needs appropriate to Mathematics, Physical Science, and Biology teachers in Limpopo province. To achieve such content validity (e.g. Zeller, 1997), and in line with recommendations of Mulder (1986), 147 important stakeholders in mathematics and science education were invited to comment on the need items and to modify them or add to them should this be necessary in their opinion. Stakeholders were also requested to give a rationale for their suggestions. Individuals invited to comment on the draft STIN-LP were selected because of their expertise in mathematics and science education, and were drawn from seven categories of stakeholders in mathematics and science education at the provincial and national level in South Africa, namely, department of education officials (i.e. in the Curriculum Support Services Directorate), academics, Senior Certificate examiners of the three subjects, members from the education desk of teacher unions (i.e. South African Democratic Teachers Union [SADTU], Professional Educators' Union [PEU], and Suid Afrkaanse Onderwysers Unie [SAOU]), members of professional mathematics and science education associations (i.e. Southern African Association for Research in Mathematics, Science and Technology Education [SAARMSTE], and Association of Mathematics Education of South Africa [AMESA]), curriculum (i.e. subject) advisors in the three subjects, and staff of science centres and non-governmental organisations working in mathematics and science education in the province (e.g. the Phalaborwa Foundation, etc.).

After individuals were contacted to determine whether they would participate, the questionnaire was posted to the stakeholders together with a self-addressed and stamped envelope to return their responses. The stakeholders were requested to read each item in the questionnaire carefully and to decide whether the item was relevant to applicable

Table 1 Return rate (%) of stakeholders' responses in the validation of the Science Teachers Inventory of Needs for Limpopo Province (STIN-LP) for teachers of Mathematics, Physical Science, and Biology

Validation category	Mathematics			Physical Science			Biology			Overall		
	Sent out	Returned	(%)	Sent out	Returned	(%)	Sent out	Returned	(%)	Sent out	Returned	(%)
Provincial Department of Education officials	2	2	100	3	3	100	2	1	50	7	6	80
Provincial Senior Certificate examiners	4	3	75	3	3	100	2	2	100	9	8	89
Provincial teacher union officials	3	3	100	3	2	67	3	2	67	9	7	78
Members of professional mathematics/science education associations	2	2	100	2	2	100	2	0	0	6	4	67
Mathematics/science education academics	16	9	56	8	5	63	9	4	44	33	18	55
Provincial curriculum advisors	22	13	59	37	30	81	13	9	69	72	52	72
NGO/Science centre staff	5	2	40	5	2	40	1	0	0	11	4	36
Total	54	34	63	61	47	77	32	18	56	147	99	67

subject teachers in Limpopo province, and was clearly expressed. If the item was not relevant or was ambiguous, they were asked to write a brief justification for the exclusion of an item or to suggest changes in wording. Stakeholders were also requested to give possible additional needs, which were not covered in the questionnaire, and to provide a brief justification of why the item(s) (i.e. needs) should be included. Lastly, they were asked to read carefully through all the instructions in the questionnaire and to decide whether the instructions were clear and unambiguous. If the instructions were not, they were asked to suggest changes in wording. The responses of 99 stakeholders were ultimately received, yielding an overall response rate of 67% (Table 1).

Stakeholders' responses were then analysed. This analysis involved placing responses for each item into categories such as "delete", "change content", and "modify language". Thereafter, appropriate modification of items was made in the light of the stakeholders' responses. Items about computer usage in the classroom (e.g. "Select and order software for microcomputers in your school") were removed as it was felt that most schools in Limpopo province do not have electricity and therefore cannot use computers. Terminology aligned with outcomes-based education (OBE) was also used in the light of recent curriculum reforms (e.g. the expression "various forms of assessment" was used instead of "test data"; "learners" was substituted for "students"; "instructional material" was changed to "teaching materials", etc.). Consequently, out of the 52 items related to INSET needs contained in STIN-3, nine were deleted, three were modified, 40 were used unchanged (i.e. they used the original need concept but still contained changes made in the initial modification [see above]), and four new items were added as a result of stakeholders' expert opinions.

The particular type of demographic information to be elicited from teachers in the STIN-LP was established in collaboration with relevant officials from Limpopo Department of Education (e.g. details of teachers' professional qualifications, years of teaching experience, highest academic qualification in content subjects, etc.). Eleven items related to the teachers' demographics (e.g. "What is the population of the community in which your school is situated?") that are irrelevant to the South African and Limpopo province contexts were removed and replaced by eleven relevant items (e.g. "Number of learners in your largest Mathematics/Physical Science/Biology class this year?"). Thereafter, an English Second Language expert was requested to inspect the language used in the instrument so that it is appropriate for English Second Language speakers in Limpopo province. (This individual was engaged by virtue of his expertise and experience in writing English school textbooks for Sepedi first language speakers.) This was achieved by fastidiously reading through all the instructions, guidelines, and items of the STIN-LP questionnaire and carefully considering their language demands. Appropriate changes were then made as per the recommendations, taking due care that the meaning of the items was not changed.

Pilot-test

The validated STIN-LP was thereafter pilot-tested on a sample of Mathematics, Physical Science, and Biology teachers in three administrative districts of the Limpopo Department of Education. The purpose of the pilot-test was to find out whether teachers understood the instructions, the statements (i.e. items), and answer options in the questionnaire, and to ascertain whether they found all of them to be unambiguous. The selection of teachers was based on the type of context in which the school at which they were teaching was located (e.g. whether urban, township, or rural) in order to cover the major types of schools representing the vast majority of teachers in the province. The questionnaire was given to 60 teachers of each subject (N = 180) either individually or via their principals, and were returned via the same route. The pilot-test teachers were asked to read through instructions and items, and then to underline sentences, phrases, and words they did not understand or felt to be ambiguous. One-hundred-and-thirty-two responses were received (a 73% response rate), and the questionnaire was modified in light of the responses of the pilot-test teachers who identified mostly only minor issues.

The final STIN-LP

The final version of the STIN-LP contains 98 items arranged into six sections. Section A contains two items that identify teachers in terms of the subject they teach (i.e. Mathematics, Physical Science or Biology) and the subject in which they teach the most lessons per week. Section B consists of 47 items that gauge teachers' INSET needs in the original seven categories of STIN, i.e. improving personal competence (10 items), specifying objectives for instruction (6 items), diagnosing and evaluating learning (2 items), planning instruction (3 items), delivering instruction (14 items), managing instruction (5 items), and administering instructional facilities and equipment (7 items). In these 47 items, response options range from "not familiar" to "great need" as in the original STIN. Examples of needs items from the seven categories are included in the Appendix. The number of items per need category of STIN-LP was derived from the total number of suggested omissions from and additions to the original STIN-3 items which, in turn, had their origin in the empirically derived STIN of Zurub and Rubba (1983) (Baird *et al*., 1994). Section C contains 26 items that use forced-choice options to determine demographic infor-

mation about teachers and their schools (e.g. type of school, highest professional and academic qualification, age, teaching experience, etc.). The 14 items in section D describe possible problems that confront teachers, e.g. "Outdated teaching materials (e.g. text books) ...", "Class size too large", etc. and that could be addressed through INSET (e.g. designing own teaching materials, learning specific approaches for teaching large classes, respectively). These items have a five-point answer option ranging from "not really a problem" to "a serious problem". This section was included in the original STIN and maintained in STIN-LP. Finally, eight items in section E determine the frequency of use of particular teaching strategies (e.g. "Demonstrations by the teacher ...", "Problem-solving approach...", etc.), offering five response options from "never" to "weekly". Again, this section was included in the original STIN and maintained in STIN-LP. The last item in STIN-LP, and the only item in section F, asks for the EMIS number of the teacher's school (a unique reference number). This item was included in order to facilitate the calculation of the proportion of schools covered in the planned survey of mathematics and natural sciences teachers in Limpopo province. As in STIN-3, teachers are given the opportunity to list needs not covered in the instrument on a blank page of the questionnaire. In order to ensure a high response rate, the total number of items was kept to fewer than 100.

Information on the reliability of the STIN-LP was obtained by administering the instrument to 552 Mathematics, 352 Physical Science, and 478 Biology teachers in Limpopo province. The items' alpha coefficient and the instrument's Guttman split-half reliability coefficient were, respectively, 0.97 and 0.83 for Mathematics teachers, 0.95 and 0.83 for Physical Science teachers, and 0.95 and 0.85 for Biology teachers. The high value of these coefficients for all three groups of teachers indicates that the STIN-LP is reliable in determining mathematics and science teachers' demographic profiles and perceived INSET needs.

Further evidence for the validity of the STIN-LP — in particular its 47 INSET need items in seven categories — comes from the comparison of items in these categories to the Norms and Standards for Educators (Republic of South Africa, 2000). This document describes "...the *roles*...[and] their associated set of *applied competences* (norms) ... for the development of ..." teachers (italics in the original) (Republic of South Africa, 2000:9), and the list of roles and competences "... is meant to serve as a *description* of what it means to be a competent ..." teacher (italics in the original) (2000:13). Assigning roles and competences to each of the 47 need items in STIN-LP reveals that these items address five of the stipulated seven roles of a teacher, except the teacher's 'community, citizenship and pastoral' role and that of the teacher as 'scholar, researcher and lifelong learner'. Overall, 36% of the 47 need items pertain to the teacher as a 'learning mediator', 32% to the teachers as a 'learning area/subject/discipline/phase specialist', 11% each to the teacher as a 'interpreter and designer of learning programmes' and as a 'leader, administrator and manager', and 4% to the teacher as an 'assessor'. (Three items, 6%, could not be attributed to any of the seven roles.) Moreover, each of the need categories is dominated by items pertaining to appropriate roles for that category. For example, 70% and 30% of items in the category of improving personal competence pertain to the teacher as a learning area/subject specialist and learning mediator, respectively. Similarly, 71% and 21% of items in the category of delivering instruction pertain to the teacher as a learning mediator and learning area/subject specialist, respectively. Also, all of the items in the categories of diagnosing and evaluating learners, and planning instruction, pertain to the teacher as an assessor and interpreter and designer of learning programmes and materials, respectively. Turning to the notion of teachers' applied competence, 68%, 19% and 6% of the items deal with issues of practical, foundational, and reflexive competence (Republic of South Africa, 2000), respectively. Although the STIN-LP was developed and validated more or less at the same time as the Norms and Standards were released, and was, therefore, not purposely based on this document, there is nevertheless evidence of good alignment between the INSET need items and categories of STIN-LP and this important policy document pertaining to teacher education. This indicates that the need items of STIN-LP reflect teaching capabilities that the South African Department f Education regards as important.

Conclusion

The careful adaptation of STIN-3 and the rigorous development and validation of the Science Teacher Inventory of Need for Limpopo Province (STIN-LP) was achieved by taking cognisance of the views of, firstly, 99 important stakeholders in mathematics and science education (who were mostly appropriate curriculum advisors, academics, and Senior Certificate examiners); and, secondly, 132 teachers in the three subjects who piloted the instrument. Moreover, the possibility is maximised that the meaning of the instrument's items and instructions will be perceived by the respondents as intended. This was achieved by a) ensuring that the language demands of the instrument were appropriate for English Second Language speakers, b) using examples to clarify the meaning of items, and c) using visual cues such as different formatting of words or phrases in the items and instructions of the instrument. It is therefore believed that the development and validation processes followed have resulted in the Science Teacher Inventory of Needs for Limpopo Province (STIN-LP) containing items that are relevant and inherently comprehensible to mathematics and science teachers in Limpopo province in their quest to improve their classroom practice. Furthermore, there is good alignment between INSET need items of the instrument and Norms and Standards for Educators. The STIN-LP is therefore considered to provide a valid and reliable way of establishing the perceived professional needs of teachers of Mathematics, Physical Science and Biology in Limpopo province, as well as determining essential demographic information believed to be important in the planning of successful, effective, and sustainable INSET activities. The use of the STIN-LP in Limpopo province will hopefully significantly facilitate attempts to improve mathematics and science education in this rural province — one of three that contain the majority of secondary school pupils in South Africa (Department of Education, 2003c).

Acknowledgements

We thank the large number of individuals who acted as validators of the INSET items, as well as those who participated in the pilot-test of STIN-LP. This study is based upon work supported by the National Research Foundation.

Note

A copy of the Science Teacher Inventory of Needs for Limpopo Province (STIN-LP) is available from the first author.

References

Abu Bakar, KH, Rubba PA, Tomera AN & Zurub AR 1988. Jordanian and Malaysian science teachers' prominent perceived needs: a comparison. *Journal of Research in Science Teaching*, 25:573-587.

Abu Bakar KH & Rubba PA 1985. The construct validity of the science teacher inventory of need: Recommendations and modifications. *Educational and Psychological Measurement*, 45:699-704.

Arnott A, Kubeka Z, Rice M & Hall G 1997. *Mathematics and science teachers: Utilisation, supply and training in South Africa. Edusource Report 97/01*. Craighall: Edusource.

Baird WE, Easterday K, Rowsey RE & Smith T 1993. A comparison of Alabama secondary science and mathematics teachers: Demographics and perceived needs. *School Science and Mathematics*, 93:175-182.

Baird WE, Prather JP, Finson KD & Oliver JS 1994. Comparison of perceptions among rural versus non-rural secondary science teachers: A multistate survey. *Science Education*, 78:555-576.

Baird WE & Rowsey RE 1989. A survey of secondary science teachers' needs. *School Science and Mathematics*, 89:273-284.

Cohen L, Manion L & Morrison K 2000. *Research methods in education,* 5th edn. London: Routledge Falmer.

Darling-Hammond L 2000. How teacher education matters. *Journal of Teacher Education*, 51:166-173.
Darling-Hammond L, Berry B & Thoreson A 2001. Does teacher certification matter? Evaluating the evidence. *Educational Evaluation and Policy Analysis*, 23:57-77.
Department of Arts, Culture, Science and Technology 1996. *White Paper on Science and Technology: Preparing for the 21st century*. Pretoria: Government Printer.
Department of Education 2000. *Preliminary report. 2000. Senior Certificate Examination*. [Online] Available url:
http://education.pwv.gov.za/Archives/Matric/2000/Subject%20results%20-%20Report%202000%20Color.xls
Department of Education 2001. *Preliminary report. 2001. Senior Certificate Examination*. [Online] Available url:
http://education.pwv.gov.za/Matric/2001/Subject%20Results%20Report%202001.xls
Department of Education 2003a. *National Curriculum Statement Grades 10–12 (General). Overview*. Pretoria: Government Printer.
Department of Education 2003b. *Report on the Senior Certificate Examination. 2003*. [Online] Available url:
http://education.pwv.gov.za/index.asp?src=dvie&xsrc=388.
Department of Education 2003c. *Education statistics in South Africa at a glance in 2001*. Pretoria: Government Printer.
Easterday KE & Smith T 1992. A survey of mathematics teacher needs. *School Science and Mathematics*, 92:212-219.
Goldhaber D & Brewer DJ 2000. Does teacher certification matter? High school teacher certification status and student achievement. *Education Evaluation and Policy Analysis*, 22:129-145.
Hill HC, Rowan B & Ball DL 2005. Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, 42:371-406.
Jbeily KA & Barufaldi JP 1985. A profile of the needs and concerns of English speaking public secondary school and concerns of English speaking public secondary school science teachers from five geographic regions of the Republic of Lebanon. *ERIC Document Reproduction Service,* No. ED 259 880.
Lee ME & Glover OH (eds) 1995. *Conference on Science, Mathematics and Technology Education Policy. Proceedings: Vol. 1: Conference report and recommendations*. Pietersburg: Northern Province Department of Education, Arts, Culture and Sports.
Lubben F 1994. The convergence of teachers and providers' views on INSET needs: The case of the non-specialist physics teacher in Swaziland. *International Journal of Educational Development*, 14:43-49.
MacMillan JH & Schumacher S 1993. *Research in education. A conceptual introduction*. 3rd edn. New York: Harper Collins.
Mailula EME 1995. The role of tertiary institutions and department of education in providing teacher training and support in Science and Mathematics. In: Lee ME (ed.). *Conference on Science, Mathematics and Technology Education Policy. Proceedings: Vol. 2. Papers by keynote speakers*. Pietersburg: Northern Province Department of Education, Arts, Culture and Sport.
Mulder JC 1986. *Statistical techniques in education*. Pretoria: HAUM Tertiary.
Ngoepe PE 1995. The status of Science, Mathematics and Technology Education in the Northern Province. In: Lee ME (ed.). *Conference on Science, Mathematics and Technology Education Policy. Proceedings: Vol. 2. Papers by keynote speakers*. Pietersburg: Northern Province Department of Education, Arts, Culture and Sports.
Republic of South Africa 2000. National Education Policy Act (27/1996): Norms and Standards for Educators. *Government Gazette,* Vol. 415, No. 20844. Pretoria: Government Printer.
Rubba PA 1981. A survey of Illinois secondary school science teacher needs. *Science Education*, 65:271-276.
Statistics South Africa 2003. *CENSUS 2001: Census in brief,* 2nd edn. Report No. 03-02-03. Pretoria: Government Printer.
Tashakkori A & Teddlie C (eds) 2003. *Handbook of mixed methods in social and behavioral research*. Thousand Oaks, CA: SAGE.
Van Driel JH, Verloop N & De Vos W 1998. Developing science teachers' pedagogical content knowledge. *Journal of Research in Science Teaching*, 35:673-695.
Zeller RA 1997. Validity. In: Keeves JP (ed.). *Educational Research, Methodology and Measurement An international handbook,* 2nd edn. Cambridge: Cambridge University Press.
Zurub AR & Rubba PA 1983. Development and validation of an inventory to assess science teacher needs in developing countries. *Journal of Research in Science Teaching*, 20:867-873.

Appendix

Two examples are given of items in each of the seven INSET need categories included in the Science Teacher Inventory of Needs for Limpopo province (STIN-LP):

Category	Examples of item
Improving personal competence	Develop skills in recognising and correcting common misconceptions in Mathematics / Physical Science / Biology among your learners
	Update your knowledge of career opportunities for learners related to Mathematics / Physical Science / Biology
Specifying objectives for instruction	Identify learning objectives (i.e. outcomes) which specify knowledge needed by learners in Mathematics / Physical Science / Biology
	Develop lesson plans (i.e. learning activities) which integrate Mathematics / Physical Science / Biology with other subjects
Diagnosing and evaluating learning	Design assessment items (e.g. questions or tasks) which assess achievement of learning objectives (i.e. outcomes) in Mathematics / Physical Science / Biology
	Use various forms of assessment to identify learning difficulties in Mathematics / Physical Science / Biology
Planning instruction	Develop lesson plans (i.e. learning activities) for topics in Mathematics / Physical Science / Biology
	Select commercially prepared teaching materials (e.g. textbooks, charts, models, etc.) for Mathematics / Physical Science / Biology
Delivering instruction	Demonstrate process skills (e.g. generalising, defining, etc.) in Mathematics / Physical Science / Biology
	Apply concepts taught in Mathematics / Physical Science / Biology to daily life of learners (i.e. to real-life situations)
Managing instruction	Maintain learner discipline in your Mathematics / Physical Science / Biology classes
	Evaluate your own teaching effectiveness as a Mathematics / Physical Science / Biology teacher (i.e. become a reflective teacher)
Administering instructional facilities and equipment	Identify sources of free and locally available teaching materials for Mathematics / Physical Science / Biology
	Select supportive materials (e.g. library and reference books, videos, etc.) for teaching in Mathematics / Physical Science / Biology

Rüdiger Laugksch is an Associate Professor in the School of Education at the University of Cape Town. His research interests include science teacher development and training at in-service level, policy issues related to the provision of teaching and learning in the natural sciences, and the South African research endeavour in science education.

Angeline Rakumako is Acting Sectional Head of Further Education and Training at the Thabamoopo Education Multi-Purpose Centre in the Limpopo Department of Education. She holds an MEd degree in mathematics education and has taught at secondary and tertiary level for 13 years. She is presently Mathematics Curriculum Advisor in Capricorn District.

Tsalane Manyelo is Biology Curriculum Advisor in Capricorn District of the Limpopo Department of Education. He holds an MEd degree in science education and has lectured in biology, physical science and general science for five years.

Daniel Mabye is Acting Coordinator for General Education and Training in Capricorn District of the Limpopo Department of Education. He holds an MEd degree in science education and has taught physical science and biology for eight years. He is presently Physical Science Curriculum Advisor in Capricorn District.