

- Chief Directorate Surveys and Land Information, 1993: Suggested maps for use in schools, colleges, universities and education departments, (notes available for teachers), Mowbray, South Africa.
- Chief Directorate: Surveys and Land Information, 1995: *Maps of South Africa* (Index), Mowbray, South Africa.
- Chief Directorate: Surveys and Land Information, 1997: *Maps of South Africa* (Index), Mowbray, South Africa.
- Chief Directorate Surveys and Mapping, 1997: *Mapping South Africa*, (brochure), Mowbray, South Africa.
- Chief Directorate: Surveys and Mapping, 1998: *Maps of South Africa* (Index), Mowbray, South Africa.
- Chief Directorate Surveys and Mapping, 1998: *MapAware Test Map*, Mowbray, South Africa.
- Clark, E.A.G., 1989: Geography as a school subject in South Africa, *South African Geographical Journal*, 71(1), 46-55.
- Clarke, D.G., 1996: Learning to read maps, *Landinfo*, 3, 8-9.
- Clarke, D.G., 1997: Mapping for the reconstruction of South Africa, in D. Rhind (ed.), *Framework for the World*, GeoInformation International, Cambridge, 48-62.
- Clarke, D.G., 1998: Free maps for secondary schools, *Landinfo*, 5(1), 5.
- Cohen, L. and Manion, L. 1985 (2nd ed.) : *Research Methods in Education*, Croom Helm, London.
- Collet, J., c.1988: *Looking at Maps*, READ Educational Trust, Johannesburg.
- Cowie, T., 1994: The relationship between standard 10 higher grade geography and the first year geography undergraduate course at university: an examination, *Geogram*, South African Geographical Society Schools Newsletter, 10, 3-7.
- Cowley, J.W., 1984: Geography teachers facing enormous difficulties and challenges, *Matlasedi*, 3(2), Mmabatho.
- Cowley, J.W., 1987: School geography in Bophuthatswana, *Tikologo*, A Journal for the promotion of Geography and Environmental Science in Bophuthatswana, 1, 77-87.
- Cox, B. 1989: Skills in school geography, in R. Gerber and J. Lidstone (eds.), *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 65-75.

D

- Daly, D.W., 1979: Can Keller plan work in schools?, *Aspects of Educational Technology*, X111, Kogan Page, London, 158-163.
- Davies, L.S., 1983: *An investigation into the problems in the use of topographic survey maps among secondary school pupils in Zimbabwe*, unpublished M.Phil. thesis, University of Zimbabwe.
- Davies, D.H., 1988: School geography: a university perspective, *South African Geographer*, 15(1/2), 116-126.
- Department of Education, 1997: Draft Statement on the National Curriculum for Grades 1-9, *Government Gazette 6 June 1997*, 384(18051), Pretoria.
- Department of Education and Culture, undated: *Working Document for Geography, Higher Grade, Standards 8, 9 and 10*, dates of implementation 1993, 1994, 1995, House of Assembly, Cape Town.
- Department of Education and Training: *1992 Annual Report*, Government Printer, Pretoria.
- Department of Education and Training: *1993 Annual Report*, Government Printer, Pretoria.
- Department of National Education, (c.1992): *A Curriculum Model for Education in South Africa*, Pretoria.
- Department of Land Affairs, 1998: Scale of Fees for Products and Services Supplied by the Chief Directorate: Surveys and Mapping, *Government Gazette*, 18689 (275), Pretoria.
- Deterline, W.A., 1962: *An Introduction to Programmed Instruction*, Prentice-Hall, Englewood Cliffs, N.J.
- Dewey, J., 1896: The reflex arc concept in psychology, *Psychological Review*, 3, 357-370. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Dixon, M., 1993a: Self-imposed stranglehold on recovery, *Financial Times*, June 23, p.14. Reference in Wolf, A., 1995: *Competence-Based Assessment*, Open University Press, Buckingham.
- Dixon, M., 1993b: Immeasurable waste of human talent, *Financial Times*, July 7, p.11. Reference in Wolf, A., 1995: *Competence-Based Assessment*, Open University Press, Buckingham.

Donaldson, M., 1978: *Children's Minds*, Fontana, referred to in Boardman, D., 1983: *Graphicacy and Geography Teaching*, Croom Helm, London.

Downs, R.M., Liben, L.S. and Daggs, D.G., 1988: On education and geographers: The role of cognitive developmental theory in geographic education, *Annals of the Association of American Geographers*, 78(4), 680-700.

Downs, R.M., Liben, L.S. and Daggs, D.G., 1990: Reply: Surveying the landscape of developmental geography: A dialogue with Howard Gardner, *Annals of the Association of American Geographers*, 80(1), 124-128.

Downs, R.M. and Liben, L.S., 1991: The development of expertise in geography: A cognitive-developmental approach to geographic education, *Annals of the Association of American Geographers*, 81(2), 304-327.

Duckworth, E., 1979: Either we're too early and they can't learn it or we're too late and they know it already: The dilemma of "Applying Piaget", *Harvard Educational Review*, 49, 297-312.

Dumbutshena, T., 1993: Helping cream of the crop, *Sunday Times*, August 22, Johannesburg.

Dunn, J.M., 1992: Translation and development theory in geographic education: A model for the genesis and production of geography instructional materials in a competitive funded grant environment, *Journal of Geography*, 91(3), 97-105.

E

Earle, J., 1985: *New Window on the World Standard 6*, Juta, Cape Town.

Earle, J., 1985: *New Window on the World Standard 7*, Juta, Cape Town.

Edwards, R., 1989: An experiment in student self-assessment, *British Journal of Educational Technology*, 20(1), 5-10.

Eiselen, L., 1991: *Zap Map* (video series), Kagiso, Cape Town.

Entwistle, N., 1987: Motivation to learn: Conceptualisations and practicalities, *British Journal of Educational Technology*, 35(2), 129-148.

F

Feldmann, H-U., 1997: Fun and games in learning how to read maps in T. Kanakubo and K. Kanazawa (eds.), *Proceedings of the Seminar on Cognitive Map, Children and Education in Cartography*, held by the International Cartographic Association from November 8-10 1996 in Gifu, Japan.

Feuerstein, R., 1980: *Instrumental Enrichment, an Intervention Program for Cognitive Modifiability*, Scott Foresman, Illinois.

Feuerstein, R., Rand, Y. and Rynders, J.E., 1988: *Don't Accept Me As I Am: Helping "Retarded" People to Excel*, Plenum, New York.

Fletcher, S., 1991: *NVQs Standards and Competence. A Practical Guide for Employers, Managers and Trainers*, Kogan Page, London. Reference in Wolf, A., 1995: *Competence-Based Assessment*, Open University Press, Buckingham.

Frazee, S., 1968: *Where Are You? All About Maps*, Meredith Press, New York.

Fullager, A.P. and Virgo, H.E., (3rd ed.) 1984: *Map Reading and Local Studies*, Hodder and Stoughton, London.

Fullan, M., 1993: *Change Forces*, Falmer Press, London.

G

Gagné, R.M. and Briggs, L.J., 1974: *Principles of Instructional Design*, Holt, Rinehart and Winston, New York.

Galbraith, I., 1979: *Map Reading and Analysis*, Oxford University Press, Oxford.

Gardner, H., 1986: The development of symbolic literacy in M.E. Wrolstad and D.F. Fisher (eds.), *Toward a New Understanding of Literacy*, Praeger, New York, 39-56.

Garner, W.L., 1966: *Programmed Instruction*, The Center for Applied Research in Education, New York.

Geographical Association (The), 1998: *Geography through the window*, (poster), Geographical Association, Sheffield.

Gerber, R.V., 1982: An international study of children's perception and understanding of type used on atlas maps, *The Cartographic Journal*, 19(2), 115-121.

Gerber, R.V., 1984: Factors affecting the competence and performance in map language for children at the concrete level of map reasoning, *Cartography*, 13(3), 205-213.

Gerber, R. and Wilson, P., 1984: Maps in the classroom, in J. Fein, R. Gerber and P. Wilson (eds.) *The Geography Teacher's Guide to the Classroom*, Macmillan, Sydney, 146-157.

Ghaye, A.L. and Robinson, E.G., 1989: Concept maps and children's thinking: A constructivist approach, in F. Slater (ed.) *Language and Learning in the Teaching of Geography*, Routledge, London, 115-139.

Goodman, K.S., 1967: Reading: A psycholinguistic guessing game, *Journal of the Reading Specialist*, 6, 126-135, reference in S.K. Kitao, 1989: *Reading, Schema Theory and Second Language Learners*, Eichosha Shinsha, Tokyo.

Grabe, W., 1985: Reassessing the term 'interactive', paper presented at the 19th Annual TESOL Convention, New York. Reference in Silberstein, S., 1987: Let's take another look at reading: Twenty-five years of reading instruction, *English Teaching Forum*, October, 29-35.

Graves, N., 1975: *Geography in Education*, Heinemann, London.

Guelke, L., 1976: Cartographic communication and geographic understanding, *The Canadian Cartographer*, 13(2). 107-122.

Guelke, L., 1979: Perception, meaning and cartographic design, *The Canadian Cartographer*, 16(1). 61-69.

H

Haggett, P., 1983: *Geography A Modern Synthesis*, 3rd ed., Harper and Row, New York.

Hanekom, D., Minister for Agriculture and Land Affairs 1998: *Address to the National Assembly on the Occasion of the Budget Vote of the Department of Land Affairs*, 23 April 1998, Cape Town.

Harris, P.C. and Giffard E.O., 1970: *Let's Make Maps*, Collins-Longman Atlases, Glasgow.

Hodgkiss, A.G., 1981: *Understanding Maps a Systematic History of Their Use and Development*, Dawson, Folkestone.

Hudson, T., 1982: The effects of induced schemata on the 'short circuit' in L2 reading: Non-decoding factors in L2 reading performance, *Language Learning*, 32, 1-31. Reference in Kitao, S.K., 1989: *Reading, Schema Theory and Second Language Learners*, Eichosha Shinsha, Tokyo.

Hurry, L.B., 1978: *A Handbook for Geography Teaching in Southern Africa*, Via Africa, Goodwood.

Hurry, L.B., c.1986: *Exploring Geography 8*, Via Afrika, Goodwood.

I

Inhelder, B. and Piaget, J., 1959: *The Growth of Logical Thinking*, Routledge and Kegan Paul, London. Reference in Duckworth, E., 1979: Either we're too early and they can't learn it or we're too late and they know it already: The dilemma of "Applying Piaget", *Harvard Educational Review*, 49, 297-312.

Innes, L.M., 1995: The implications of the 'new style' South African topographic map for teaching map reading, paper presented at the First International Geography Conference, Geography in a Changing Society: Critical Choices for Change in Southern Africa, 10-14 July 1995, Durban.

Innes, L.M., 1997: Cartography and children in South Africa, paper tabled at the meeting of the Cartography and Children Working Group at the ICA Conference in Stockholm, 24.06.97.

Innes, L.M., 1997: Are you map aware?, *Landinfo*, 4(6), 24-28.

Innes, L.M., 1998: Map awareness and map literacy, *journal*, monthly newsletter, Directorate: Communication Services of the Department of Land Affairs, Pretoria, 1/98, 9-10.

Institut Cartogràfic de Catalunya, 1997: 15 713 422 distributed sheets of the *Mapa comarcal de Catalunya 1:50 000* Cartographic divulging record in Catalonia, Newsletter of the Institut Cartogràfic de Catalunya, 2, 1.

K

Karodia, M.S. and Dhoodhat E., undated: *Map Skills Made Easy – for Stds 8-10*, Help At Hand Series No 7, Stanger, South Africa.

Keats, J.S., 1982: *Understanding Maps*, Longman, London.

Keller, F.S., 1968: Goodbye teacher, *Journal of Applied Behavioural Analyses*, 1, 79-89.

Keller, F.S., 1969: *Learning; Reinforcement Theory*, Random House, New York.

Keller, F.S., 1974: *The Keller Plan Handbook*, Random House, New York.

Kemp, R., 1983. *Mapwork Two*, Edward Arnold, London.

Kilpatrick, W., 1914: *The Montessori System Examined*, Houghton Mifflin, Boston.
Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.

Kirman, J.M. and Goldberg, J., 1992: Grade six children's perception of a map symbol, *Journal of Geography*, 91(1), 38-40.

Kitao, S.K., 1989: *Reading, Schema Theory and Second Language Learners*, Eichosha Shinsha, Tokyo.

Knowles, M., 1975: *Self-directed Learning*, Association Press, Chicago.

Kriel, L.P., 1993a: Die Posisie van aardrykskunde in 'n kurrikulummodel vir onderwys in Suid-Afrika, *South African Geographer*, 20(1/2), 142-147.

Kriel, L.P., 1993b: The national curriculum model and geography: status, content and challenges, paper presented at a symposium (11 August 1993), *A Future for Geography in Education*, University of Pretoria.

L

Lambert, D., 1986: *Maps and Globes*, Wayland, Hove, East Sussex.

Langhan, D.P., 1993: *The Textbook as a Source of Difficulty in Teaching and Learning*, HSRC Publishers, Pretoria.

Learning Press, 1997: Geography Mapware (sic.), *Educational Supplement* to City Press, 24.08.97.

Lewin, K., 1951: *Field Theory in Social Science*, Harper and Row, New York. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.

Liebenberg, E.C., 1973. *Die Topografiese Kartering van Suid-Afrika, 1879-1972: 'n Histories-Geografiese Ontleding*, unpublished M.A. Thesis, University of South Africa.

Liebenberg, E.C., Rootman, P.J. and van Huysteen, M.K.R., 1976: *The South African Landscape*, Butterworths, Durban.

Liebenberg, E.C., 1986 (revised 1992): *Techniques for Geographers, Book 1*, Butterworths, Durban.

Liebenberg, E.C., 1998: Teaching map use in a multicultural environment, *South African Geographical Journal*, 80(2), 111-117.

Lötter, J.P.K., 1997a: The schooling system and university admission in South Africa, paper tabled at a meeting (17-18 March 1997) with Lesotho Education Representatives, Matriculation Board, Pretoria.

Lötter, J.P.K., 1997b: Minimum general university admission requirements in South Africa, paper tabled at a meeting (30 July 1997) with Danish Education Representatives, Matriculation Board, Pretoria.

Lumsdaine, A.A. and Glaser, R., 1960: *Teaching Machines and Programmed Learning*, National Education Association of the United States, Washington.

M

- Mackrory, P.A., 1995: Concept Development in Geography in Primary School Pupils, unpublished M.A Thesis, University of the Witwatersrand, Johannesburg.
- Magi, L.M., 1981: Black university geography students' perception of school geography and the geography teacher, *South African Geographer*, 9(2), 145-153.
- Marran, J.F., 1990: Review of B. Schneider's The language of maps, Series A: The surface of the earth, Series B: Location and distance, *Journal of Geography*, 89(1), 38.
- May C., 1991: *Maps and Decisions*, Hodder and Stoughton, London.
- Mayhew, V., 1984 3rd ed.: *Illustrated Guide to Southern Africa*, Reader's Digest, Cape Town.
- McGee, O., Grant, L. and Madikizela, N., 1995: Teaching geography to underprepared students in South African universities: the Pietermaritzburg experience. Paper presented at the first international geography conference of the Society for South African Geographers, 10-14 July 1995, Geography in a Changing Society: Critical Choices for Change in Southern Africa, Pietermaritzburg, South Africa.
- Meissner, W., 1997: Teaching material for cartographic education and training of children in T. Kanakubo and K. Kanazawa (eds.), *Proceedings of the Seminar on Cognitive Map, Children and Education in Cartography*, held by the International Cartographic Association from November 8-10 1996 in Gifu, Japan.
- Meux A.H., (4th ed.) 1975: *Reading Topographical Maps*, Hodder and Stoughton, London.
- Ministry of Education, 1997: Call for comments on the draft statement on the national curriculum for grades 1-9, Government Gazette, 18051(788), 1-256.
- Modungwa, C.D., undated, c.1987: *Introducing Topographical Maps and Aerial Photographs*, C.D.M. Publishers, Mmabatho.
- Monkhouse, F.J., Steyn, J.N. and Boshoff, L.P., 1983: *A Dictionary of Geography Southern African Edition*, De Jager-Haum, Pretoria.
- Montessori, M., (translated by A.E. George) 1912: *The Montessori Method*, Lippincott, Philadelphia. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Morrison, H.C., 1931: *The Practice of Teaching in the Secondary School*, University of Chicago Press, Chicago. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.

Motshhekg, E.M., 1969: An experimental investigation of the colour discriminative ability of Bantu students, unpublished M.A. thesis, University of South Africa, Pretoria.

Muehrcke, P.C., 1978: *Map Use, Reading, Analysis and Interpretation*, J P Publications, Madison.

N

Ndlwana, M., 1991: *A Critical Analysis of Problems Encountered by Senior Secondary School Pupils in the Reading and Interpretation of 1:50 000 Topographical Maps and Aerial Photographs with Special Reference to Black Pupils in Transkei*, unpublished M.Ed. thesis, Rhodes University, Grahamstown, South Africa.

Nicholson, J.M. and Morton, J.G., 1967 (1st ed., 1974 3rd ed.): *Working With Maps*, Shuter and Shooter, Pietermaritzburg.

Norwich, O.I., 1993: *Maps of Southern Africa*, A.D. Donker, Johannesburg.

O

Olson, J.M., 1976: A coordinated approach to map communication improvement, *The American Cartographer*, 3(2), 151-159.

Olson, J.M., 1979: Cognitive cartographic experimentation, *The Canadian Cartographer*, 16(1), 34-44.

Okpala, J.I.N., 1989: Talking and problem-solving: Reality orientated problem solving questions: A strategy for inducing productive verbalization for externalizing and correcting misconceptions in map work in secondary schools (sic), in F. Slater (ed.) *Language and Learning in the Teaching of Geography*, Routledge, London, 71-91.

Okpala, J.I.N., 1989: Teaching styles in reading and interpreting topographical maps - the Nigerian experience, in R. Gerber and J. Lidstone (eds.), *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 31-38.

Ordnance Survey, 1997a: *Annual Report and Accounts 1996/97*, The Stationery Office, London.

Ordnance Survey, 1997b: *Mapping News*, Issue 11, Ordnance Survey.

Ormeling, F., 1997: Teaching map use concepts to children in T. Kanakubo and K. Kanazawa (eds.), *Proceedings of the Seminar on Cognitive Map, Children and Education in Cartography*, held by the International Cartographic Association from November 8-10 1996 in Gifu, Japan.

Ottosson, T. 1988: What does it take to read a map?, *Cartographica*, 25(4), 28-35.

P

- Pagel, A.E., 1984: *An introduction to mapwork*, Educamus, January, 14-16.
- Parkhurst, H.H., 1922: *Education on the Dalton Plan*, Bell and Sons, London. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Pateni, C.N., 1997: The role of cartography in a developing country like South Africa :A look at the need for the education of black professional and technical cartographers to drive the mapping process in South Africa in fulfilment of the objectives of the reconstruction and development programme (RDP), *Proceedings 18th ICA/ACI International Cartographic Conference*, Swedish Cartographic Society, Gävle.
- Peterson, M.P., 1985: Evaluating a map's image, *The American Cartographer*, 12(1), 41-55.
- Peuquet, D.J., 1988: Representations of Geographic Space: Toward a conceptual synthesis, *Annals of the Association of American Geographers*, 78(3), 375-394.
- Piaget, J., 1955: *The Child's Construction of Reality*, Routledge and Kegan Paul, London. Reference in Burton, M.StJ.W., 1989: Class encounters with the third dimension, *South African Geographer*, 16(1/2), 130-138.
- Piaget, J. and Inhelder, B., 1956: *The Child's Construction of Space*, Routledge and Kegan Paul, London. Reference in Boardman, D., 1983: *Graphicacy and Geography Teaching*, Croom Helm, London.
- Piaget, J., 1964: Development and learning, in R.E. Ripple and V.N. Rockcastle (eds.), *Piaget Rediscovered*, Cornell University Press, Ithaca, 7-19.
- Piaget, J., 1971: *Science of Education and the Psychology of the Child*, Lorigman. Reference in Boardman, D., 1983: *Graphicacy and Geography Teaching*, Croom Helm, London.
- Piaget, J., 1972: Development and learning, in C. Stendler and F. Stendler (eds.), *Readings in Child Behaviour and Development*, Harcourt Brace Jovanovich, New York.
- Potgieter, D. and Olën, S. 1993: The view from above: Map reading skills project, *International Information and Library Review*, 25, 259-271.
- Pratton, J. and Hales, L.W., 1938: The effects of active participation on student learning, *Journal of Educational Research*, 79(4), 210-215.
- Pritchard, J.M., 1980: *A New Map Reading Course for Southern Africa Book 1*, Macmillan, London.

Pritchard, J.M., 1983: *A New Map Reading Course for Southern Africa Book 2*, Macmillan Boleswa, Manzini.

Publishing Training Project, 1994: Editing for language accessibility, (course notes) the Publishers' Association of South Africa, Johannesburg.

R

Raadam, T., 1989: Traditional Danish practice in cartographic learning, in R. Gerber and J. Lidstone (eds.), *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 84-89.

Reynhardt J.H. and Holmes P.J. 1988: *Geography in Perspective A Guidebook for Std 9*, De Jager-Haum, Pretoria.

Reynhardt J.H., Holmes P.J. and Steyn, J.H. 1988: *Geography in Perspective A Guidebook for Std 10*, De Jager-Haum, Pretoria.

Roberts, G., 1978: *Southern African preference surface contrasts: processes in constructing appraisive, cognitive representations and tentative interpretations*, unpublished B.A. Hons., mini-thesis, Randse Afrikaanse Universiteit.

Robertson, A., 1980: *Maps and Mapping (Down to Earth Series)*, Hutchinson Education, Cheltenham.

Robinson, A.H. and Petchenik, B.B., 1975: The map as a communication system, *The Cartographic Journal*, 12(1), 7-15.

Romiszowski, A. and Atherton, B., 1979: Creativity and control -neglected factors within self-instruction programme design, in *Aspects of Educational Technology, XXXIII*, Kogan Page, London, 45-52.

Ross S., 1988: *Introducing Physical Geography and Map Reading*, Longman, Harlow.

Rowntree, D., 1979: Developing a self-instructional course on how to develop self-instructional courses!, *Aspects of Educational Technology, XXXIII*, Kogan Page, London, 131-136.

S

Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.

Salt, C.D., 1971: An Investigation into the Ability of 11-12 Year-Old Pupils to Read and Understand Maps, unpublished M.A. thesis, University of Sheffield. Referenced in Boardman, D., 1983: *Graphicacy and Geography Teaching*, Croom Helm, London.

- Sandford, H.A., 1980: Directed and free search of the school atlas map, *The Cartographic Journal*, 17(2), 83-92.
- Sandford, H.A., 1983: Typology and characteristics of pupils' desk atlases, *South African Journal of Photogrammetry, Remote Sensing and Cartography*, 13(4) 217-226.
- Sandford, H.A., 1986: Objectives of school mapwork, *Teaching Geography*, October, 22-26.
- Sandford, H.A., 1989: School-based research into pupil's mapwork difficulties and their solution, in R. Gerber and J. Lidstone (eds.) *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 333-338.
- SAQA, undated, c.1997: *SAQA Bulletin*, South African Qualifications Authority, Pretoria.
- Sauvain, P.A., 1973: *Maps And How To Read Them*, Franklin Watts, London.
- Seethal, C.E.P., 1983: Senior black geography exam failures – What's the problem?, reference in Cowley, J.W., 1987: School geography in Bophuthatswana, *Tikologo*, A Journal for the promotion of Geography and Environmental Science in Bophuthatswana, 1, 77-87.
- Scott, D. and Collings, S., 1992: *Maps, Graphs and Numbers*, Foundation Series, Juta, Kenwyn, South Africa.
- Sekete, P.G.I., 1991: Teaching Mapwork Skills in R.D. Yule (ed.), *Approaches to Geography Teaching*, Lexicon Publishers, Johannesburg.
- Sekete, P.G.I., 1995: *An investigation into problems with topographic map comprehension by first year college of education students in North West (Province)*, Unpublished Master of Science research report, University of the Witwatersrand, Johannesburg.
- Silberstein, S., 1987: Let's take another look at reading: Twenty-five years of reading instruction, *English Teaching Forum*, October, 29-35.
- Skinner, B.F., 1953: *Science and Behavior*, Macmillan, New York. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Skuy, M. (ed.) 1991a: *Mediated Learning Experience Working Manual*, Cognitive Research Programme, Division of Specialised Education, University of the Witwatersrand, Johannesburg.
- Skuy, M. (ed.) 1991b: *Cognitive Functions and Dysfunctions Working Manual*, Cognitive Research Programme, Division of Specialised Education, University of the Witwatersrand, Johannesburg.

- Skuy, M. (ed.) 1993: *Illustrating Feuerstein's Instrumental Enrichment Programme Working Manual*, Cognitive Research Programme, Division of Specialised Education, University of the Witwatersrand, Johannesburg.
- Smit, T. 1994: The reading of topographical maps – an elementary model for secondary schools, paper presented at the IGU Conference (September 1994), Prague and published in *Geographiedidaktische Forschungen*, 25.
- Smith, C.A., 1977: A test concerning the relative readability of topographic and orthophotomaps, *The American Cartographer*, 4(2), 133-143.
- Smith, F., 1985: *Reading*, Cambridge University Press, Cambridge.
- Smith, H. 1985: Field Trialling, in K. Alexander and D. Blanchard (eds.), *Educational Software a Creator's Handbook*, Tecmedia, Loughborough.
- Smith, W.I. and Moore, J.W., 1962: *Programmed Learning*, Van Nostrand, Princeton, N.J.
- Stevens, A.L. and Rumelhart, D.E. 1975: Errors in reading: Analysis using an augmented network model of grammar, reference in Kitao, S.K., 1989: *Reading, Schema Theory and Second Language Learners*, Eichosha Shinsha, Tokyo.
- Stimpson, P., 1989: Questionnaire surveys in geography education research: Some problems and possible solutions, in R. Gerber and J. Lidstone (eds.) *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 339-343.
- Swanevelder, C.J. Du Toit, and Barnard, P.J., 1987: *Senior Geography For Standard 8*, Nasou, Cape Town.
- Swiss Federal Office of Topography, undated: Conventional Signs of the Swiss topographic maps, (information leaflet), Swiss Federal Office of Topography, Wabern.
- T**
- Taim, O., 1984: *The Authoring of a Computer Aided Instruction Programme to Teach Completed Staff Work to Business Management*, unpublished thesis, Master of Education, University of South Africa, Pretoria.
- Talyzina, N.F., 1984: The contemporary condition of the activity theory of learning, *Contemporary Educational Psychology*, 9, 229-234.
- Teck, L.B., 1989: Effects of practical experience and sequential skills in map reading in R. Gerber and J. Lidstone (eds.), *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 80-83.

- TenBrink, T.D., 1974: *Evaluation, A Practical Guide for Teachers*, McGraw-Hill, New York.
- Thelen, H.A., 1963: Programmed materials today: critique and proposal, *The Elementary School Journal*, 64, 189-196. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Thomas, P.W., 1954: Technical Instruction No. 14, Topographical Place Names (T.11/1/14), Topo Branch: Trigsurvey (now the Chief Directorate: Surveys and Mapping), Mowbray, South Africa.
- Thomas, P.W., 1962: Technical Instruction No. 14, Topographical Place Names, Notes and Additional Instructions (T.11/1/14A), Topo Branch: Trigsurvey (now the Chief Directorate: Surveys and Mapping), Mowbray, South Africa.
- Thomas, P.W., 1982a: The topographical 1:50 000 map series of South Africa, *South African Journal of Photogrammetry, Remote Sensing and Cartography*, 13(2), 77-88.
- Thomas, P.W., 1982b: The topographical 1:50 000 map series of South Africa, part II, *South African Journal of Photogrammetry, Remote Sensing and Cartography*, 13(3), 171-184.
- Thomas, P.W., 1983: The topographical 1:50 000 map series of South Africa, part III, *South African Journal of Photogrammetry, Remote Sensing and Cartography*, 13(5), 331-343.
- Thomas, P.W., 1984: The topographical 1:50 000 map series of South Africa, part IV, *South African Journal of Photogrammetry, Remote Sensing and Cartography*, 14(1), 37-46.
- Thorndike, E.L. 1913: *Educational Psychology, Vol. I, The Original Nature of Man*, Teachers College Press, Columbia University, New York. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Thorndike, E.L. 1913: *Educational Psychology, Vol. II, The Psychology of Learning*, Teachers College Press, Columbia University, New York. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Transvaal Education Department, undated: *Final Core Syllabus for Geography, Higher Grade, Standards 8, 9 and 10*, implementation dates 1985, 1986, 1987, Pretoria.
- Transvaal Education Department, undated: *Final Core Syllabus for Geography, Ordinary Grade, Standards 5-7*, implementation date 1985, Pretoria.
- Tuckey, H.P., 1989: *Testing and improving students' understanding of three-dimensional representations in chemistry*. Unpublished M.Ed. Thesis, University of the Witwatersrand.

Tuckey, H.P. and Selvaratnam, M., 1993: Studies involving three-dimensional visualisation skills in chemistry: A review, *Studies in Science Education*, 21, 99-121.

Turk, B., 1980: *Map Practice*, University Tutorial Press, Slough.

Turk, B., 1983: *Map Skills*, University Tutorial Press, Slough.

U

U. S. Geological Survey, undated. *Map Adventures*, (teachers' resource package), U.S. Department of the Interior.

U. S. Geological Survey, undated: *What do Maps Show?*, (teachers' resource package), U.S. Department of the Interior.

U. S. Geological Survey, undated: *Exploring Maps*, (teachers' resource package), U.S. Department of the Interior.

V

van den Bogaerde, F., 1987: Preparing for the twenty-first century, *Unisa Alumnus*, University of South Africa, Pretoria, 9-12.

van der Schee, J., 1989: Thinking Geography with maps, in R. Gerber and J. Lidstone (eds.), *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 76-79.

Verhetsel, A., 1989: In search of a more efficient mental image of the world, in R. Gerber and J. Lidstone (eds.), *Developing Skills in Geographical Education*, International Geographical Union, Brisbane, 319-326.

Vlok, A.C., 1992: School desk atlases: South African practice and international trends, *South African Geographer*, 19(1), 146-157.

Vygotsky, L.S., 1962: *Thought and Language*, M.I.T. Press, Cambridge, Massachusetts.

W

Walker, M., 1994: Professional development through action research in township primary schools in South Africa, *International Journal of Educational Development*, 14(1), 65-73.

Warwick, P., 1987: How do children "see" geographical pictures?, *Teaching Geography*, April, 118-119.

- Washburne, C.W. and Marland, S.P., 1963: *Winnetka: The History and Significance of an Educational Experiment*, Prentice-Hall, Englewood Cliffs. Reference in Saettler, P., 1968: *A History of Instructional Technology*, McGraw-Hill, New York.
- Weber, R.M., 1970: First graders use of grammatical context in reading, reference in S.K. Kitao, 1989: *Reading, Schema Theory and Second Language Learners*, Eichosha Shinsha, Tokyo.
- Wesso, H and Parnell, S., 1992: Geography education in South Africa: colonial roots and prospects for change, in C. Rogerson and J. McCarthy (eds.), *Geography in a Changing South Africa*, Oxford University Press, Cape Town.
- Western Cape Education Department, 1996: *The Reading, Interpretation and Analysis of Topographic Maps: An Elementary Model for Secondary Schools*, Advisory Service: Geography, Guide 3/1996, Cape Town.
- White, I.D., Mottershead, D.N. and Harrison, S.J., 1984: *Environmental Systems*, Allen and Unwin. London.
- Wilkinson, G.M., 1979: Peer instruction in learning packages, *Aspects of Educational Technology*, XXXIII, Kogan Page, London, 143-147.
- Winter, K., 1992: Inquiry learning in geography education, *South African Geographer*, 19(1/2).
- Wolf, A., 1995: *Competence-Based Assessment*, Open University Press, Buckingham.
- Wood, A., 1979: A modular system of self-instruction in educational technology within a course of teacher training, *Aspects of Educational Technology*, XXXII, Kogan Page, London, 189-195.
- Wood, M., 1997: Cartography into the New Millennium in T. Kanakubo and K. Kanazawa (eds.), *Proceedings of the Seminar on Cognitive Map, Children and Education in Cartography*, held by the International Cartographic Association from November 8-10 1996 in Gifu, Japan.

Z

- Zeuli, J.S. and Floden, R.E., 1987: Cultural incongruities and inequities of schooling: Implications for practice from ethnographic research?, *Journal of Teacher Education*, 38(6), 9-15.

APPENDIX A

SUPPORT FOR IMPROVED GRAPHICACY

While preparing the initial research proposal, a number of companies were approached for comment on the value of improving the graphicacy of learners through the medium of improved map reading ability. The letters which follow indicate the support of:

A.1 the building industry

A.2 the computer industry

A.3 the mining industry.

A.1

*Amalgamated Union Of Building Trade Workers
of South Africa
Amalgameerde Unie Van Bouwvak-Werkers
van Suid-Afrika*

2de Verdieping, Trades Hall Oos, Andersonstraat 90, Johannesburg - 2nd Floor Trades Hall East, 90 Anderson Street.

UITVOERENDERAAD / EXECUTIVE COUNCIL

TELEPHONE/TELEPHONES: 836-9061
FAX : 838-1629

PO5815/P.O. BOX 5378
Johannesburg
2000

REF:

REF:J.C.S.003/91

MRS. L. INNES
9 VISSER STREET
FARRARMERE
BENONI
1501

13 JUNE 1991

Dear Mrs. Innes

I would like to thank you for approaching our Trade Union for comment on your proposals as we feel that it is of the utmost importance that Trade Unions should play an even bigger role in education at all levels than is being presently practised. Training in Trades should not only start once the student has left matric but should be implemented in his High School years so that it can facilitate the student in choosing positively his career path at an early age instead of being confused with a career path when leaving school.

The following points should be taken into consideration when designing a education program that can benefit the Building Industry when discussing graphic skills:-

Map Reading in Geography should be linked to your basic drawing Technology in technical drawing classes, so that students can compare and relate Map Reading with technical drawings, there by forming a real life conception of graphics in every day enviroment.

The use of flow-charts, graphs, plans, work sheets ect. should be acquired in High School so that once training begins for a specific career e.g. general Foreman, Construction Supervisors, etc. in other words your contract leaders. They can then relate all of the above to planning the



A.1 (cont)

-2-

everyday activities that will take place on a construction site.

Being able to use the different instruments in mapwork assists in future job training where the student will then be using a Theodo Light and Dumpy Level in the planning and setting out of buildings on various types of terrain where topographical layout of proposed sites needs to be perceived in order to set out the buildings and to forecast problems that could arise from the various types of terrain that can be encountered when acquiring a site for proposed construction.

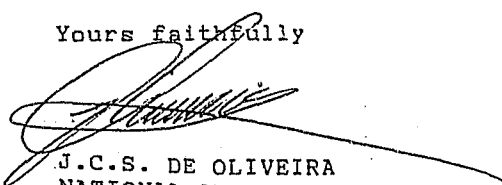
The above are just a few examples of the way we see your project assisting future students with intentions of making the Building Industry their career.

Furthermore I would suggest that you should contact the following people who would be able to support you with further information:

Mr. Richard Hurry	Director of Kirchmann & Hurry Construction and President of Bifsa.
Mr. Mike Kirchmann	Director of Kirchmann & Hurry and Lecturer at Wits.

I hope that the above information will assist you in your efforts in procuring better education standards in South Africa. If any further assistance is required do not hesitate to contact us and please keep us informed of your progress.

Yours faithfully



J.C.S. DE OLIVEIRA
NATIONAL ORGANISER

Johannesburg

PO Box 1419 Johannesburg 2000
124 Main Street Johannesburg 2001
Tel. (011) 224-9111
Telex: SA 495636
Fax: (011) 224-3003

21 May 1991

Mrs L Innes
9 Visser Street
Farrarmere
Benoni
1501

Dear Mrs Innes,

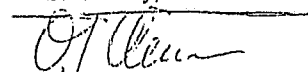
Re: MAPTRIX Research Proposal

Thank you for sharing your ideas concerning this very interesting proposed investigation of yours to improve 'graphicacy skills' in learners. Some of my comments are the following:

MAPTRIX (Improving map reading and interpretation skills): These skills are certainly used in a different way in my field of work. Our employees have to understand flow-charts, business information both on high technology equipment and in hard copy format. The ability to assimilate conceptual data is a regular event in the computer industry. The three dimensional aspects of your proposed work also has merit. Each year new technology appears on the market which improves the presentation of data in the Mining, Retailing, and Manufacturing Industries. Hence, if pupils and students have had an improved didactic experience in recognising and interpreting data as you wish to do, it should have a positive transfer effect to the work place once the learners graduate and qualify for improved work opportunities. The areas of Systems Design, Application Development, Project Management, and related fields in the Information Technology Industry would certainly appreciate new staff with improved skills in these areas.

I wish you success in your research endeavours. Should you wish to test any of your ideas with specific (may be modified) areas of application suitable to the High Technology Industry, I shall be willing to give you any guidance or help that you may need.

Yours sincerely,



O. Taim (B.A, DTE, M.Ed cum laude)
(Education/Training Consultant)

Anglo American Corporation of South Africa Limited

91/385/mm

Incorporated in the Republic of South Africa Registration No. 01/05309/06

A.3

June 11, 1991

Mrs L Innes
9 Visser Street
Farrarmere
BERONI
1501

47 Main Street, Johannesburg 2001
PO Box 61587 Marshalltown 2107
Telex 4-07167 SA Telegraph Anmercosa
Facsimile (011) 638-3221
Telephones:
Switchboard (011) 638-9111
Direct line (011) 638-

SCHOLARSHIP & BURSARY UNIT

Dear Mrs Innes

MAPTRIX RESEARCH PROPOSAL

I have read your proposal on mapwork research with interest as I agree that the need to improve the quality of the communication of spatial information is of great importance in this day and age.

It is the function of the Graduate Recruitment Department to provide the operating Divisions of the Anglo American Corporation and De Beers Consolidated Mines with graduate manpower. Our scholarships in the main are awarded for Engineering and Geology. Whilst Geography is not a pre-requisite for these courses of study, those students who have studied the subject must surely be at an advantage.

Much of the university course material and indeed, the later practical application in the job situation of the engineer and the geologist, involves the use of graphs, maps, drawings and other graphic material. I therefore commend your proposal to research the extent of the poorly developed graphicacy skills of students and to develop a system of teaching which will enhance these skills.

In the light of present circumstances, especially in Black education, I believe your goals of cost effectiveness, discrepancies in achievement and self-instruction are highly relevant and of great importance.

I extend my very best wishes to you and wish you every success in this important venture.

Yours sincerely



T J HALL (MR)

Divisional Training Manager
Graduate Recruitment Department

TJH/ck/385/mm

Directors: J. Ogilvie Thompson (Chairman) N.F. Oppenheimer (Deputy Chairman) W.G. Boustred (Deputy Chairman) L. Boyd T.N. Chapman Dr E.M.A.F. Ferreira (Portuguese)
G.C. Fletcher, M.C. R.M. Goddard E.P. Gush R.N. Hambro (British) L. Hewitt M.B. Holmeyer J.A. Holmes (British) M.W. King P.J.R. Leyden (British) A.B. McKerron D.G. Nicholson (British)
M.C. O'Dowd Sir Philip Oppenheimer (British) T.L. Pretorius D. Rankin G.W.H. Rolly P.F. Ratel C.J. Saunders H.R. Sluck (American) The Hon. J.H. Steyn C.L. Sunter (British) A.J. Trahar
Dr A.L. Vilakazi (American) G.S. Young
Alternate Directors: R.M. Brown B.E. Bullitt (British) Dr J.W. Campbell (British) R.M. Crawford A.D. Deuchar (Australian) J.F. Drysdale (British) Dr H.B. Oyer R.A.A. Gower
R.A. Hambro (British) J.B. Hawthorne M.J. Hervey G.M. Holland K.M. Hosking R.P. Lander (Zimbabwean) J.C. Marlers A.E. Oppenheimer (British) G.M. Ralle D.L. Tillestad
S.W. van der Colff D.J. van Jaarsveld

APPENDIX B

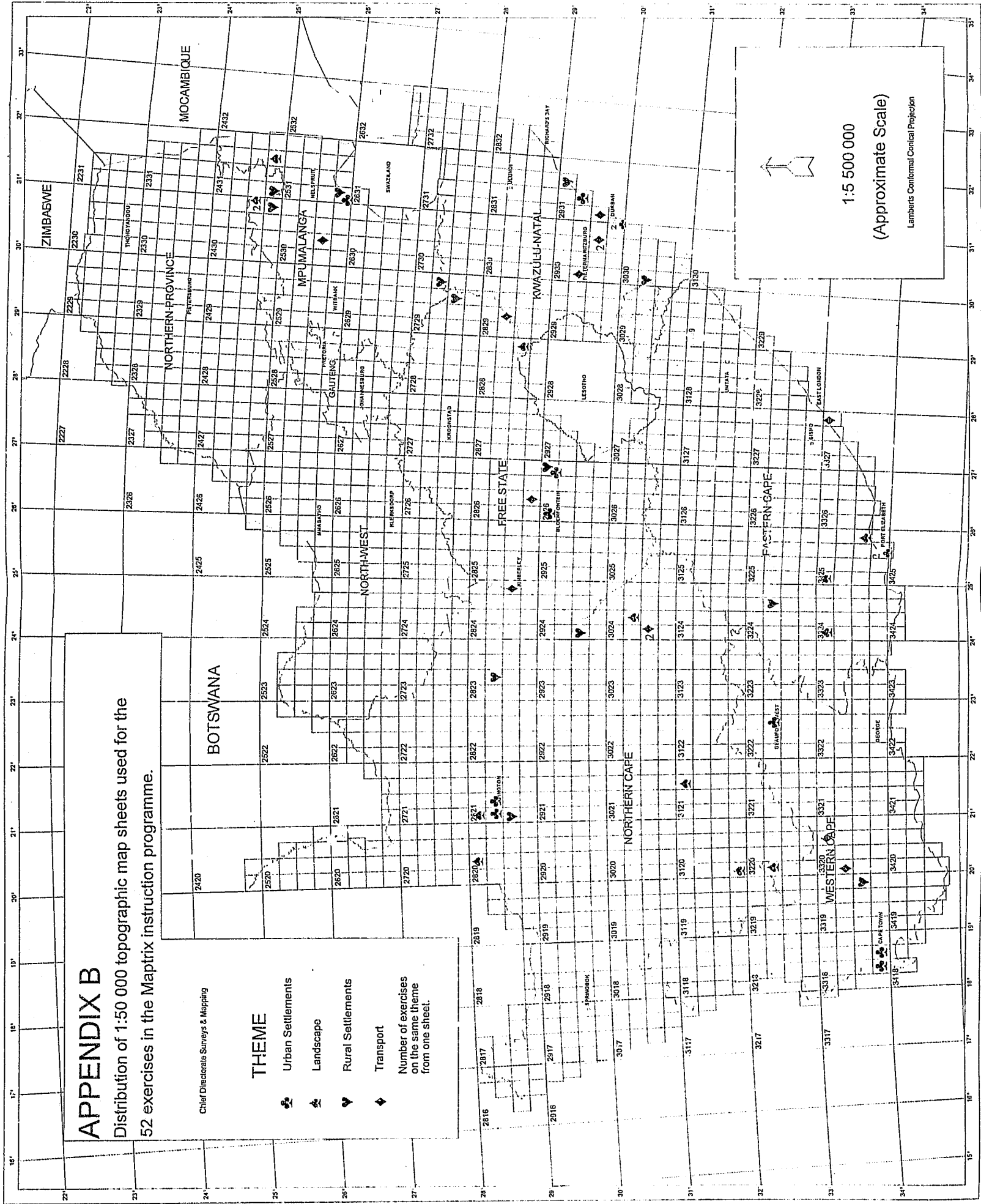
Distribution of 1:50 000 topographic map sheets used for the 52 exercises in the Maptrix instruction programme.

Chief Directorate Surveys & Mapping

THEME

- Urban Settlements
- Landscape
- Rural Settlements
- Transport

Number of exercises on the same theme from one sheet.



APPENDIX C
AN EXAMPLE OF SOME OF THE ITEMS USED TO COMPILE A
WORK CARD AND AN ANSWER CARD (5♠)
(as listed in figure 5.2)

Items used for the front of the work card:

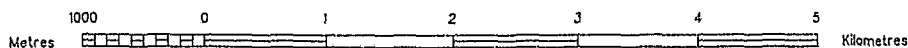
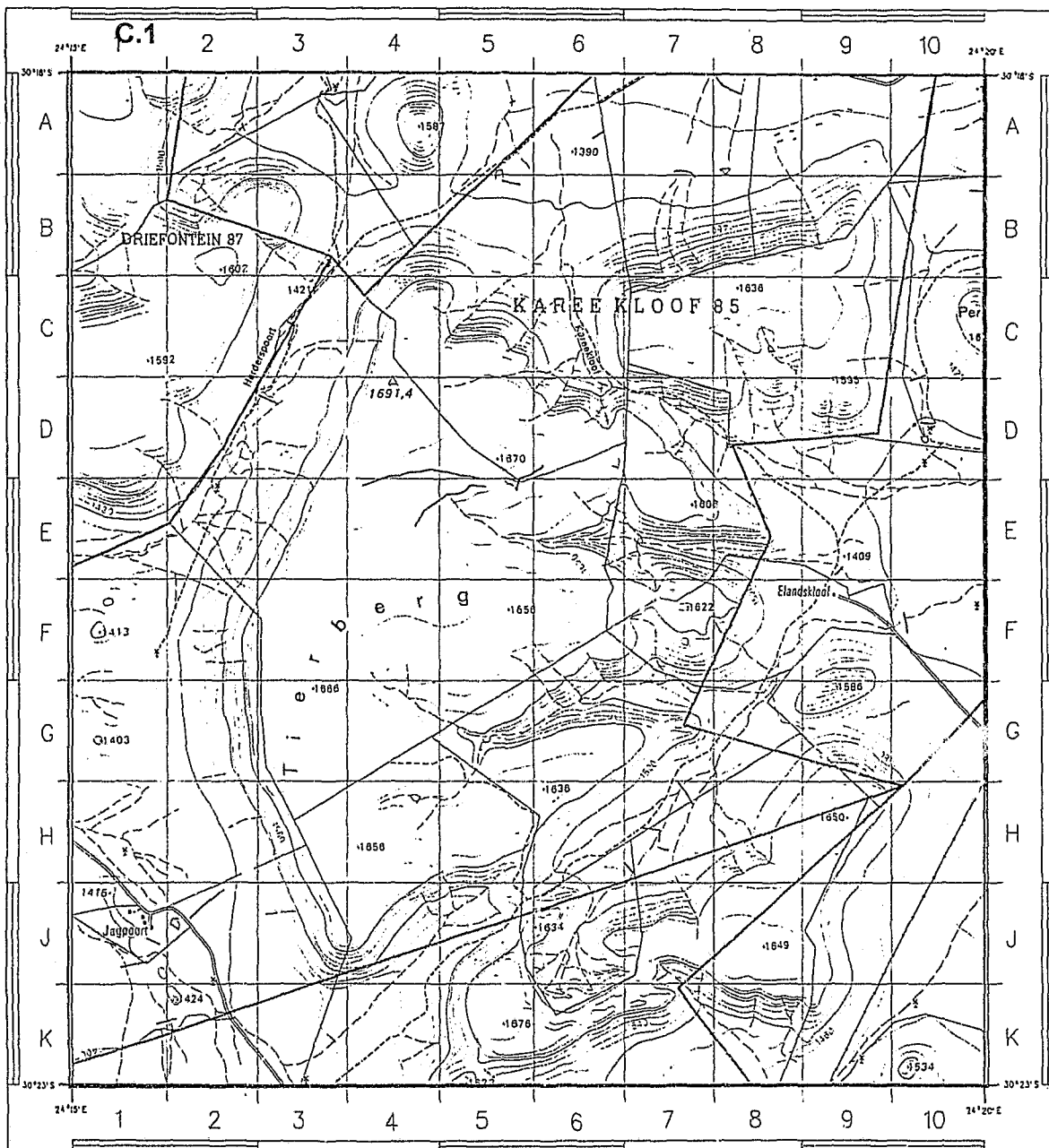
- **C.1** A monochrome copy of the selected map extract showing the alpha-numeric grid and the reference list (map key)
- **C.2** The exercise including the introductory text and ten graded questions

Items for the back of the work card

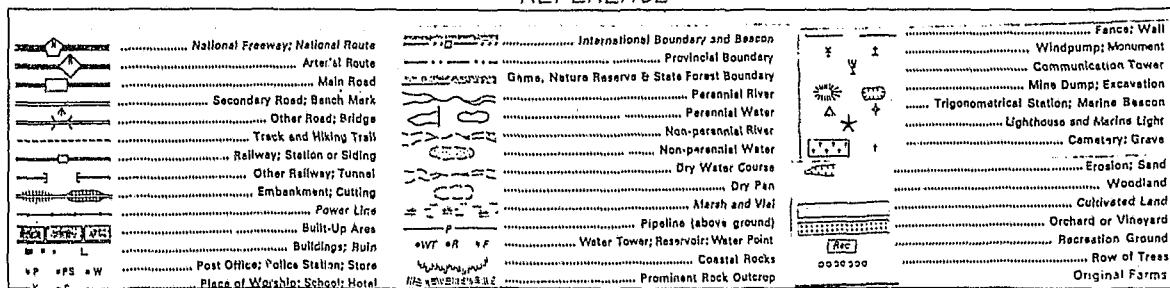
- **C.3** The selection of ten illustrated symbol explanations (reduced to A3)
- The lesson text for 5♠ is included in appendix E.3

Items used for the answer card

- **C.4** The ten answers
- The 5♠ playing card is not illustrated.



REFERENCE



APPENDIX C.2

LANDSCAPE

5♣

PHILIPSTOWN 3024AD Map Extract 30°18'S; 24°15'E

This area is near Philipstown in the north eastern corner of the Karoo. The sandy, flat-topped hills and sparse semi-desert vegetation make this area difficult to live in. The landscape is easy to examine on the map because there are very few signs showing settlement or economic activity.

1. The highest point on each topographic map sheet is shown in bold, dark numbers. Name the map symbol and give the height of the point in D4.
2. River valleys in a hilly area provide flat ground for easier travelling. What will you drive on if you go through *Herderspoort* (D2, C3)?
3. A butte is another name for a flat topped hill. There is a good example of a butte in A4. Give the height on top of this butte.
4. The map area consists of flat topped hills rising from a flat plain. Using the spot heights as a guide, write down which two of the following blocks are part of the flat plain: G3, K1, C1, E9, J8.
5. In this semi-desert landscape water provision is very important. Name the 2 features in A3 which help ensure a permanent water supply.
6. When there is a thunderstorm in an arid area, there is very little vegetation to protect the sandy surface. Most of the rain water runs off over the surface carrying away the soil. At first the erosion forms a small gully, this grows deeper each time it rains to form a donga which eventually deepens to form a gorge (*kloof*). Name the gorge in C6.
7. The gorges in C6 and D7 are being eroded by two non-perennial streams which flow in different directions when it rains. Give the block reference where the stream draining towards the east leaves the map area.
8. The dark contour line at the base of the butte in A4 is 1400 m. How high is the butte above the surrounding country side?
9. Water flows fastest down the steepest slope. In which of the following blocks are there the most, fast flowing non-perennial streams; E6, B7, J6, H1?
10. Tierberg (G3 to F4), a high flat-topped tableland known as a mesa, covers most of the farm Karee Kloof (named in C5, C6, C7). Follow the original farm boundary from the edge of the map (A10) towards H10 where three boundaries meet. Give the references for two blocks where this part of the Karee Kloof farm boundary bends on the points of narrow spurs.

APPENDIX C.4

LANDSCAPE

5♣

PHILIPSTOWN 3024AD

1. trigonometric station, 1 691,4 m
2. track
3. 1 587 m
4. K1, E9
5. wind pump and dam
6. Kareekloof
7. E10
8. $(1\,587\text{ m} - 1\,400\text{ m}) = 187\text{ m}$.
9. J6
10. E8 and G7

APPENDIX D

TWELVE STEPS IN DESIGNING THE MAPTRIX INSTRUCTION PROGRAMME

(after Gagné and Briggs, 1974)

Step 1 Analysis and identification of needs

The broad problem of poor mapwork performance and the need for improvement are discussed and the focus on topographic map reading is justified.

Step 2 Definition of goals and objectives

A hierarchy of component skills is outlined, specific learning units are identified and performance objective statements are constructed and analysed.

Step 3 Identification of alternative ways to meet needs

Various strategies for teaching map reading are evaluated.

Step 4 Design of system components

The main components of the programme are: the assessment component, both formative and summative; the map reading exercises including the questions and answers, and the support material which aids the learners when they begin the programme (but is relied on less as skills improve). The final format of these components includes work cards, answer cards and a pupil booklet accompanied by a local topographic map sheet suitably packaged in a teaching kit.

Step 5 Analyses of resources required, resources available and constraints

Extracts from topographic map sheets and illustrations for map symbols must be acquired. Appropriate computer hardware, software and expertise are identified.

Step 6 Action to remove or modify constraints

Time and a unique employment opportunity eventually overcome financial and other resource constraints. Friends and colleagues make their skills available to overcome other obstacles.

Step 7 Selection or development of instructional materials

The compilation of instructional materials includes the selection of map extracts, overlaying of a reference grid and the authoring of the map reading exercises and answers as well as the authoring and illustrating of the support material, including lesson texts and symbol explanations. Instructions for following the programme are formulated.

APPENDIX D (cont)

Step 8 Design of student assessment procedures

Answer sheets and progress graphs are designed for a pupil booklet to give the learners and their teachers immediate feedback.

Step 9 Field testing; formative evaluation and teacher training

A pre- and post-test are used to assess the efficacy of the programme prior to completion of all components. Learners' responses guide the improvement of the programme while it was still at this formative stage. Teacher training needs are identified during the pilot test and classroom trial.

Step 10 Adjustments, revisions and further evaluation

The completion of the prototype learning programme is guided by the findings of the pilot test. Confusion resulting from the wording of instructions and exercises, is identified and removed. Support material such as symbol explanations and lesson texts are completed.

Step 11 Summative evaluation

A full report on the school trial is prepared.

Step 12 Operational installation

The objective of the research project is to develop a self-instruction method for learning to read the South African topographic map. The prototype resulting from this method has been developed and limited testing has been done. Recommendations for the further development and assessment of this method in schools are made.

APPENDIX E

EXAMPLE OF LESSON TEXTS FOR THE THEME LANDSCAPE ♠

Work cards in the spades suit focus on the landscape. The objective of the exercises is to offer learners the opportunity to read maps showing a wide variety of landscapes using different map signs especially those indicating height. To ensure that variations from rugged to undulating relief are encountered, exercises are divided into three groups. Learners must select a minimum of one card from each group. The map extracts for the subdivisions within this theme have been selected as follows:

- picture cards: Ace, Jack, Queen and King show flat and undulating plains.
- odd numbers: 3, 5, 7 and 9 feature individual mountains or mountain ranges.
- even numbers: 2, 4, 6, 8 and 10 focus on valleys.

E.1 DEFINITION OF THE MAIN THEME

(used at the start of all lessons in the theme)

Landscape is what we see everywhere around us. Topographic maps show features of the landscape. We will take a look at different kinds of landscape and then study some of the map symbols which show what the landscapes of different areas are like.

By the time you have mastered this topic, you will be able to

- read the height clues on topographic maps,
- identify different slopes and
- be able to describe different types of landscapes.

E.2 SUB-THEME: PLAINS

(used on work cards Ace ♠, King ♠, Queen ♠, and Jack ♠)

PLAINS are landscapes which are flat or have very gentle slopes. They may differ from a low lying coastal plain to an elevated (high) plateau.

LANDSCAPE is a word with many different meanings.

CULTURAL LANDSCAPE, sometimes called *man-made landscape*, describes what people have done to change the natural surroundings.

- Buildings and roads, mine dumps and excavations, bridges and dams are all built to serve our towns and cities. Such built up areas have an *urban landscape*.
- In farming areas we see cultivated lands, orchards, vineyards and plantations. These show that people have changed the natural veld into productive land, producing a *rural landscape*.

NATURAL LANDSCAPE is what we see around us that people have left unchanged. Other ways of describing natural landscape are *physical features* or *relief*. These include rivers, coastlines, mountains and plains where there are few settlements (places where people settle or live). Natural vegetation is also part of the landscape. Some parts of the natural landscape have been declared *nature reserves* so that these areas cannot be changed by people.

HEIGHT CLUES on topographic maps include

- **Rivers** which show where the low lying ground is; remember that water always flows downhill.
- **Spot heights** give the exact height above sea level of a particular spot (place).
- **Bench marks** are found on topographic maps along roads and railway lines. A little arrow and a number give the exact height of a road or railway line at the point of the arrow.
- **Trigonometric or trig stations** are marked by concrete pillars which must be erected for accurate topographic mapping. The trigonometric station, where a beacon is erected, is shown on the map by a triangle. The number below the triangle is the height of the ground, the number beside the triangle is the registration number of the station.
- **Contour lines** on a topographic map join all places of the same height above sea level. There are no contour lines on the landscape. Remember that the higher the value of the number on the contour line, the higher the land lies. Lower value numbers mean lower areas. All the places which lie on the same contour line are at the same height above mean (average) sea level. The numbers are written so that the top of the number is towards the top of the slope.

E.3 SUB-THEME: MOUNTAINS

(used on work cards 3♠, 5♠, 7♠, and 9♠)

MOUNTAINS are the high lying areas of the landscape made up of combinations of different slopes.

LANDSCAPE FEATURES are a combination of different uphill and downhill slopes shown by the pattern of the contour lines and other clues. Read the explanations for contour lines and trig stations on this page *[illustrated symbol selections for this sub-theme all included these two symbols]* and look at the spot heights on the map. Remember that water always flows downhill so rivers must flow from high to low ground.

- **Steep slopes** are shown by contours which are close together.
- **Gentle slopes** are shown by contours which are far apart.
- **Concave slopes** are steep at the top and gentle at the bottom.
- **Convex slopes** are gentle at the top and steep at the bottom.
- **Even or regular slopes** may be steep or gentle but have the same distance between contours.
- **Terraced slopes** are alternately steep and gentle.

A **hill** is identified by contour lines which join up to form roughly circular shapes which get smaller and smaller towards the highest point.

A **valley** is always easy to spot because there is either a perennial or non-perennial stream crossing the point of the V-shaped contours. The lowest contour lines are on the inside of the V.

Mountain **ridges** have contour lines which make sausage shapes at the top. You can clearly see the streams draining downhill on each side, away from the top of the ridge which often forms a watershed (division between drainage basins).

A **spur** is recognised by the long finger shaped contours extending out from the top of a mountain or hill. Spurs are narrow areas of high ground which often separate river valleys.

A **watershed** is an area of high ground (often following a ridge) which causes rain water to flow downhill towards the low ground on either side. There is no separate symbol for a watershed but the fact that streams flow away from an area surrounded by closed contour lines tells us that it is high ground.

E.4 SUB-THEME: VALLEYS

(used on work cards 2♠, 4♠, 6♠, 8♠ and 10♠)

VALLEYS are low-lying landforms where rivers flow.

RIVERS carry water and are shown by blue lines on a map. Water always flows downhill so streams and rivers always flow from high ground down to lower ground. Rivers can sometimes tell us how steeply or gently the land slopes. Rivers will usually flow straight down a steep slope but they will flow from side to side across a flat area.

DRAINAGE BASINS are the areas drained by a river system. The watershed forms the highest edge of the drainage basin and is where the source of the river is. From the high ground the river and its tributaries join and flow downhill towards the mouth which is the lowest part of the drainage basin and is usually the sea.

RELIEF refers to the shape of the land and is described by measuring height above sea level or *altitude*. We need to understand how the uphill and downhill shape of the land is shown on the flat surface of a map. Apart from the clues that water gives us about high and low lying parts of the landscape, here are four more clues to use when gathering information about the shape of the landscape.

Spot heights give the exact height above sea level of a particular spot (place).

Bench marks are found on topographic maps along roads and railway lines. A little arrow and a number give the exact height of a road or railway line at the point of the arrow.

Trigonometric or trig stations are marked by concrete pillars which must be erected for accurate topographic mapping. The trigonometric station, where a beacon is erected, is shown on the map by a triangle. The number below the triangle is the height of the ground, the number beside the triangle is the registration number of the station.

Contour lines on a topographic map join all places of the same height above sea level. There are no contour lines on the landscape. Remember that the higher the value of the number on the contour line, the higher the land is. Lower value numbers mean lower areas. All the places which lie on the same contour line are at the same height above sea level.

APPENDIX F

INSTRUCTIONS FOR FOLLOWING THE PROGRAMME

(on the front cover of the pupil booklet)

Instructions

1. Pick a card - any card
2. Open your answer book in the section displaying the same sign as the card you have selected: ♦, ♣, ♥, ♠
3. Write down the time
4. Write down the card number
5. Study the map and answer the questions in the spaces provided herein
6. Use the lesson and explanations only if necessary
7. When you have attempted each question write down your finish time
8. Put the card back in the correct box
9. Take the correct answer card
10. Mark your answers
11. Add up your score and indicate the total
12. Fill in your progress chart at the back
13. Choose another card from the box of the same suit and repeat steps 3 to 12
14. You are required to answer at least one picture card, one odd number card and one even number card
15. After this minimum of three cards, continue answering cards from the same suit until you score 8/10. This means you have mastered a Topic - Well Done!
16. Go to the next suit and repeat steps 1 to 15.

Good Luck!

APPENDIX G

MAPTRIX PROOF READING REPORT

NAME _____ DATE _____

Card Code ♣ ♦ ♥ ♠
 (please ✓) Urban settlement Transport Rural Settlement Landscape

Card No. (✓) Ace 2 3 4 5 6 7 8 9 10 Jack Queen King

Name of Map Extract _____

Introductory Text Interesting? (please ✓) ☺ ☹ ☹

Suggestions? _____

Questions and Answers Start time _____

Question number	Please fill in your answer	Check ✓ or X	Comments (see options below or else comment freely)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Questions and Answers Finish time _____

Options A Question was not clear (please suggest an improvement if possible)
 B Answer on sheet was incorrect (give correct answer if possible)
 C Block reference in question was wrong (should be....)
 D Block reference in answer was wrong (should be....)

Exercise Text Interesting? ☺ ☹ ☹ Difficult? ☺ ☹ ☹

Suggestions? _____

APPENDIX H

PRE- AND POST-TESTS

(each test consists of two pages)

H.1 TEST MAP FROM MOWBRAY STYLE CHART

H.2 MAPTRIX TEST S with answer sheet as used for pilot test

H.3 MAPTRIX TEST E with answer sheet as used for pilot test

H.4 Cover letter used to introduce the Maptrix programme during the school trial

H.5 MAPTRIX TEST S used for school trial

H.6 MAPTRIX TEST E used for school trial

H.7 ANSWER SHEET used for school trial

H.2

MAPTRIX TEST S

Name the transport features shown in black, in the blocks below.

1. I11
2. D15
3. E3
4. What do you think the black squares and rectangles in H9 are used for?
5. If you went to stay at Montana (C3-D3) in False Bay, what kind of holiday accommodation would be available?
6. Apart from the shop in New Era (C10-B10), name one other place where you could go and purchase some small items.
7. What is the unnamed feature associated with mining found in G10?
8. Name the feature stretching from A2 to E5.
9. What kind of construction is indicated along the transport feature in B6?
10. The blue line around Somerpunt (E1) is smooth, suggesting an even coastline, perhaps a beach. What does the black line around Stanley Point (G5) indicate?
11. The line between D5 and E5 is drawn over an area of crosses. What do these crosses indicate?
12. Identify the site indicated in the unusual writing (Gothic script) in block C19.
13. How many dams are there in block C12?
14. In which of the following blocks does a non-perennial river occur, D10, I14 or B19?
15. What feature occupies the area between Mowbray Aerodrome (H9-H10) and Salt River Station (H10)?
16. From where do the people at Ratsegae (I21) get their water?
17. In block D8 there is a man made weir across the river. What natural river feature can also be seen in this block?
18. Water is being drawn from the dam in G11, how does it reach the buildings in G9?
19. What height does the darker contour line in H19 indicate?

H.2 (cont)

20. In which of the following blocks does a dry pan occur, C2, A2 or E21 ?
21. Serious soil erosion has occurred near Mentzdam (G14). In which block has most erosion occurred?
22. What kind of farming is done at Boschrant (H15)?
23. Of the two farms named Antrim in I11 and I12, the one with the water point is better protected from wind. What map evidence supports this statement?
24. Follow the green line which starts in A19 and name the feature which this boundary encloses.
25. What sign in G4 helps guide ships into the harbour?

H.2 (cont)

MAPTRIX TEST S

ANSWER SHEET

Please fill in your answers in the spaces below, try to fill all the spaces even if you take a calculated guess! Please fill in the start time at the beginning and the time when you finish. Thank you!

START TIME	13
1	14
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	22
10	23
11	24
12	25

FINISH TIME _____

H.3

MAPTRIX TEST E.

Identify the transport features shown in black in the following blocks.

1. F16
2. E11
3. A21
4. What do you think the black squares and rectangles in G9 and G10 are used for?
5. At Pumalanga (G20) most people are farmers. What building indicates that someone is making a living without farming?
6. At which special function building in F6 will you find large numbers of young people?
7. There are two similar unnamed features in F10 which are associated with mining, what are they?
8. What is the feature stretching from G9 to G10 used for?
9. What kind of construction is indicated along the transport feature in A6?
10. Which side of Bantry Bay would not be safe for swimming, the part in E4 or F4? In your answer give the block reference and in one word give the reason.
11. Which feature in block D14 could have provided shelter for the original settlers in this area?
12. What is indicated by the symbol in H12 which is labelled in unusual lettering (Gothic script) in H12?
13. Name the largest dam in the map area.
14. A confluence is where two rivers join. In which block does a non-perennial tributary join a perennial river: F13, I14 or D18?
15. What natural feature does the Brinkspruit flow through in I10?
16. Clewer Agricultural Holdings (C4) is well supplied with water. Apart from a dam, river and wind pump, from where else do they draw water?
17. What feature occurs in the Vaal River in block B13?

H.3 (cont)

18. A canal has been built to irrigate the farms near Mentzdam. This canal crosses a stream bed (in the corner of H15). Name the construction which makes this possible.
19. What height does the contour line in B20 indicate?
20. In which of the following blocks does a sandy river bed occur, B19, H18 or B1?
21. Although the Drakensburg is higher, Ntabende (D17) is rockier. Which conventional sign indicates this fact?
22. The farm Rotsvas (C9) produces grain and not fruit like the surrounding farms. What evidence from the map supports this statement?
23. What kind of vegetation grows in the Tugela valley along most of the river's course (C19 to I12)?
24. What sports facility is indicated in E8?
25. What is the sign in H6 which warns ships about the dangerous rocks?

H.3 (cont)

MAPTRIX TEST E

ANSWER SHEET

Please fill in your answers in the spaces below, try to fill all the spaces even if you take a calculated guess! Please fill in the start time at the beginning and the time when you finish. Thank you!

START TIME	13
1	14
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	22
10	23
11	24
12	25

FINISH TIME _____



Hi!

Welcome to maptrix

My name is **Carto**, you'll see a lot of me around the **maptrix** programme. Want to know where it got its name? Well it could be from the matrix or grid of lines drawn over the maps to help you find the information you need or it could be from the tricks you'll learn from the programme to help you read maps.

Before getting into the programme itself, we would like to find out how much you already know about topographic maps. Please answer these questions. Try your best to complete the questions but rather leave the ones you are not sure of and come back to them at the end. If you are still not sure of the answer, please draw a line through the answer block.

Now have a close look at the map. If you know anything about South African geography, and I'm sure you do, you might think that the map is all wrong! The Drakensburg Mountains are definitely not so close to the sea. The Indian Ocean is off the east coast of South Africa and Lesotho is nowhere near the coast. Well it is a little strange. It has been made up specially from all the signs you would probably find on the latest series of South African topographic maps. It's really just a fun map and therefore just the right place to start working through the **maptrix** programme.

Please don't make any marks on the map itself. Your answers must be written on the prepared answer sheet. Please don't forget to write down the time when you start and finish.

Thank you for your help

Carto

Identify one transport feature shown in **black** in each of the following blocks.

1. I11
2. D15
3. E3
4. What are the black squares and rectangles in H9?
5. If you went to stay at Montana (C3-D3) in False Bay, what kind of holiday accommodation would be available?
6. Apart from the shop in New Era (C10-B10), name one other place where you could go and purchase some small items.
7. What is the unnamed feature associated with mining found in G10?
8. Name the feature stretching from A2 to E5.
9. What kind of construction is indicated along the transport feature in B6?
10. The blue line around Somerpunt (E1) is smooth, suggesting an even coastline, perhaps a beach. What does the black line around Stoney Point (G5) indicate?
11. The line between D5 and E5 is drawn over an area of crosses. What do these crosses indicate?
12. Name the site indicated in the unusual writing (Gothic script) in block C19.
13. How many dams are there in block C12?
14. In which of the following blocks does a non-perennial river occur, D10, I14 or B19?
15. What feature occupies the area between Mowbray Aerodrome (H9-H10) and Salt River Station (H10)?

H.5 (cont)

16. From where do the people at Raitlogae (I21) get their water?
17. In block D8 there is a man made weir across the river. What natural river feature can also be seen in this block?
18. Water is being drawn from the dam in G11, how does it reach the buildings in G9?
19. What height does the darker contour line in H19 indicate?
20. In which of the following blocks does a dry pan occur, C2, A2 or E21 ?
21. Serious soil erosion has occurred near Mentzdam (G14). In which block has most erosion occurred?
22. What kind of farming is done at Boschrant (H15)?
23. Of the two farms named Antrim in I11 and I12, the one with the water point is better protected from wind. What map evidence supports this statement?
24. Follow the green line which starts in A19 and name the conservation area which this boundary encloses.
25. What sign in G4 helps guide ships into the harbour?

H.6

maptrix

TEST E

Identify one transport feature shown in **black** in each of the following blocks.

1. F16
2. E11
3. A21
4. What are the black squares and rectangles in G9 and G10?
5. At Pumalanga (G20) most people are farmers. What building indicates that someone is making a living without farming?
6. Name the special function building in Salem (C21) where young people could go after school to get something to eat.
7. There are two similar unnamed features in F10 which are associated with mining, what are they?
8. What is the feature stretching from G9 to G10 used for?
9. What kind of construction is indicated along the transport feature in A6?
10. Which side of Bantry Bay would not be safe for swimming along the coast: the part in E4 or F4? In your answer give the block reference and in one word give the reason.
11. Which feature in block D18 shows that some of the original settlers in this area have abandoned their home?
12. What is indicated by the symbol in H12 which is labelled in unusual lettering (Gothic script) in H13?
13. Name the largest dam in the map area.
14. A confluence is where two rivers join. In which block does a non-perennial tributary join a perennial river: F13, I14 or D18?
15. What natural feature does the Brinkspruit flow through in I10?

H.6 (cont)

16. Clewer Agricultural Holdings (C5) is well supplied with water. Apart from a dam, river and wind pump, from where else do they draw water?
17. What feature occurs in the Vaal River in block B13?
18. A canal has been built to irrigate the farms near Mentzdam. This canal crosses a stream bed (in the corner of H15). Name the construction which makes this possible.
19. What height does the contour line in B20 indicate?
20. In which of the following blocks does a sandy river bed occur, B19, H18 or B1?
21. Although the Drakensburg is higher, Ntabende (D17) is rockier. Which conventional sign indicates this fact?
22. The farm Rotsvas (C9) produces grain and not fruit like the surrounding farms. What evidence from the map supports this statement?
23. What kind of vegetation grows in the Tugela valley along most of the river's course (C19 to I12)?
24. What sports facility is indicated in E8?
25. What is the sign in H6 which warns ships about the dangerous rocks?

H.7

maptrix

ANSWER SHEET

NAME _____

TEST S / E (PLEASE TICK WHICH ONE YOU WERE GIVEN)

Please fill in your answers in the spaces below, try to fill all the spaces even if you take a calculated guess! Please fill in the start time at the beginning and the time when you finish. Thank you!

START TIME	13
1	14
2	15
3	16
4	17
5	18
6	19
7	20
8	21
9	22
10	23
11	24
12	25

FINISH TIME _____

APPENDIX I

LETTER OF ENCOURAGEMENT

Report on mapawareness

I would like to express my greatest pleasure on my involvement in your research programme, Maptrix. I find the exercises so helpful on interpretation and analysis of maps. These exercises improved our feature and speed observations skills. This programme made me realise the importance and purpose of features on maps, you get to analyse and to know the area closely as possible [i.e different functions; activities; street patterns; etc.]

In my opinion the programme is essential and very helpful if implemented from lower level to curb the ignorance and illiteracy of maps in our communities. There should be means of reaching-out to the disadvantaged communities throughout the country to promote the programme and preach the gospel effectively. It is very easy to suggest Media but is not really a solution due to the fact that not everybody owns a TV set, Radio, or could afford to purchase newspapers due to economic factors [i.e taking unemployment into consideration]. There is quite a lot that I learn from this programme and I appreciate the development. Keep up the good work and revive the spirit of Map Literacy.

Forward with the "Action Programme Maptrix" Forward!!!! I thank you!

Yours faithfully
Allan Diniso

18/07/97


APPENDIX J - Summary of pupil data

Class 1 Pupil code	Pre Test		Post Test		Diff		Gain	Gender	Home Language	Age
	/24	%	/24	%	/24	%				
1	13.0	55	20.0	80	7.0	29	54	F	English only	15 years 9 months
2	12.0	50	22.0	92	10.0	42	83	F	English and Afrikaans	14 years 9 months
3	17.0	71	18.5	78	1.5	6	9	M	English only	16 years 3 months
4	10.0	42	20.5	86	10.5	44	105	M	English only	16 years 6 months
5	8.0	34	20.0	84	12.0	50	150	F	English only	15 years 3 months
6	9.0	39	17.0	71	8.0	34	89	M	English only	15 years 3 months
7	9.0	39	17.5	74	8.5	36	94	F	English and Afrikaans	15 years
8	18.0	76	20.0	84	2.0	8	11	M	English only	15 years 3 months
9	9.0	39	18.0	76	9.0	39	100	F	English only	15 years 3 months
10	3.0	13	16.5	69	13.5	57	450	F	English only	15 years 9 months
11	14.5	61	23.0	97	8.5	36	59	F	English and Afrikaans	15 years
12	8.0	34	17.5	74	9.5	40	119	F	English only	15 years
13	11.5	48	17.0	71	5.5	23	48	F	English and Afrikaans	15 years
14	6.5	27	12.5	53	6.0	25	92	F	English only	15 years 3 months
15	13.0	55	18.0	76	5.0	21	38	M	English only	15 years
16	14.0	59	21.5	90	7.5	32	54	F	English only	15 years 3 months
17	11.0	46	20.0	84	9.0	39	82	F	English and Afrikaans	15 years 3 months
18	10.5	44	18.5	78	8.0	34	76	M	English and Xhosa	13 years 9 months
19	7.5	32	8.0	34	9.5	2	127	F	English and Afrikaans	15 years 3 months
20	13.0	55	19.0	80	6.0	25	46	F	English and Afrikaans	16 years
21	14.5	61	23.0	97	8.5	36	59	F	English and German	14 years 9 months
22	11.0	46	15.0	63	4.0	17	36	F	English only	15 years
23	17.0	71	19.5	82	2.5	11	15	F	English only	15 years
24	16.0	67	16.0	67	0.0	0	0	F	English and Afrikaans	14 years 9 months
25	11.5	48	17.0	71	5.5	23	48	M	English and Xhosa	14
26	15.5	65	19.5	82	4.0	17	26	F	English and Afrikaans	14 years 6 months
27	9.0	39	17.0	71	8.0	34	89	F	English only	15 years
28	18.0	76	23.0	97	5.0	21	28	M	English and Afrikaans	15 years
29	10.0	42	16.5	69	6.5	27	65	M	English only	15 years 3 months
30	16.0	67	17.5	74	1.5	6	9	F	English only	15 years 3 months
31	10.0	42	19.0	80	9.0	39	90	F	English and Afrikaans	14 years 9 months
32	14.5	61	18.5	78	4.0	17	28	M	English and Afrikaans	15 years 3 months

APPENDIX J (cont.)

Class 1 (cont.) Pupil code	Pre Test		Post Test		Diff		Gain	Gender	Home Language	Age
	/24	%	/24	%	/24	%				
33	16.0	67	16.0	67	0.0	0	0	M	English and Afrikaans	15 years 6 months
34	14.0	59	13.0	76	4.0	17	29	F	English and Afrikaans	15 years 3 months
35	15.0	63	20.0	84	5.0	21	33	M	English and Afrikaans	14 years 9 months
36	9.5	40	16.5	69	7.0	29	74	M	English and Afrikaans	15 years 3 months
37	5.5	23	17.0	71	11.5	48	209	F	English and Afrikaans	15 years 3 months

Class 2 Pupil code	Pre Test		Post Test		Diff		Gain	Gender	Home Language	Age
	/24	%	/24	%	/24	%				
38	9.0	38	16.5	69	7.5	31	83	M	English and Afrikaans	15 years 3 months
39	12.0	50	16.0	67	4.0	17	33	M	English and Afrikaans	15 years
40	10.0	42	16.0	63	6.0	21	60	M	English and French	15 years 3 months
41	8.0	34	16.5	69	8.5	35	106	M	English and Afrikaans	15 years 3 months
42	4.5	19	12.5	53	8.0	34	178	M	English and Afrikaans	16 years 3 months
43	9.0	39	11.0	46	2.0	7	22	F	English and Afrikaans	15 years 3 months
44	10.5	44	17.0	71	6.5	27	62	M	English only	15 years 9 months
45	12.0	50	13.0	55	1.0	5	8	M	English only	15 years 3 months
46	7.5	32	13.0	55	5.5	23	73	F	English and Afrikaans	15 years
47	5.5	23	20.5	86	15.0	63	273	M	English only	17 years
48	5.0	21	12.0	50	7.0	29	140	F	English and Xhosa	17 years
49	5.0	21	10.0	42	5.0	21	100	M	Xhosa only	15 years 6 months
50	8.0	34	12.5	53	4.5	19	56	F	English and Xhosa	15 years 9 months
51	10.0	42	16.0	67	6.0	25	60	F	English and Xhosa	17 years
52	4.0	17	12.0	50	8.0	33	200	F	English and Xhosa	15 years 6 months
53	13.0	55	19.5	82	6.5	27	50	F	English and Xhosa	14 years 6 months
54	19.5	82	20.5	86	1.0	4	5	M	English and Afrikaans	15 years 9 months
55	8.5	36	13.0	55	4.5	19	53	F	English and Xhosa	17 years
56	6.5	27	6.0	25	-0.5	-2	-8	M	English and Xhosa	16 years 3 months
57	2.0	8	7.0	29	5.0	21	250	M	Xhosa only	16 years 9 months
58	10.5	44	18.0	76	7.5	32	71	F	English and Afrikaans	15 years 9 months
59	5.0	21	18.5	78	13.5	57	270	M	English and Afrikaans	15 years 3 months
60	10.5	44	15.0	63	4.5	19	43	M	Xhosa only	15 years 3 months
61	5.0	21	20.0	84	15.0	63	300	M	English and Afrikaans	14 years 9 months
62	5.0	21	11.0	46	6.0	25	120	F	English and Xhosa	16 years 3 months
63	3.5	15	11.5	48	8.0	33	229	F	Xhosa only	16 years

APPENDIX K - Time reduction for school trial

Pupil code	Pre-test				Post-test				Time reduction
	Answers		Time		Answers		Time		
	attempted	correct	actual	estimated	attempted	correct	actual	estimated	
1	18	13.0	23	30	24	20.0	19	19	11
2	18	12.0	23	30	24	22.0	23	23	7
3	24	17.0	23	23	24	18.5	21	21	2
4	16	10.0	23	34	24	20.5	31	31	3
5	24	8.0	23	23	24	20.0	15	15	8
6	24	9.0	23	23	24	17.0	22	22	1
7	18	9.0	23	30	24	17.5	25	25	5
8	24	18.0	23	23	24	20.0	20	20	3
9	19	9.0	23	29	24	18.0	25	25	4
10	15	3.0	23	36	24	16.5	27	27	9
11	20	14.5	23	27	24	23.0	19	19	8
12	16	6.0	23	34	24	17.5	30	30	4
13	22	11.5	23	25	24	17.0	23	23	2
14	24	6.5	23	23	24	12.5	25	25	-2
15	22	13.0	23	25	24	18.0	23	23	2
16	24	14.0	23	23	24	21.5	20	20	3
17	18	11.0	23	30	24	20.0	18	18	12
18	24	10.5	23	23	24	18.5	22	22	1
19	24	7.5	23	23	24	8.0	15	15	8
20	24	13.0	23	23	24	19.0	20	20	3
21	24	14.5	23	23	24	23.0	20	20	3
22	22	11.0	23	25	24	15.0	25	25	0
23	24	17.0	26	26	24	19.5	20	20	6
24	24	16.0	23	23	24	16.0	20	20	3
25	18	11.5	23	30	24	17.0	27	27	3
26	20	15.5	23	27	24	19.5	22	22	5
27	24	9.0	19	19	24	17.0	16	16	3
28	24	18.0	20	20	24	23.0	17	17	3
29	22	10.0	23	25	24	16.5	20	20	5
30	24	16.0	22	22	24	17.5	20	20	2
31	19	10.0	23	29	24	19.0	18	18	11
32	24	14.5	23	23	24	18.5	20	20	3
33	24	16.0	23	23	24	16.0	17	17	6
34	24	14.0	23	23	24	18.0	20	20	3
35	24	15.0	20	20	24	20.0	17	17	3
36	18	9.5	23	30	24	16.5	22	22	8
37	22	5.5	23	25	24	17.0	25	25	0
38	16	9.0	25	37	24	16.5	29	29	8
39	24	12.0	25	25	34	16.0	27	27	-2
40	13	10.0	25	46	24	15.0	26	26	20
41	17	8.0	25	35	24	16.5	19	19	16
42	16	4.5	25	37	24	12.5	29	29	8
43	16	9.0	25	37	24	11.0	29	29	8
44	21	10.5	25	28	24	17.0	27	27	1
45	24	12.0	25	25	24	13.0	25	25	0
46	22	7.5	28	30	24	13.0	25	25	5
47	15	5.5	25	40	24	20.5	28	28	12
48	16	5.0	25	37	22	12.0	28	30	7
49	24	5.0	25	25	24	10.0	25	25	0
50	15	8.0	25	40	24	12.5	29	29	11

APPENDIX K (cont)

	Pre-test				Post-test				
Pupil	Answers		Time		Answers		Time		
code	attempted	correct	actual	estimated	attempted	correct	actual	estimated	reduction
51	17	10.0	25	35	24	16.0	24	24	11
52	24	4.0	25	25	24	12.0	29	29	-4
53	24	13.0	23	23	24	19.5	24	24	-1
54	24	19.5	25	25	24	20.5	24	24	1
55	18	8.5	25	33	24	13.0	28	28	5
56	24	6.5	26	26	24	6.0	28	28	-2
57	12	2.0	25	50	17	7.0	28	39	11
58	21	10.5	25	28	24	18.0	24	24	4
59	16	5.0	25	37	24	18.5	25	25	12
60	24	10.5	25	25	24	15.0	24	24	1
61	19	6.0	25	31	24	20.0	24	24	7
62	15	5.0	25	40	24	11.0	25	25	15
63	17	3.5	25	35	24	11.5	28	28	7
sum	1293	648.5	1495	1805	1513	1047.5	1470	1483	322
mean	20.5	10.3	23.7	28.7	24.0	16.6	23.3	23.5	5.1
std.dev	3.6	4.2	1.5	6.6	1.6	3.8	4.1	4.5	4.8
min	12.0	2.0	19.0	19.0	17.0	6.0	15.0	15.0	-4.0
max	24.0	19.5	28.0	50.0	34.0	23.0	31.0	39.0	20.0

APPENDIX L - Exercise analysis

Pupil code	Hearts										Spades										Diamonds										Clubs										n		
	A	2	3	4	5	6	7	8	9	10	J	Q	K	A	2	3	4	5	6	7	8	9	10	J	Q	K	A	2	3	4	5	6	7	8	9	10	J	Q	K				
1					4			9					9																												9		
2	8					5	8																																		10		
3																																										8	
4	7																																									5	
5		7							10					9		8	6																									12	
6			7	6									8																													11	
7		8				5							9		5		6																									10	
8									10	10																															7		
9						8							5																													10	
10										6				9		7																									7		
11														9																												11	
12																																										10	
13	8												9																													13	
14					4				5				9																													7	
15		9													9	10																										13	
16			8										8																													11	
17	10	9																																								9	
18						8							9																													10	
19													9																													9	
20					3				7																																	12	
21																																											12
22																																											11
23	7																																										16
24	10																																										10
25					7	7							6																													9	
26						8																																					12
27			7	8																																							13
28																																											10
29			4	6																																						9	
30																																											10
31	8					5																																				9	
32	7																																										12
Mean	8	8	7	7	6	7	8	8	9	7	8	9	9	8	7	8	6	6	7	8	7	8	8	8	8	8	8	8	7	9	8	8	9	8	9	8	9	9	7	9	9	Sub.	

APPENDIX L (cont)

APPENDIX M.1 - Question analysis (Hearts)

Wrong Answer Frequency for 2 Hearts										
Question number	1	2	3	4	5	6	7	8	9	10
	1	0	1	1	1	1	1	1	1	1
	1	1	1	0	1	1	1	1	1	1
	1	0	1	1	1	0	1	1	1	1
	1	0	1	0	1	0	1	1	1	0
	1	0	1	1	1	0	1	1	1	0
	1	0	1	1	1	0	1	1	1	1
	1	0	1	1	1	0	1	1	1	0
	1	0	1	1	1	0	1	1	1	1
	1	0	1	0	1	0	0	1	0	0
	1	0	1	0	1	1	0	1	0	0
	1	0	1	1	0	1	0	1	1	1
	1	1	1	1	1	1	0	1	1	1
	1	0	1	1	0	0	1	1	0	0
	1	1	1	0	1	0	1	1	1	0
	1	0	1	1	1	0	1	1	1	0
	1	1	1	0	1	1	1	1	1	1
Total Correct:	16	4	16	10	14	6	12	16	13	8
Total Incorrect:	0	12	0	6	2	10	4	0	3	8
Percentage Error:	0	75	0	37.5	12.5	62.5	25	0	18.75	50

Wrong Answer Frequency for 5 Hearts										
Question number	1	2	3	4	5	6	7	8	9	10
	1	1	1	0	1	1	1	0	0	1
	1	1	0	1	1	0	1	1	1	1
	1	1	1	1	1	0	0	1	1	1
	1	1	0	1	1	1	1	1	1	1
	1	1	1	1	1	1	0	1	1	1
	1	1	0	1	0	1	1	0	1	1
	0	0	1	0	0	1	1	0	0	0
	0	1	0	1	1	0	1	0	0	0
	1	1	1	0	0	0	1	0	1	0
	1	1	0	0	1	1	1	0	1	1
	0	1	0	1	0	1	0	0	1	1
	0	1	0	0	0	1	1	0	0	0
Total Correct:	8	11	5	7	8	8	9	4	8	8
Total Incorrect:	4	1	7	5	4	4	3	8	4	4
Percentage Error:	33.3	8.3	58.3	41.7	33.3	33.3	25.0	66.7	33.3	33.3

Wrong Answer Frequency for King of Hearts										
Question number	1	2	3	4	5	6	7	8	9	10
	1	1	1	1	1	1	1	1	1	1
	0	1	1	0	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	0
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	0	1
	1	1	1	1	0	1	1	0	1	1
	1	1	1	1	1	1	1	0	1	1
	1	0	1	1	1	1	1	0	0	1
	1	1	1	1	1	0	1	0	1	1
	1	1	1	1	1	1	1	1	0	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	0
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	0
Total Correct:	13	13	14	13	13	13	14	10	11	11
Total Incorrect:	1	1	0	1	1	1	0	4	3	3
Percentage Error:	7.14	7.14	0.00	7.14	7.14	7.14	0.00	28.57	21.43	21.43

APPENDIX M.2 - Question analysis (Spades)

Wrong Answer Frequency for 2 Spades										
Question number	1	2	3	4	5	6	7	8	9	10
	0	1	1	1	1	0	1	0	0	0
	0	1	1	0	1	1	1	1	1	1
	0	1	1	1	0	1	0	0	1	1
	1	1	1	1	1	1	1	1	1	1
	1	0	1	0	0	0	0	0	0	0
	0	1	1	0	1	1	1	1	1	1
	1	1	1	1	0	0	1	0	1	1
	1	1	1	0	0	1	1	0	0	0
	1	1	1	1	1	1	1	1	1	0
	1	1	1	1	1	1	1	0	1	1
	1	0	1	1	0	1	0	1	1	1
	1	1	0	1	1	1	1	1	0	0
Total Correct:	8	10	11	8	7	9	9	6	8	7
Total Incorrect:	4	2	1	4	5	3	3	6	4	5
Percentage Error:	33.3	16.7	8.3	33.3	41.7	25.0	25.0	50.0	33.3	41.7

Wrong Answer frequency for 3 Spades										
Question number	1	2	3	4	5	6	7	8	9	10
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	0	1	1	0	0	0
	1	1	1	1	1	1	1	1	1	0
	0	1	1	1	1	1	0	0	0	1
	0	1	1	1	0	1	1	0	0	0
	0	1	1	0	1	1	0	1	1	1
	1	1	0	1	1	1	0	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	0	1	1
	0	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	0	0
	1	1	1	1	1	1	1	1	0	1
	1	1	1	0	0	1	1	0	0	0
	1	0	1	1	1	1	0	1	1	0
Total Correct:	11	14	14	13	12	15	11	10	9	9
Total Incorrect	4	1	1	2	3	0	4	5	6	6
Percentage Error:	26.7	6.7	6.7	13.3	20.0	0.0	26.7	33.3	40.0	40.0

Wrong Answer Frequency for Jack of Spades										
Question number	1	2	3	4	5	6	7	8	9	10
	1	1	1	1	1	1	1	0	1	1
	1	1	1	1	1	1	0	0	1	1
	1	1	1	1	1	1	1	1	1	0
	1	1	1	1	1	1	0	0	0	1
	1	1	1	1	0	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	0	0	0
	1	1	1	1	1	0	0	1	0	0
	0	1	1	0	1	0	1	1	1	1
	1	1	1	1	1	1	0	0	1	1
	1	1	1	1	1	1	1	1	1	1
Total Correct:	10	11	11	10	10	9	7	6	8	8
Total Incorrect	1	0	0	1	1	2	4	5	3	3
Percentage Error:	9.1	0.0	0.0	9.1	9.1	18.2	36.4	45.5	27.3	27.3

APPENDIX M.3 - Question analysis (Diamonds)

Wrong Answer Frequency for 2 Diamonds										
Question number	1	2	3	4	5	6	7	8	9	10
	1	0	1	1	1	0	0	1	1	0
	1	1	1	1	1	1	1	1	1	0
	1	0	0	1	1	1	1	0	1	1
	1	0	1	1	1	1	0	0	1	1
	1	1	0	1	1	1	1	1	1	0
	1	1	1	1	1	1	1	1	1	1
	1	1	1	0	0	0	0	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	0	0	1	0	0	0
	1	1	1	1	0	1	1	1	1	1
	1	1	0	1	1	1	1	1	1	1
	1	1	1	1	1	0	0	1	1	1
	1	1	1	1	1	1	0	0	1	1
	1	1	1	1	0	0	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
Total Correct:	15	12	12	14	11	10	10	11	14	11
Total Incorrect:	0	3	3	1	4	5	5	4	1	4
Percentage Error:	0.0	20.0	20.0	6.7	26.7	33.3	33.3	26.7	6.7	26.7

Wrong Answer Frequency for 3 Diamonds										
Question number	1	2	3	4	5	6	7	8	9	10
	1	0	1	0	1	1	1	1	1	1
	1	1	1	1	1	1	1	0	0	0
	1	0	0	1	0	1	1	1	1	1
	1	0	0	0	1	1	1	0	1	1
	0	0	0	0	1	1	1	1	1	1
	1	0	1	0	1	1	1	0	1	1
	1	1	1	0	1	1	0	1	1	1
	0	0	1	0	1	1	1	0	0	0
	1	0	1	1	1	1	0	0	1	1
	1	1	0	0	1	1	1	1	1	1
	1	0	1	0	1	1	1	1	1	1
	1	0	0	1	1	1	1	1	1	0
	1	0	0	0	1	1	1	1	0	1
	1	0	0	1	1	1	0	1	1	1
	1	0	0	0	1	1	1	0	1	1
	1	0	1	0	1	1	1	1	1	1
	1	0	0	1	1	0	0	1	1	1
Total Correct:	15	3	8	6	16	16	13	11	14	14
Total Incorrect:	2	14	9	11	1	1	4	6	3	3
Percentage Error:	11.8	82.4	52.9	64.7	5.9	5.9	23.5	35.3	17.6	17.6

APPENDIX M.3 (cont.)

Wrong Answer Frequency for Ace of Diamonds										
Question numbers	1	2	3	4	5	6	7	8	9	10
	1	1	1	0	1	0	0	1	1	1
	1	1	1	0	1	1	1	1	1	0
	1	1	0	1	1	0	1	1	1	1
	1	1	0	0	1	1	1	1	1	0
	0	1	1	1	1	1	1	1	1	0
	1	1	1	0	1	0	1	1	1	0
	1	1	1	0	0	0	1	0	0	1
	1	0	1	1	0	0	0	0	0	0
	1	0	1	1	1	1	0	0	0	1
	0	1	1	1	1	1	0	1	1	0
	1	1	0	1	1	0	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	0
	1	1	1	0	1	1	1	1	0	1
	1	1	0	0	0	0	1	1	1	1
Total Correct:	14	14	12	9	13	9	12	13	12	9
Total Incorrect	2	2	4	7	3	7	4	3	4	7
Percentage Error:	12.5	12.5	25.0	43.8	18.8	43.8	25.0	18.8	25.0	43.8

APPENDIX M.4 - Question analysis (Clubs)

Wrong Answer Frequency for 6 Clubs										
Question numbers	1	2	3	4	5	6	7	8	9	10
	1	1	1	1	1	1	1	0	0	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	0	1	1	1	1	1
	1	1	1	0	1	1	1	1	0	1
	1	1	1	1	1	1	1	1	1	1
	1	0	0	1	0	1	1	0	0	0
	1	1	1	1	0	1	1	1	1	1
	1	1	1	1	1	1	0	0	0	0
	1	0	1	1	0	1	1	0	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	0	1
Total Correct	11	9	10	10	7	11	10	7	6	9
Total Incorrect	0	2	1	1	4	0	1	4	5	2
Percentage Error	0.0	18.2	9.1	9.1	36.4	0.0	9.1	36.4	45.5	18.2

Wrong Answer Frequency for 9 Clubs										
Question numbers	1	2	3	4	5	6	7	8	9	10
	0	1	1	1	1	1	0	1	1	1
	1	1	1	1	1	1	1	0	1	1
	0	1	1	1	0	1	1	1	1	1
	0	1	1	0	1	1	0	0	1	0
	1	1	1	1	1	1	1	1	1	0
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	0	0	0	0
	1	1	1	1	1	1	1	0	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	0
	1	1	1	1	1	1	1	0	1	1
	1	1	1	1	1	1	1	1	1	0
Total Correct	9	12	12	11	11	12	9	7	11	7
Total Incorrect	3	0	0	1	1	0	3	5	1	5
Percentage Error	25.0	0.0	0.0	8.3	8.3	0.0	25.0	41.7	8.3	41.7

Wrong Answer Frequency for Queen of Clubs										
Question numbers	1	2	3	4	5	6	7	8	9	10
	1	1	1	1	0	1	1	1	1	0
	1	1	1	1	1	0	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	0	1	1	0	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	0	1	1	1	1	1
	1	1	1	1	0	1	0	1	1	1
	1	1	1	1	1	1	1	1	1	1
	0	1	1	1	1	1	0	0	1	1
	1	1	1	1	0	1	1	1	1	1
	1	1	1	1	1	1	1	1	1	1
	1	1	1	1	1	0	1	1	1	1
	1	1	1	1	0	1	1	1	1	1
	1	1	1	1	0	1	1	0	1	1
Total Correct:	14	15	15	15	8	13	13	12	15	14
Total Incorrect:	1	0	0	0	7	2	2	3	0	1
Percentage Error:	6.7	0.0	0.0	0.0	46.7	13.3	13.3	20.0	0.0	6.7

Author Innes L M

Name of thesis Learning To Read The South African 1:50 000 Topographic Map: The Development Of A Self-Instruction Method Innes L M 1998

PUBLISHER:

University of the Witwatersrand, Johannesburg

©2013

LEGAL NOTICES:

Copyright Notice: All materials on the University of the Witwatersrand, Johannesburg Library website are protected by South African copyright law and may not be distributed, transmitted, displayed, or otherwise published in any format, without the prior written permission of the copyright owner.

Disclaimer and Terms of Use: Provided that you maintain all copyright and other notices contained therein, you may download material (one machine readable copy and one print copy per page) for your personal and/or educational non-commercial use only.

The University of the Witwatersrand, Johannesburg, is not responsible for any errors or omissions and excludes any and all liability for any errors in or omissions from the information on the Library website.