

**INTEGRATING ROAD TRAFFIC SAFETY EDUCATION IN
THE TEACHING AND LEARNING OF SCIENCE AND
TECHNOLOGY**

BY

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DEDICATION

This thesis is dedicated to the following persons:

- The Holy Trinity (God the Father, Son, and Holy Spirit).
- Evangelist (*late: died on 09-02-2004 as this study was being finalised*) and Mrs S.I. Aungwa, who gave birth to me, loved me, raised me, sent me to school, and encouraged me to go through the most critical stages of the academic path.
- My Elder brothers Dave and Joseph (*late: died on 29-01-1988*) who set good examples to me in life.

Mama Esther Ntshabele, who has been a mother with a difference. A grandmother to my Son Isaiah Tumelo and Daughter Mercy Tshiamo.

- My wife – Valencia whose love and support to me cannot appropriately and sufficiently be expressed in words. Without her in my life, life would have (probably) not been what it is to me today. *I am talking here about a woman (who perhaps outweighs the woman) outlined in Proverbs 31.*
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May God Almighty - the Father of our Saviour Jesus Christ, bless you all in Jesus' name *Amen*.

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ABSTRACT

The title of the study is *integrating road traffic safety education in the teaching and learning of science and technology*. The overall goal of this study was to develop a tool for the integration of Traffic Safety Education (TSE) in the teaching and learning of Science and Technology in School. As such, four research questions (stated in 1.2.1 to 1.2.5) were raised on critical aspects of the problem so as to direct the course of the study to provide solutions to the problem. These research questions were formulated into the aims of the study as stated in section 1.3. To attain these aims, a *literature study* and *interviews* were conducted.

Through interviews and a literature study, it was found (among other things) that:

- TSE has great potential for the reduction of road accidents/collisions, and its teaching in school will prepare our learners to be safe road users.
- Science and Technology has tremendous impact on traffic safety, and the three have much in common, which does provide room for them to be integrated in school curricula.
- School educators are not adequately equipped to integrate TSE in the different learning areas.

Consequently, *an integration model called "Multilateral learning area integration model" has been developed for the integration of TSE in the learning areas of natural science and technology (see 7.2 and 7.3 for details).*

Eleven recommendations were made in section 8.4 on the basis of the conclusions (in section 8.3) drawn from the proceedings of interviews and the literature study. These recommendations if implemented accurately, would undoubtedly contribute to solving the problem investigated in the study.

This study has therefore made a valuable contribution to laying a solid foundation for combating the problem of high road accidents/collisions on South Africa roads.

Key concepts: Integration, Traffic, Safety, Education, Science, Technology, Teaching, Science teaching, Learning, Learning areas, Curriculum, Outcomes-Based Education, Road Safety, Traffic Safety, Traffic Safety Education.

OPSOMMING

Die titel van hierdie studie is die integrering van verkeersveiligheidsopvoeding in die leerareas van natuurwetenskap en tegnologie. Die oorhoofse doel van hierdie studie was die ontwikkeling van 'n instrument vir die integrering van Verkeersveiligheidsopvoeding (VVO) in die onderwys en onderrig van Wetenskap en Tegnologie op Skool. As sulks, is vier navorsingsvrae (gestel in 1.2.1 tot 1.2.5) geopper oor kritieke aspekte van die probleem om die rigting van hierdie studie so te rig dat dit oplossings sou verleen aan die gestelde probleem. Hierdie navorsingsvrae was geformuleer binne die doelwitte soos gestel in afdeling 1.3. Om hierdie doelwitte te kon bereik is 'n literatuurstudie gedoen en onderhoude gevoer.

Deur middel van onderhoude en 'n literatuurstudie is dit bevind (onder andere) dat:

- VVO groot potensiaal het vir die vermindering van padongelukke/botsings en die onderrig op skool sal die leerders voorberei om veilige padgebruikers te wees.
- Wetenskap en Tegnologie het 'n geweldige impak op verkeersveiligheid, en die drie het baie in gemeen, wat die ruimte laat dat hulle geïntegreer kan word op skool.

- Onderwysers is nie toepaslik toegerus om VVO in die verskillende leerareas op skool te integreer nie. Gevolglik, is 'n integrasiemodel genaamd "Multilaterale leerarea integrasie model" ontwikkel vir die integrasie van VVO in die leerareas van natuurwetenskap en tegnologie (sien 7.2 en 7.3 vir besonderhede).

Elf aanbevelings is in afdeling 8.4 gemaak op grond van die onderhoude en die literatuurstudie.

Hierdie aanbevelings, indien behoorlike geïmplimenteer, sal sonder twyfel bydra tot die oplossing van die probleem soos ondersoek is in hierdie studie.

Hierdie studie lewer daarom 'n waardevolle bydrae tot die lê van 'n stewige fondament vir die bekamping van die probleem van hoë padongelukke/botsings op Suid-Afrikaanse paaie.

Trefwoorde: Integrasie, Verkeer, Veiligheid, Opvoeding, Wetenskap, Tegnologie, Onderrig, Wetenskaponderrig, Leer, Leerarea, Kurrikulum, Uitkomstgerigte Onderwys, Padveiligheid, Verkeersveiligheid, Verkeersveiligheidsopvoeding.

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CHAPTER ONE

1. ORIENTATION TO THE STUDY

This study was geared towards establishing common grounds or aspects among science, technology and road traffic for the purpose of integrating traffic safety education in the teaching and learning of natural science and technology in schools. In this chapter, the problem being researched and the need to research it are stated. Also, the questions that were posed to be answered (1.2.1 to 1.2.5), the aims that have been set to be attained with the study (1.3.1 to 1.3.5), and the method of research that was utilised towards the achievement of the aims are outlined in 1.4. Furthermore, the key concepts of the study were operationalised in 1.5 with the intention to facilitate understanding, focus arguments, and draw scientific lines pointing to the desired and or possible solutions to the problems addressed. Finally, a preview of the contents of the other five chapters was given in 1.6.

1.1 Background and problem statement

The escalating death toll, injuries, and carnage due to road traffic accidents on South African roads (annually) are a point of concern. Trinca *et al.*, (1988:10) state that a high vehicle-based death and injury rate indicates a low level of traffic safety (awareness, knowledge) in a society. Looking at the death and injury rate caused by road traffic accidents; it is appropriate to say that South Africa has a low level of traffic safety (awareness and knowledge). According to the Road Traffic Safety Foundation (1998:2.1),

in the five years 1988, 1993, 1996, 1997 and 1998, a total of 2 390 880 collisions were recorded. Of these collisions, 48 768 were classified as fatalities and 611 844 as injuries (of different levels of severity). In addition, 1 965 114 vehicles underwent damages of various kinds. Notwithstanding, the cost of traffic accidents in 1998 alone amounted to R13 446 million (Road Traffic Safety Foundation, 1998:2.1). Several factors such as substance abuse, driving/using the road under influence of alcohol, fatigue, road rage, ignorance of traffic rules, negligence, environmental and or weather conditions have consistently been suggested as causes of these road traffic accidents (Economic Commission for Africa, 1997:56). Seemingly, nothing is being done about the absence of a comprehensive educational strategy for the teaching and learning of traffic safety education in the South African school curricula which, is another major set-back for the lack of proper knowledge, skills, and positive attitudes required for safer road usage. Various control measures such as engineering measures, traffic policing, law enforcement, legislative measures and mass media related measures (Department of Transport, 1997:6) are being taken but without substantial results – as evident in the statistics given above. It is therefore imperative that until a comprehensive educational approach regarding road traffic safety is instituted in the country's education system this problem may not be adequately addressed.

Notwithstanding the above, Alston (1999), Bester and Du Preez (1999), Labuschagne and Vanderschuren (1999) indicate that technological advancements (for example, traffic technology, communication systems - cell-phones - and road infrastructure) aimed at improving transportation are opposed by the lag in apposite knowledge and skills of road users. A situation that seemingly becomes contributory to the road traffic accidents that

are occurring in South Africa. This situation is apparent in view of the swifter vehicles, good road network, travelling at very high speeds, traffic congestion, complex road environment and facilities that require competency in order to use them properly and safely. The unfortunate thing however, is the lack or absence of adequate education that would equip road users to cope adequately with the increasing complex road traffic situation. The gap between technology advancement, knowledge and skills seem to be contributing to more road traffic accidents. Road traffic accidents therefore seem to have become like one of the epidemics, which is claiming lives. *One of the great challenges in this regard which, faces all road users, policy makers, road traffic management, and educators is that of curbing this carnage and thereby instilling a high degree of safety on roads.* Part of the solution could be the giving of apposite attention to the need of vigorously educating road users (by means of a systematic educational approach which targets behaviour modification) regarding safe road usage (Trinca, *et al.*, 1988; Economic Commission for Africa, 1997:67). The vigorous educating of road users as intended here would imply utilising every viable opportunity, for example, educational structures which are in place that would effectively educate people towards safe participation in traffic situations. One such a structure is the school educational institutions. In the structures of educational institutions, traffic safety education can be integrated within all eight learning areas in order to reach all the children who are at school – a good percentage of the South African population. The approaches of educational institutions will help in educating a new generation of safe road users and thereby minimise deaths on roads due to road traffic accidents. The idea of providing a solution to the problem of road traffic accidents via the teaching and learning of traffic safety education in schools tallies with the recommendation of the

Economic Commission for Africa (1997) that “road safety should be a separate, graded subject at all schools”.

Why is the teaching and learning of traffic safety education in schools considered as part of the solution to the problem of road traffic accidents? Traffic safety education needs to be taught in schools due to its significance for the inculcation of the knowledge, skills and attitudes needed in safe use of the road. Irrespective of the different opinions that people hold about the issue of teaching road safety education in schools, road traffic safety skills are for everybody and they need to be learnt just like other life skills. Iornengen (2000:5) asserts that some people “think that knowledge of traffic safety belongs only to those who engage it as a profession, or those involved in law enforcement and the like; but this is a misconception. Participating in traffic situations without the required knowledge, skills and attitudes is a dreaded risk that no normal human being should dare take. As one of the life skills, traffic safety skills are essential for people in all sectors of life.”

Iornengen (2000:5) states further that “it is a fact that every human being who is a road user – irrespective of profession or career, level of knowledge or qualification – has to participate safely in traffic situations. This can only be achieved through education and training that emphasises the acquisition of the skills, knowledge and attitudes that are necessary for safe participation in traffic.” There is a need for us to promote traffic safety in all spheres of both the public and the private sectors in order to empower road users for safer road usage (Aaronsohn, 2003:146; Iornengen, 2000:5; Ruben, 2004:85-86). This view has implications for the teaching of traffic safety education in schools just like other subjects or at least its inclusion through integration.

Another reason for the need to teach and learn traffic safety education in school is rooted in research findings. Research (International Road Federation, 1986:110-117) indicate that in countries such as the United States of America (USA), Great Britain, Denmark, Finland, Norway etcetera, the death toll and injuries due to road traffic accidents are very low. The reason for the low accident rate, according to the research, is attributed to the fact that in these countries, road safety education is taught in schools and is a compulsory part of school curricula (International Road Federation, 1986:110).

Given the degree of success with teaching and learning of traffic safety education as a compulsory component of the school curriculum as experienced in other countries, {for example, traffic safety education programmes are integrated into the secondary school curriculum and the impact is evident (Giummarra, 2003)}, it is imperative that something similar should occur in South Africa. Unfortunately, in South Africa, road traffic safety (education) is not one of the school subjects or learning areas (Department of Education, 1997:9). However, it is important that traffic safety education be taught to all our young people so that they can participate safely in road traffic situations (Economic Commission for Africa, 1997). One of the questions that comes to mind at this juncture is why and *how can road traffic safety be taught in South African schools?* Providing good answers to this question (within the South African context of education system) could favour the integration of road traffic safety in the teaching and learning of school subjects or learning areas. Considering integration as part of the solution towards addressing road traffic accidents however, *leads one to the question of why and how traffic safety education be integrated in school subjects or learning areas in a way that achieves the aims with traffic safety education in*

South Africa? It is in this consideration that the *idea and effort* to do this study emanated in order to come up with concrete techniques or dimensions for the integration.

Furthermore, the choice of natural science and technology learning areas for this study is strategic. That is, the role that science and technology plays in our country's road traffic environment and the safety thereof that is crucial as a basis for their integration. It is evident and acceptable that the influence of science and technology seemingly permeates all spheres of life. There is hardly any activity of human beings that is isolated from science and or technology. The foregoing is eminent in transportation activities, road design and construction, medical practices, agricultural endeavours, schooling, industrial techniques and approaches, entertainment methods, which are facilitated and or made successful by science and technology (Bendtsen & Larsen, 1999:14-16; Borrás, 2001:55-59; Elvik *et al.*, 1999:4-5; Johansson & Nilsson, 1999:9-11). However, the extent to which science and technology hold an influential grip on individual and or collective sector(s) of life remains apparent. Against this background, it would be appropriate to consider the question: *to what extent do the teaching and learning of science and technology impact on road traffic safety and vice versa? How does participation in (or the practice of) road traffic influence technological methods for the practice of traffic technology and science? How do the natures of science, technology, and road traffic safety inform one another? What elements, aspects or features of science, technology, and road traffic inform one another?*

The researcher contended that answers to these questions would shed some light on aspects that were vital (Leonard, 2003:41) regarding how traffic safety education should

be integrated in the teaching and learning of the learning areas of natural science and technology.

This study was therefore a response to the need of providing suggestions and guidelines for integrating traffic safety education in the teaching and learning of the learning areas of natural science and technology. It was therefore paramount to investigate the relationships that exist among road traffic safety, technology and science towards establishing grounds or pillars for their integration. To this end, the questions that came to the fore were presented in section 1.2.

1.2 Research questions

The questions that this study addressed were:

- 1.2.1 What relationship exists among science, technology and traffic safety upon which integration of traffic safety education could be based?
- 1.2.2 What impact has science and technology on traffic safety?
- 1.2.3 Which strategies could be used to integrate traffic safety education in the learning areas of natural science and technology?
- 1.2.4 Are there any hindrances to the integration of traffic safety education in the mainstream school curriculum? and
- 1.2.5 How and why should traffic safety education be integrated in the learning areas of natural science and technology?

These research questions were in turn formulated into the aims of the study as in 1.3.

1.3 Aims of the study

The aims of this study were to:

- 1.3.1 Determine the relationship that exists among science, technology and traffic safety that can warrant their integration.
- 1.3.2 Outline the impact of science and technology on traffic safety.
- 1.3.3 Discuss strategies that could be used for integrating traffic safety education in the learning areas of science and technology.
- 1.3.4 Establish whether or not there are hindrances to the integration of traffic safety education in the mainstream school curriculum, and
- 1.3.5 Develop an integration model, which indicates how traffic safety education should be integrated in the learning areas of natural science and technology.

In order to attain these aims, the methodology outlined in 1.4 was selected.

1.4 Methodology

The methodology of this study entailed the following components:

1.4.1 *Literature study*

A thorough literature study was done to acquire understanding of the main concepts under study (see section 1.5). To achieve this, all the available data bases (both national and international) were consulted during the study, for example, the NEXUS, SABINET - On-line, the EBSCOHost web and various other web-based sources as well as a DIALOG search were conducted to gather recent (from 1990-2004) studies on the subject. The following key concepts/words were used in the search: Integration, Traffic, Safety,

Education, Science, Technology, Teaching, Science teaching, Learning, Learning area, Curriculum, Outcomes-Based Education (OBE), Road Safety, Traffic Safety, Traffic Safety Education.

It ought to be mentioned that an on-line computer (internet search) was conducted (in 2001, 2002, 2003 & 2004) on the mentioned key words and only very few articles and other sources were found. This is probably due to the specialised nature of the field in the sense that very few academics engage this field and as such very insignificant number of scientific research is done and published as compared to other fields like engineering and normal education specialisations. Especially, on the topic of this study, there is no evidence in scientific literature explored of similar studies conducted on it and this state of affairs clearly explains the scarcity of scientific sources on the topic on the internet/web.

The curricula or Outcomes-Based Education oriented syllabi of the learning areas of natural science and technology was also done. That is, the national curriculum statements and policy were analysed to determine how road traffic safety, science and technology intertwine, and to ascertain whether or not they provide for the integration or co-option of Traffic Safety Education in classroom/laboratory.

1.4.2 Population

The study planned nine focus group interviews of which only seven materialised (see section 5.8 for the reasons why only 7 focus group interviews instead of 9 were held). The plan was to hold one focus group interview in each of the 9 provinces of South Africa (see Table 1.1 below for a list of provinces). Each focus group interview was to consist of four interviewees (two persons each from the Departments of Transport and Education), as

such a total number of 28 persons (N=28) were interviewed. These persons were chosen from the ranks of:

- Curriculum specialists (7 in total were interviewed).
- Subject advisors of the natural science, technology and life orientation learning areas (7 in total were involved in the focus group interviews).
- Road Safety directors/managers (7 directors and 7 managers took part in the study).

The nine (9) provinces of South Africa are listed in an alphabetical order on Table 1.1 below.

Table 1.1 List of the provinces of South Africa

<i>S/No</i>	<i>Name of province</i>	<i>S/No</i>	<i>Name of province</i>
1	Eastern Cape	6	Mpumalanga
2	Free State	7	Northern Cape
3	Gauteng	8	North West
4	KwaZulu Natal	9	Western Cape
5	Limpopo		

1.4.3 Interviews

Leedy and Olmrod (2001) state that in qualitative studies the interview format is either open-ended or semi-structured. As such, semi-structured qualitative interviews based on the designed interview schedule (see Appendix B for the interview schedule) were conducted in the form of an open-ended format - asking the same set of questions in the same sequence and wording to each group of interviewees in senior positions (such as

directors, managers, and subject specialists in the fields of technology, natural science, life orientation, and traffic safety education) in the Departments of Education and Transport towards determining how traffic safety education can be integrated in natural science and technology. Also, these interviews helped in ascertaining the hindrances to the integration of road safety education in schools, for example, the extent to which in-service educators, educators and curriculum developers have been prepared/equipped to handle the integration. As stated in section 1.4.2, nine focus group interviews were to be conducted of which only seven took place due to reasons stated in section 5.8. These focus group interviews in the provinces set valid grounds for generalisation of the findings of the study for the whole of South Africa.

1.5 Introduction to the key concepts of the study

1.5.1 Prologue

It is important to provide (at least) a working definition for the key concepts used in the study. However, many of the key concepts that are (assumed to be) used frequently and are easily identifiable with the general public, especially, within the education community (such as *education, teaching, learning, curriculum, science teaching*) – have not been included in the concept definition. This means, only terms that are assumed to be relatively unfamiliar to the general public are given attention under 1.5.

In the process of presenting working definitions, some selected definitions offered by different authorities as pertain the concepts in question were studied and analysed. These

were done in a way that supports the line of arguments in the study. The concepts considered to be requiring working definition were defined in section 1.5.2 to 1.5.6.

1.5.2 *Integration*

Integration is the noun form of the verb “integrate”. The Oxford Advanced Learner’s Dictionary of current English (OALD, 1995:620) provides two meanings to the word “integrate”. The first meaning is “to combine two things in such a way that one becomes fully a part of the other”. The second meaning is “to become or make to become fully a member of a community, rather than remaining in a separate group e.g. because of one’s race, colour etc”. Also, the Long-man Dictionary of Contemporary English (LDCE, 1984:582) provides two meanings to the word “integrate”. The first meaning is “to join to something else so as to form a whole” and the second meaning is “to join in society as a whole; spend time with members of other groups and develop habits like theirs”. Gelineau (2004:163) defines integration as making connections between and among different things, for example, integrating arts across the elementary school curriculum with subjects like social studies, science, mathematics, language arts and poetry to mention only a few. This kind of integration is the one intended for discussion in this study.

Going by these definitions, one may not foresee the possibility that traffic safety education is combined with science of technology in a manner that they become one. This would be a tough task to achieve, however, the study perceives a situation where themes that are common among the three fields would be matched and taught to learners.

To integrate traffic safety education into learning programmes, in view of the above-mentioned, requires that traffic safety education must be “assimilated” into a larger whole like Literacy or Life Skills Education. This would create a situation where traffic safety education inseparably belongs to the nature of the mentioned learning programmes and forms an “indispensable part” of it. To this effect, Banks (2004:892) maintains that curriculum transformation brings new scholarship and conceptual frameworks which include identification of the connections between and interactions among the disciplines/subjects and should result in the structuring of a curriculum that through its content and pedagogy affirms the interconnectedness of human life, experience, and creativity. This is the kind of curricular transformation that is needed in South Africa which would among other aspects incorporate TSE in a manner that produces all-round citizens who are also safer road users.

Integration of traffic safety education in particular learning areas among other things requires each educator to be creative and to have initiative. It could be said that only educators who fully comprehend the aspects of the above-mentioned concept, will also be able to apply it successfully.

1.5.3 *Learning area(s)*

According to the South African Revised National Curriculum Statement for Grade R – 9 of the National Department of Education (NdoE, 2001:20), “a *learning area* is a field of knowledge, skills and values, which has unique features as well as connections with other

fields of knowledge and *learning areas*". In the South African National Curriculum Statement, there are eight (8) *learning areas*. These *learning areas* are:

- Languages
- Mathematics
- Natural Sciences
- Technology
- Social Sciences
- Arts and Culture
- Life orientation, and
- Economic and Management Sciences.

1.5.4 Outcomes-Based Education

Outcomes-based education as discussed by Spady (1994) incorporates both systemic change and curriculum change. To illustrate this, in answer to the question "What does the term '*Outcomes-based Education*' really mean?" Spady responds as follows:

"*Outcomes-based education* means clearly focussing and organising everything in an educational system around what is essential for all students to be able to do successfully at the end of their learning experiences. This means starting with a clear picture of what is important for students to be able to do, then organising curriculum, instruction, and assessment to make sure this learning ultimately happens" (Spady, 1994: 1).

According to the South Africa Qualifications Authority (1995) and Van der Vyver (1999) the word *outcomes* suggests a relationship with *outcomes-based education*. Spady (1994) makes the point that *outcomes-based education* is not only about curriculum

change. It is about changing the nature of how the education system works – the guiding vision, a set of principles and guidelines that frame the education and training activities that take place within a system. If one accepts that *outcomes-based education* is about systemic change, then there is likely to be a dimension that challenges current practices of curriculum development and delivery. However the point needs to be emphasised: *outcomes-based education* is primarily about systemic change and not curriculum change. The National Qualifications Framework (NQF) then in its commitment to a system of education and training that is organised around the notion of *learning outcomes*, is about systemic change (Jacobs, 1999).

Spady (1999) further states that *outcomes-based education* is about a consistent, focussed, systematic, creative implementation of 4 principles:

- **Clarity of focus on the learning outcomes** that ultimately students need to demonstrate; these complex role performance abilities and the corresponding South African conception could possibly be the critical cross-field education and training *outcomes*.
- **The design-down / build-back approach** to building the curriculum; the curriculum design starts with the abilities, skills, knowledge, attitudes that one ultimately wants students to demonstrate and ensures that the assessment is focussed on what the learner has achieved in relation to these *learning outcomes* rather than focussing on what was presented during the course of delivery.

- **High expectations;** the expectation must be that learners are able to achieve these *outcomes* and therefore it is necessary for those who work in the system to behave and structure what they do in working with learners, in such a way that they are enabled to achieve these outcomes;
- **Expanded opportunity;** there is a necessity to move beyond the rigid blocks we have created around education e.g. blocks of time and the traditional organisation of learning institutions (Department of Education, 1995).

In the National Standards Body (NSB) regulations, *outcomes are defined as the contextually demonstrated end products of the learning process* (South African Qualification Authority, 1998b). Hence in the NQF paradigm, the successful planning and delivery of a learning programme is only possible when the desired endpoint or endpoints are clear i.e. the desired learning *outcomes*. There are choices to be made within the learning programme design and development in respect of methodology, assessment, technological resources to be used etc. Within an outcomes-based system, these choices need to be governed by the extent to which a particular decision contributes ultimately to the achievement of the desired *learning outcomes*, be they *specific or critical outcomes* (Spady, 1999).

Notwithstanding the above, in order to address the fundamental problems in our system (of relevance, integration and coherence, access, articulation, progression and portability, credibility and legitimacy) in a transparent way for all users of the system; the decision was taken to establish a qualifications framework. The qualification framework is a set of principles and guidelines by which records of learner achievement are registered to enable recognition of acquired skills and knowledge;

the records reflect the required *outcomes* of the learning process. Hence at the systems organisational level, the NQF determines that a system organised around the notion of *learning outcomes* will drive education and training in South Africa (Spady, 1999; Olivier, 2002; South African Qualifications Authority, 1998a).

1.5.5 Traffic Safety Education

Traffic safety education is a special type of education, an area of speciality, like art education, or music education. The components of traffic and safety distinguish this type of education from any other type of education. Traffic safety education is part of moral and values education (Phiri, 2003:2; Llale, 2003:2) and also focuses on traffic safety and the achievement of a high level of safe conduct in traffic. As moral education, traffic safety education has a deliberate and purposeful function to educate a person so that he/she becomes independent and responsible concerning the traffic environment (Dreyer *et al.*, 1999:43).

As specialised education, traffic safety education concerns all the actions that are performed consciously, to achieve desired safe traffic behaviour. The above implicate the equipment of the participant in traffic situation to keep herself/himself and others safe in the street by acting in a responsible way within traffic environment. It also involves the total educational concern of preparing the road user cognitively in acquiring the reasoning skills and attitudes (Phiri, 2003:20; Llale, 2003:17) that he or she will require to behave independently and responsibly in traffic. The worldview, personal philosophy, human notion, and attitudes with regards TSE largely shape the

independent behaviour of his safety and that of his fellow man (Dreyer *et al.*, 1999:43/44).

In a nutshell, the study contends that traffic safety education is a field in which the human being acquires knowledge of traffic safety, traffic safety measures and the traffic environment to which these rules apply. The road user must also develop skills for the efficient application of traffic rules and traffic safety rules for his safety and that of others. Traffic safety requires not only mere acquisition of knowledge, skills, attitudes and rules but includes the correct application of these rules.

Consequently, the road user must be schooled in traffic safety education in order for him or her to use the road or street correctly and safely and as voluntarily as possible. The road user must consequently be equipped to control the road as a sphere of life. The next sub-heading is devoted to describing who a road user is in relation to safety in traffic environment.

1.5.6 Road user(s)

A **road user** is anyone who utilises the road.

Road users can be categorised as:

- pedestrians;
- drivers, and
- passengers.
- cyclists

People of all ages are usually pedestrians, cyclists and passengers. At 16 years of age, road users qualify to ride a motorcycle. It is only from 18 years that the road user in South Africa qualifies to drive a motorised vehicle. Seldom does the driver of a motor vehicle have the road to himself. Other road users, such as pedestrians, cyclists and other vehicles do share the same road, and may lawfully move in opposite directions. The road users in every category have a specific obligation, responsibility and role to fulfil. Their role is never isolated but always stands in relation to other road users. It is therefore imperative that all the categories of road users share the road responsibly (Dreyer *et al.*, 1999:50/51).

In presenting TSE the teacher/trainer should concentrate on the various developmental phases as well as the relationship between the various categories of road users.

1.6 Preview of chapters

Chapter one concerns an orientation to the study, which entailed motivation for the study, research questions, methodology, and a general overview of the study.

In *chapters two* efforts were made to outline the relationship that exists among science, technology, and traffic safety. Their relationship, which rap around principles, laws, theories, and ethical issues, which govern the practising of science, technology and traffic safety were outlined. Aspects, which relate to science and technology, were pointed out as premises for the integration of traffic safety education with science and technology. This was done by means of analysing the curricula for natural science and technology learning areas to determine which scientific and technological principles; laws, theories

and ethical aspects implicate the operation or participation in road traffic safety. Furthermore, in *chapter three* the impact that science and technology have on traffic and traffic safety as well as road environment was described.

In chapter four, an attention was given to the discussion of various approaches that could be used in integrating traffic safety education in the teaching and learning of natural science and technology.

In chapter five, the qualitative methods and methodology, which were employed to carry out this study have been described in detail. Explanation for the actions taken towards answering the research questions of the study (see section 1.2 for the research questions) was given. Other aspects covered in this chapter include: description and construction of the interview schedule, aims of the research design, modus operandi of the focus group interviews, decoding of data, administration procedure of the qualitative methods used, validity and reliability and the interpretation of data.

Chapter six presents the data collected through focus group interviews with leading individuals in the fields of traffic safety, and learning areas of natural science and technology in all nine provinces of South Africa namely, (listing in alphabetical order): Eastern Cape, Free State, Gauteng, KwaZulu Natal, Limpopo, Mpumalanga, Northern Cape, North West, and Western Cape. It also presents the interpretation of the data and the discussion made towards achieving the set aims of the study (see section 1.3 for the aims).

In chapter seven, an integration model for the teaching and learning of traffic safety education in science and technology curricula was developed. It is intended that the model will aid both in-service educators and learners to effectively and efficiently, teach and learn traffic safety education in science and technology classrooms as well as for distance education.

Chapter eight, which was the last in this thesis, dealt with conclusions and recommendations made in view of the findings from empirical work and key issues or ideas from literature, which constituted solutions or parts thereof to the aims of the study.

CHAPTER TWO

2. RELATIONSHIPS AMONG SCIENCE, TECHNOLOGY AND TRAFFIC SAFETY

2.1 Introduction

Science, technology and traffic safety are related in many aspects as shown on Table 2.1 under section 2.5. However, looking intently at science and technology, one could say that in spite of the fact that science and technology are closely related, there also exist some differences in some aspects (as discussed extensively in Appendix D). These two fields (science and technology) impact significantly on society, that is, human activities and the way of life. Science and technology have completely permeated all spheres of life including traffic safety. There is hardly any sphere of life that does not share common aspects with science and technology. This relationship, which exists among science, technology and traffic safety becomes a central point of interest in this study.

Relationship as intended here entails a number of aspects such as “nature of”, “characteristics of”, and every element that constitutes the whole. For example, if we talk of traffic safety or technology, all their constituents therefore form the nature of these concepts. The ultimate goal therefore is to compare or relate the constituents of the one field to another and establish

what relationship exists between them. Also, the relationship intended here refers to outlining the differences and similarities among these three fields as a basis on which integration of the one with the others would find its place in the school curriculum/classroom. These differences and or similarities are enumerated on Table 2.1 (section 2.5), which contains curricular aspects of these fields of study. Furthermore, the relationship between science and technology has been extensively outlined in chapter 2.3 of their book (Howe *et al.*, 2001:73-86) titled “primary design and technology for the future”.

According to the Longman Dictionary of Contemporary English (LDCE, 1984:726), the one meaning of the term “nature” are the qualities that make someone or something different from others. This definition is chosen due to the fact that it suits the purpose and aim of this chapter, which is that of outlining the key characteristics of science and technology regarding their distinguishing qualities and techniques or methods by which they are practiced. These characteristics should then be related to those of traffic safety and establish a fundamental basis for integration in school. The nature of science is such that it requires investigation in order to know or answer questions posed due to observing the phenomena that occur in creation. In section 2.2 the nature of science is described.

2.2 Nature of Science: an overview

The nature of science is discussed at length in Appendices C and D, as such, only an overview is given under this subheading.

The word Science comes from Latin word, *Scire*, meaning “to know”, and “*Science*” is the term we use to denote the magnitude of subjects that deal with the search for basic knowledge about the Universe and all that is in it. Each of these subjects is also separately referred to as a science – for example, we speak of the science of physics or the science of chemistry – and we often group the subjects into pure and applied sciences (Sales, 1994a:270). In curriculum 2005 and 2021, a number of Learning Areas are related to the branches of science, for example, natural sciences, social sciences, mathematics, technology, and economics and management sciences (Department of Education, 1997).

The next sub-heading explains the way in which science (in general) is divided very broadly into its various branches and subjects.

2.2.1 Branches of science

As contained in the Sales (1994a:270/1), the scientific subjects can be grouped under systematic classes, or branches. Each separate subject can be thought of as belonging to a particular branch, although some science may belong to two

or more branches at the same time. Here is the list of the chief branches of science and the main subjects each branch contains:

The *Earth Sciences* include geology, meteorology, mineralogy, oceanography, and palaeontology. The *Life Sciences* include biology and the medical sciences.

The medical sciences, which are those related to the profession of medicine of healing, include anatomy, pathology, and physiology. The physical sciences include physics, chemistry, astronomy, metallurgy, and engineering.

The Social Sciences are subjects that deal with aspects of human society. They include sociology, history and archaeology, political science, geography, and economics. Other subjects in social sciences are anthropology, linguistics, and philosophy. Mathematics is for some as much an art as a science. But although mathematics can be studied for its own sake, most scientists use it as a tool. The mathematical sciences, which include statistics and computing, are constantly used in almost every branch of science (White & Spellicy, 2000; Sales, 1994a:270/1).

2.2.2 *Scientific method*

The job of the scientist has always been to explore (for events that happen) the universe. Such naturally occurring events or happenings are often known as phenomena (emanated from the Greek word *phainomai*, meaning “I show” or “I reveal”). The primary or elementary science arose from observing phenomena and asking questions to find out why they occurred. Before the

17th century scientists generally sought answers to these questions by reading what somebody had already written about them, or by consulting some known and respected man of learning. Explanations of phenomena gained in this way were usually just guesses, although occasionally the guesses were right. With only a few exceptions, scientists did not try things out to see what happened. One major exception was the Greek mathematician Archimedes who in the 3rd century BC discovered the famous principle relating to relative density (Sales, 1994a:271; White & Spellicy, 2000).

From about AD 1600, the Italian astronomer Galileo began to conduct experiments. Gradually other scientists performed experiments too, and wrote down their findings. Their experiments revealed facts about the Universe. As more facts became known, it was found that some of the facts were related to one another. They were summarised in general principles called *laws*. The laws opened the way for further experiments to see if the laws were obeyed all the time. Thus the body of scientific knowledge grew rapidly. Sometime later, experiments caused scientists to modify the laws they had discovered in order to take account of new or unexpected phenomena (Sales, 1994a:271/2; White & Spellicy, 2000).

The gathering and organisation of scientific knowledge by experiment and observation, the testing of scientific theories by carrying out experiments; and the adaptation of theories to take account of newly discovered facts are all

part of the *scientific method*. None of the major advances of the late 20th century in space exploration, telecommunications, computing, and information technology would have been possible without a thorough understanding of the basic *scientific principles* worked out by the painstaking research tools of the scientific method. In many cases this understanding has depended on the development of accurate and complex instruments, such as the laser, microscope, or particle accelerator. Nowadays, experts trained in different branches of science often work together in well-equipped research institutes. Using ever more precise instruments, the scientists of today continue their search for facts using the systematic methods that have evolved over the past 400 years (Sales, 1994a:272; Sales, 1994b:133).

From these systematic methods of science, the findings are applied through the technological process described in section 2.3 and the products as well as services become useful to mankind.

2.3 Nature and the process of technology

The nature of technology is covered at length in Appendix D; as such only the process of technology is discussed under this subheading.

Have you ever wondered how things are made? For example, how was the cell-phone or motorcar made? Answering this question implicates the technological process. According to Baker *et al.*, (1999:V) the technological

process describes the way things are made. There are four different elements in the technological process:

- *Investigating.*
- *Designing.*
- *Making, and*
- *Evaluating.*

It is important to note that these elements do not have to follow each other in any particular order. These elements are described in sections 2.3.1 to 2.3.4.

2.3.1 Investigate to find out information

The term “investigate” means to find out about something or phenomenon with a view to gaining insight and generating opinion(s) that will lead to making of conclusions regarding the matter(s) being investigated. Before people design and make products they need to find out different kinds of information. The information that they find will help them decide:

- What the product should do;
- What to make the product from;
- How to make the product;
- The size of the product

Consider the example in figure 2.1 (below) which points to how the investigation could be done.

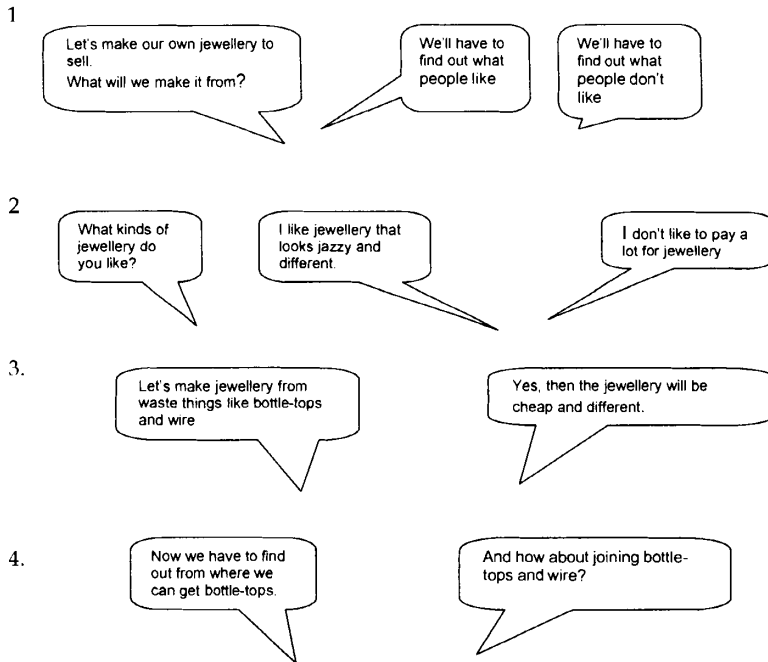


Figure 2.1: Investigation stage of the technological process. (Adated from Baker et al., 1999:v.)

2.3.2 Designing a product

Baker et al., (1999:VI) contend that when people think about developing ideas for a product, we say that they design the product. The ideas are often drawn on paper first and then made into models to show what the product will look like and how it will work.

For example, if *Tumelo* and *Tshiamo* (as scientists and engineers) would like to design a car, they first have to draw all the ideas that they could think of about the type of car they intend. Then *Tumelo* and *Tshiamo* would select which ideas they like best and why they like them. Once they had selected their best ideas, they can add more to it (if necessary). *Tumelo* and *Tshiamo* then could subsequently draw a final picture of their design. They would also decide on how big the car should be and what it should be made from.

2.3.3 *Making the product*

When you are happy with your design, you can make your product.

Sometimes when you start to make the product, you find that you do not know how to do something. Then you need to learn how to do it. You may also find out that you cannot build your design because some information has changed. Then you need to change your design before you can carry on making the product (Baker *et al.*, 1999:VII).

When you make something it is important to remember these two rules:

- Always work carefully and safely so that nobody will get hurt.
- Always look after the materials, tools and equipment you use so that they do not get damaged.

2.3.4 *Evaluate what you are doing*

According to Baker *et al.*, (1999:VIII) it is important that you evaluate what you do all the time:

Design and evaluate as you make: when you evaluate something you think about some of the following things:

- Will this work well?
- How can I make this look attractive or interesting?
- What do I really like about this?
- Is there anything I want to change?

2.4 **Nature of traffic safety**

It will be inappropriate to discuss the nature of science and technology without doing the same with traffic safety, especially, as the emphasis of this chapter is on establishing the relationship among the three fields.

Traffic safety is a compound term that is made up of two sub terms viz.: traffic and safety. Each of these sub-terms are defined and viewed as separate phenomena (as described in the succeeding paragraphs), and a combination of the two gives a higher and an added value to their meanings and significances as opposed to a case when each is considered separately. For example, applying the concept of safety to a traffic

situation implicates and qualifies how the interaction among the people, vehicles, and goods handling as are engaged in a traffic situation should be conducted (White & Spellicy, 2000; Dreyer *et al.*, 1999). The study therefore maintains that the quality and degree of safeness of movement in traffic situations and environments involving the coming and going, the moving of or transporting of persons and goods on roads or streets from place to place, usually (but not always) with the idea of movement in opposite directions simultaneously would therefore signify traffic safety.

When considered separately, the term “traffic” refers to:

- vehicles moving on a public highway, especially of a specified kind, and density.
- the transportation of goods from one point to another,
- the coming and going of people
- dealings or communication between people.

On the basis of the foregoing, the term “traffic” could be considered to having a broad meaning that could be classified into:

- ✓ any form of movement or “coming and going”, and
 - ✓ interaction (White & Spellicy, 2000; Dreyer *et al.*, 1999).
-

Furthermore, the term "safety" denotes:

- security,
- freedom of danger,
- protection and refuge (without fear), but also
- the condition of being safe, free from danger or risks (Anon, 2000; Dreyer *et al.*, 1999).

There are three components that make up the concept of (road) traffic, namely static, dynamic, and interaction.

The *static component* comprises of:

- roads,
- pavements,
- traffic lights,
- kerbstones, and
- other road signs: for example, the yellow light or traffic signs like the stop sign.

The *dynamic or movement component* consists of:

- vehicles,
- pedestrians.

Safety in traffic depends on among other things, the roadworthiness of vehicles, the clothing of pedestrians, motorcyclists, cyclists, and the speed with which the components travel in the traffic. The traffic participant has to possess qualities like knowledge of traffic rules, observation of speed limits, personality factors, knowledge of vehicles and other people's behaviour, as well as willingness to take responsibility. The knowledge of the traffic participant is influenced by several factors such as his development level, previous experience, cognitive level, social orientation, as well as attitudes toward obeying or disobeying of the traffic rules (Anon, 2000; Dreyer *et al.*, 1999; White & Spellicy, 2000).

These three components are constantly in *interaction* and must therefore not be perceived as being effective in themselves as *separate components*. Traffic has become part of the everyday reality in which the present-day human being finds him/herself. Modern street traffic is, however, so complex that traffic rules, regulations and prescriptions are necessary for its control. The human being must therefore be equipped and become skilled at conducting him/herself safely in the traffic situation with regards him/herself and his/her fellow road-users (Economic Commission for Africa, 1997; Dreyer *et al.*, 1999).

Furthermore, man's *inborn need to defend himself* against loss of life, injuries or harm is morally expressed in the sixth of the Ten Commandments - of God

Almighty - which can be explained as follows: that men may not only "harm or wantonly endanger" another but also themselves.

When safety is related to traffic it implies that the participant in traffic situation must:

- survive in the street or road traffic,
- be protected against traffic dangers. This requires rules that will guide conduct in traffic situations, so that somebody who ventures in the street might reach his/her destination safely.

It also implies that the intended and expected accident free movement or interaction among the traffic components, could lead to no incidents of collisions, no bodily injuries, deaths and no economic loss. In this regard "traffic safety" usually implies the prevention of loss of lives and injuries, as well as all measures that can be taken to prevent traffic accidents. For this reason the traffic and transportation legislation and its enforcement are indispensable parts of traffic safety (Economic Commission for Africa, 1997; Dreyer *et al.*, 1999).

Consequent upon the above, one could maintain that traffic and safety, their principles and operations utilise to a greater extent the fruit of science and technology, so much that one is inclined to assert that without science and technology, traffic and traffic safety would not be what they are today. For example, how would vehicles themselves be manufactured? How would

airbags, anti-braking-system devices and other safety components be manufactured (Anon, 2000)?

Furthermore, due to the contribution and impact of science and technology, traffic safety is regarded as a science (White & Spellicy, 2000). This is largely because traffic safety has its methods through which scientific and technological methods are implemented or applied.

There is much more to be said about the nature of traffic safety, and as such, chapter three is devoted to outlining the impact of science and technology on traffic safety, which further characterise the nature of traffic safety, as dealt with in great length in Chapter 3 (see sections 3.2 to 3.8).

Having looked at the nature of science, the scientific method and the technological process, it is now appropriate to turn attention to the relationships that exist among science, technology, and traffic safety. To do this, section 2.5 was devoted to tabulation of the curricular elements for integration of TSE in natural and technology (see Table 2.1).

2.5 Curricular elements for integration of Traffic Safety Education in Natural Science and Technology

Curricular elements (outlining the inter-relatedness or relationship among science, technology and traffic safety) for the integration of traffic safety

education in natural science and technology have been presented in Table 2.1 below. It needs to be mentioned that the list of these curricular elements (given in Table 2.1) have not been exhaustive, however, it gives the educators and learners a good indication as to what aspects, themes, topics, and concepts overlap among these three fields of study. From these themes, topics and concepts educators and learners could select and use/integrate (the knowledge, skills, attitudes, and values) as it is appropriate to their specific Grades and learning areas.

Also, educators and learners would find topics and concepts other than those listed on the table below which they can integrate into traffic safety education with other learning areas.

Table 2.1 Curricular elements of the relationship among the three fields of study:
aspects for integration

Serial number	Themes	Natural Science	Technology	Traffic Safety
01	Laws; rules; Principles	Laws of nature: • Gravity • Laws of Motion	• Procedures • Principles of: • Methodology	• Traffic Laws (Act) • Rules of the road • Principles of road safety
02	Key foundations of development in any society	Is a key element of development	Is a key element of development	Transportation (a key element of development): • Road network • Vehicle, goods, people
03	Problem solving techniques	Procedures of problem solving	Techniques of problem solving	The SIDE (Search, Identify, Decide & Execute) driving or road usage strategy
04	Speed/Acceleration	Speed Acceleration	Speedy technologies	Speed/ Acceleration
05	Forces	Gravitational force, Friction, traction, resistance etc	Tension, Stresses, Strains, Torques etc.	Gravitational force Friction, traction, wear/tear etc.
06	Movement	Motion	Moving vehicle or technologies	Traffic/mobility
07	Momentum	Momentum		Momentum
08	Reflection Refraction Diffraction	• Reflection • Refraction • Diffraction	• Reflective technologies • Effects of refraction and diffraction	• Reflection • Visibility • Refraction • Mirages • Diffraction
09	Light	Light	Light/visibility	Light/visibility
10	Sound	Sound	Sound	Sound
11	Norms/values (i.e. culture), Ethics	Norms/values; Ethics of:	Is a norm(ative) activity itself. Ethics of:	Norms/values; Ethics of:
12	Attitudes/Skills	Attitudes/Skills	Attitudes/Skills	Attitudes/Skills
13	Images	Images	Images	Images
14	Heat/Temperature	Heat/Temperature	Heat/Temperature	Heat/Temperature
15	Work/Energy	Work/Energy	Work/Energy	Work/Energy
16	Distance	Distance	Distance	Distance
17	Pressure	Pressure	Pressure	Pressure
18	Power/Electricity	Power/Electricity	Power/Electricity	Power/Electricity
19	Safety	Safety precautions	Safety precautions	Safety in Traffic

The contents of Table 2.1 are put together on the basis of information from *Baker et al.*, (1999) and Cutnell, (1998).

2.6 Chapter summary

In this chapter, the relationship among science, technology and traffic safety was outlined through the discussion of the nature of science and technology, the scientific method and the technological process. Their relationship, which rap around principles, laws, theories, and ethical issues, which govern the practising of science, technology and traffic safety were outlined. Aspects, which relate to science and technology, were pointed out as premises for the integration of traffic safety education with science and technology (see Table 2.1 for the curricula relationship for integration). This was done by means of analysing the curricula for natural science and technology learning areas to determine which scientific and technological principles; laws, theories and ethical aspects implicate the operation or participation in road traffic safety.

Consequently as a result of the above, it is now appropriate to turn attention to the impact that science and technology has on traffic safety, traffic environment and traffic safety education. To do this, sections 3.2 to 3.8 (in chapter three) were devoted to present selected evidence of the impact of science and technology on traffic safety.

CHAPTER THREE

IMPACT OF SCIENCE AND TECHNOLOGY ON TRAFFIC SAFETY

3.1 Introduction

The purpose of this chapter is to outline the impact that science and technology have on the human environment and society in general and traffic safety in particular. This impact is discussed and or viewed from the scientific and technological advancement that mankind has made for the betterment of life. Both positive and negative impacts of science and technology on traffic safety are outlined in this chapter. In the following sub-headings (3.2 to 3.8), an evidence of the impact of science and technology on society and traffic safety is given.

3.2 The impact of science and technology on society in general

Science and technology (though a very broad field) are among the growing disciplines of knowledge in South Africa. There is much to be done in order to create a technological society (in South Africa) in which every member has some degree of scientific and technological literacy. Efforts are being made in this regard; for example, the National Research Foundation (NRF) has made technology one of its nine research focus areas (Newsletter of the NRF of July 2000) "in a new strategy to meet national and global challenges". The making

of technology as one of the eight learning areas at School in the Outcomes-based Education (OBE) (NDoE, 2001) is another indication of the importance of technology as recognised by the government for the creation of a technological society. In view of these it is important that the influence of technological developments on curriculum and teaching be considered with the aim of giving new directions for teaching and learning as we create a new society. The need for doing technology-related studies of this kind cannot be under-estimated, as it is justified in the foregoing.

Science and technology are key human endeavours that bring about development. Development is one of the things that human beings strive after to attain the maximum level of that which is within their reach. Interestingly, both individuals and groups of individuals strive for better life and conditions. Meaningful development is measured in the quality and standard of life of an individual or society and science and technology instil this. Development therefore is something desirable. However, when development goes ahead of the majority of a society or an individual, it becomes problematic. This is seen in the manner that people or organisations strive to keep pace with (technological) developments. Just like in the traffic environment and traffic safety, the schools are exposed to numerous technologies and are caught up in this state of affairs, where development goes ahead and the road users tread behind. One key question that comes to mind is how can road users keep pace with the challenges that prevail?

Thomas and Bowman (1993) highlight inhibitions from previous attempts made in this regard, whereas, Green and Gilbert (1995) suggest answers to this question, though, not adequately.

According to Sherry (1995), Collis and Moonen (2001), and Nind *et al.*, (2003:115) technological developments (such as computerised teaching and learning, teleconferencing etc) have occurred very rapidly in the past few years. These developments have placed enormous demands on traffic safety, formal educational programmes, and traffic environment. Every facet of life is increasingly experiencing these changes. Change is becoming or has become a norm! On the contrary; people are increasingly finding it difficult to cope with these changes. In the educational arena for example, it is difficult to be (on the spot) up to date with the requirements of information technology or multimedia (Treuhaft, 1995; Thomas & Bowman, 1993). What bothers so much is the fact that many changes that have taken place, swiftly in the business, traffic environment and industrial sectors have received a very slow response in the educational arena. There is a big lag between demands in the work place, road usage and school training. School training is not meeting the increasingly new demands in the work place (Teichler, 2000; Treuhaft, 1995). But learners need to be taught not only about the changes but also how to cope and function desirably with the changes (Pretorius, 2000; Du Plessis, 1995).

In view of the foregoing, one wonders about the position of educational programmes of a society when changes in the needs and values of the society begin to occur rapidly. The implications are vast, for example, these changes have to be reflected regularly in the curriculum of the school, and the skills and knowledge of teachers be upgraded constantly in order to meet demands in the work place (Pretorius, 2000; Albright & Graf, 1992). But the review or design of curriculum is not very easy as well as its implementation even after the curriculum might be updated. There is always much to be done in order to have its functionaries, including teachers, to cope with the demands of the new curriculum. The process is long, tedious and involving (Early & Rehage, 1999).

This situation as indicated above is a serious problem due to the fact that technological developments are posing new challenges on the use of road and education day by day whereas reformation on the side of education does not take place at the same speed. Green and Gilbert (1995) share this view by stating that a slow change and adoption in the academic arena are opposing the fast changes in business and industrial sectors. Consequently, Albright and Graf (1992) indicate that it is important to provide new directions for teaching and learning. If schools fail to cope with these changes, it is likely that they will yield an ineffective education result that may impede societal development. As such, this study maintains that if there is no rapid upgrading of curricula, skills, policies, and tendencies to cope with new

challenges in road safety and education brought about by technology, the expectations of minimising road accidents may not be attained.

It is in light of the above that the study to integrate traffic safety education in science and technology in school was undertaken. In the next sub-headings 3.3 to 3.8, the impact of science and technology on traffic safety and traffic environment are outlined.

3.3 The extent to which science and technology impact on traffic safety

3.3.1 *Prologue*

Under this heading, a number of scientific and technological impacts on the traffic safety environment have been selected and presented in sections 3.3.2 to 3.8.

It should be stated, in general, that the impact of science and technology on traffic safety, traffic environment and traffic safety education is felt in (among others) the following (Deen, 2004:38-40; Lindenmann, 2004:94-98; Warren, 2004:100-103; Shuey, 2004:46-48):

- Traffic engineering: better traffic calming and channelling strategies are being used, and improved road network towards addressing the problem of traffic congestion on the roads.
- Law enforcement: more efficient digital tools like the camera for speed control and tracking down other traffic violations. There are many

electronic devices with information about vehicle owners and vehicles themselves that are stored together with any traffic offence that either of the two might have contravened.

- Road environment: improved ways of displaying traffic information, traffic signs, road furniture which include different facilities for road users, bill boards and other advertising boards to mention a few.
- Traffic information dissemination like weather news, and other traffic news or information regarding accidents, which could lead to temporary closure of the road requiring the use of alternative routes.
- Improved in-vehicle technology by making them more comfortable and luxurious.
- Faster, lighter and more comfortable cars, aeroplanes, trains, and ships
- Better traffic noise reduction strategies.
- Better solutions to the problem of traffic pollution due to noise and air pollution caused by fuel, fumes etc.
- More protection devices in cars like airbags, crash helmets, shatter proof glass or windscreens.

These evidences of the impact of science and technology on traffic safety, traffic environment and TSE (highlighted above) are discussed in details in sections 3.3.2 to 3.8. These selected examples conclude chapter three of the study.

3.3.2 *Technology to fight impaired driving*

The triangular logo of the Canada Safety Council was designed to symbolise the three E's of safety - education, enforcement and engineering. The safety triangle has as its base, education. Building on education, are enforcement and engineering. In the fight against impaired driving, education is reaching most social drinkers, who by and large do not drink and drive. Enforcement agencies play a critical and highly visible role. There is less public awareness of the engineering side of the triangle, beyond the breathalyser, which is an engineered product. This may be due in part to the complexity of related scientific and legal issues (Canadian Safety Council, 2001a:3). It needs to be mentioned at this juncture that breathalysers are also being used in South Africa to track-down on drunk drivers or people driving under the influence of alcohol. Also, in the South Africa the engineering side of the three E's seem to be more prominent than the education side. There is so much emphasis on the (traffic) engineering function as opposed to low level of emphasis on the education side - this also points to the influence that science and technology have on traffic safety. It is a fact that in South Africa educational awareness is given attention mostly only during festive seasons. This shows that the education side of the triangle is not the base of the three E's but the enforcement side is the base in South Africa.

According to Canadian Safety Council (2001a:3) a number of high technological tools have been designed to help police detect and charge drinking drivers, and to prevent convicted offenders from endangering the public. A few are already being used in Canada as well as in South Africa, while others may offer future potential. The following examples of technology and strategies are being used in South Africa:

3.3.2.1 An Electronic Nose

Organised programmes of road checkpoints are one of the most effective ways to reduce drunk driving. The courts have accepted their constitutionality, recognising the right of the public to be protected against impaired drivers.

However, before requiring a test, police must have reasonable suspicion to believe the driver has consumed alcohol. Sometimes, behaviour such as erratic driving, disobeying traffic signals or excessive speed is apparent. Often an officer can clearly identify the odour of an alcoholic beverage on the person's breath. But some drinking drivers do not smell of alcohol, for a variety of reasons, and are not detected even when stopped by police (Canadian Safety Council, 2001a:4).

Passive alcohol sensors (PAS) are portable devices that detect alcohol in the ambient air. As a tool, they can help police determine quickly whether further investigation is warranted. To be charged with impaired driving under the Criminal Code, a suspect should be tested on an approved instrument; results can be admissible in court. New portable units for evidential breath testing are currently being used in some Canadian jurisdictions as well as in South Africa. These digital devices can be installed in a mobile unit for Blood Alcohol Testing (BATmobile), and require a qualified breath technician on-site (Canadian Safety Council, 2001a:4). In South Africa there are numerous problems experienced with conviction of drunk drivers or people driving under the influence of alcohol. When one is charged with driving under the influence of alcohol, there ought to be sufficient evidence in court for any convictions to be handed down. People are generally not keen to be witness in court to drunk driving cases, and the availability of medical doctors to take blood samples on the scene is a major problem as doctors are generally very busy and occupied in their consultancies.

3.3.2.2 Ignition Interlock

In the Canadian Safety Council (2001a:4), it stands that criminal convictions and driving suspensions do not stop all drinking drivers from taking the

wheel after drinking to excess. A small number of chronic offenders pay the fine, serve the time, then continue to drive drunk. Many ignore driving license suspensions, assuming they will not be caught. An ignition-interlock requires the driver to provide a deep lung breath sample before the vehicle will start. The device is usually installed in offenders' vehicles at their own expense. It prevents impaired driving as long as it is installed, while allowing use of the vehicle. Its data recorder keeps track of the BAC level during each trial, whether successful or not. Experience is finding that offenders with a high number of unacceptable tries are more likely to re-offend when the device is removed. In Alberta and Quebec, the ignition interlock has been used as a condition for licence reinstatement and parole. Promising results are leading to interest from other jurisdictions (Canadian Safety Council, 2001a:4).

3.3.3 Highways that captured data, talk to drivers, aid planning and design by themselves

Halvorsen (2002:47) states that there is no denying it, the roads are ever increasing. In the USA, US \$10 billion per year is wasted in fuel and time, waiting in stalled or slow-moving traffic. To the best of the researcher's knowledge, this element has not been calculated in South Africa but in big cities like Johannesburg, Pretoria, Cape Town and Durban, high volumes of traffic lead to delay in traffic flow causing large amounts of fuel to be consumed. Magazines articles and late night TV shows identify groups of

people by their driving habits, necessitated by the environment where they live. Road rage is an issue, a major issue in South Africa as well. There are instances where people killed others (with firearms) in road rage. All of this highlights the need for smarter roads, which have the capability to handle more traffic efficiently and to interface with the driving public. Roads that gather information on the flow of traffic, both for real-time use as well as for archival purpose to use in road design and transportation planning issues.

Sensors are an important and integral part of the equation for the gathering of information from the roads. They are typically divided into groups – intrusive and non-intrusive. The intrusive sensors are ones that are put into roads, and are typically used to gather information on each specific vehicle. Non-intrusive sensors are typically overhead and are used for the gathering of general information on the flow of the traffic (Halvorsen, 2002:47).

The enforcement of speed limits via the camera system assists in the control of the flow of traffic. It allows for realistic speed limits to be applied to the road so that the drivers obey them. It is also fairer to the travelling public because speed cameras utilising axle sensors are the most accurate and discriminatory (Halvorsen, 2002:47; Mitra & Ramakrishnan, 2001:139). The methods and strategies being used in the USA, Canada and other developed countries are being used in South Africa as well. The only difference is the degree of

success with the use of these, which is implicated by factors like level of development, cultural factors, economy and so on.

3.3.3.1 *Another value/benefit*

The state of Victoria in Australia is a heavy user of speed and red light cameras to control the flow of traffic on its many miles of roads. Vast stretches of motorway need to be controlled, and the cost of a constant police presence for speed control would be prohibitive. Speed cameras are widely used, with 230 already in place. Their requirements for accuracy and tamper resistance are some of the highest anywhere. The accuracy for speed must be within one per cent, and this must be done without any on-site calibration. This means that the sensor going into the road must be placed very accurately (actually, they are surveyed in). Prior to the system being commissioned and every six months thereafter, the site is tested for accuracy. Again, no on-site calibration is allowed. Only an axle-based sensor system allows for this level of accuracy without on-site calibration (Halvorsen, 2002:47).

3.4 Continental technologies help improve safety and comfort

Gill (2001:12) asserts that Continental Tyres International is creating integrated transportation solutions for the future. The company links drivers with the road to provide a safer, more comfortable ride. Their excellence in

design, engineering, and manufacturing processes ensure a quality product and peace of mind for customers. This ongoing pursuit of engineering excellence takes shape via a product development process that includes a thorough design analysis to ensure manufacturing feasibility, world-class quality, simplicity, and excellent value for customers. The process enables Continental to break new ground in technological innovations. The result is improved quality, reliability, durability, and customer satisfaction, as well as lower development costs. The process also helps accelerate development cycles by using proven and cost-effective parts across multiple assemblies and systems. By using these common core components, flexible, product families can be established quickly and effectively.

Continental also has a world-wide, high-speed communication network that links its engineering centres and plants in Europe, North America, and Asia. This network allows sharing of development and applications data, and leverages the firm's global engineering intellect. Continental's overall philosophy for a safety system is to offer customers choices, with various levels of complexity and one high standard of safety. Continental has combined its core competencies-brakes, brake system, air suspension systems, and tyres to make mobility safer, more comfortable, and fun. Several products demonstrate this leadership and commitment, including antilock brakes (ABS), the Electronic Stability Programme, the Intelligent Tyre brake, Brake Assist, the ContiContact Tyre, and electronic air spring suspension. These

technologies, along with others, will combine to create the ultimate in braking safety- the 30-Metre Car. Continental is uniting tyre, brake, bearing, and electronics technologies into the 30-metre Car, which will reduce stopping distance to 98 feet and help to increase traffic safety (Gill, 2001:12).

3.4.1 *Anti-lock brake systems*

ABS-which reliably prevents wheel lock when the brakes are fully applied, giving drivers extra control has become an effective safety tool. Continental's ABS Plus anti-lock brake system offers extra security for drivers. It uses more powerful software to regulate the force being applied to the wheels during braking, thus improving the vehicle's tracking and manoeuvrability (Gill, 2001:12). Many vehicles in South Africa are fitted with an ABS-plus anti-lock break system. It ought to be mentioned that these technologies are being utilised in South Africa successfully.

3.4.2 *Brake assist*

All too often, drivers unwittingly do not take advantage of the full capability of their braking systems in panic situations, thereby extending the braking distance unnecessarily. Continental's Brake Assist system solves this problem by using sensors to measure how quickly the brake pedal activates. Based on the pedal speed, the system reliably detects whether drivers intend to apply

full braking force. If so, Brake Assist immediately and automatically provides full brake pressure, yet instantly deactivates if drivers slightly reduce foot pressure on the brake pedal (Gill, 2001:12-13).

3.4.3 *Electronic stability programme*

The Electronic Stability Programme (ESP) is an interactive, high-tech safety device that significantly improves vehicle stability in all driving situations, including braking. It can help avoid potential accidents, and helps drivers maintain control of their vehicles even in critical situations. ESP senses when the drivers might lose control of their vehicles. The system activates the brakes and reduces engine torque to help drivers maintain control during the twists and turns of driving. The system is based on familiar components such as anti-lock brakes and traction control. By braking individual wheels, ESP corrects under-steer and over-steer, and helps to keep vehicles on the road. The following types of cars are utilising the ESP: Ford, Audi, BMW, Toyota, VW, Volvo, Jaguar, and Mercedes Benz (Gill, 2001:12).

3.4.4 *The intelligent tyre*

The tyre is the sole link between the road and the automobile. Because it is in direct contact with the road, it transmits the forces that accelerate, brake, and

steer. Continental has given the tyre a voice –an electromagnetic voice that reports accurately and directly on exactly what forces the tyre is transmitting. The concept is called Side-wall-Torsion (SWT), or the Intelligent Tyre. The intelligent tyre uses the flexing of the Sidewall as a sensor that delivers information about the forces that act between the road and the tyres to electronic chassis management systems (Gill, 2001:12).

Technology will eventually become an integral component of chassis control system such as ABS, traction control system, and ESP. When combined with continental's braking system, SWT creates the ultimate safety and performance package. It is a revolutionary approach to help drivers handle the dynamics of a vehicle, and it gives consumers a clear safety advantage (Gill, 2001:12).

3.4.5 *Conti-premium-contact tyres*

Gill (2001:12) asserts further that when a cat runs, the pads on its paws are slim and small, but when it lands after jumping, the contact area on its paws grows by a third, ensuring excellent grip, better control, and quicker stops. What do cat paws have to do with tyres? They helped inspire the new Conti-Premium-Contact tyre. The tyre, which is suited for vehicles with or without ABS, has a bionic contour typical of a cat paw.

Under normal driving conditions, the tyre is slim, providing protection against aquaplaning. With increased load on the tyre during braking, the force on the ground increases by more than 30 percent, enabling shorter braking distances and greater safety for motorists. The tyre closed outer shoulder with its robust treads pattern, puts more rubber on the road, ensuring excellent cornering stability, better grip, and precise steering response. The tyre also offers outstanding braking performance in wet weather, thanks to a third-generation silica compound. Wide grooves in the centre of the tread pattern, combined with angled spines, offer optimum drainage in the centre of the ground contact patch. The open inner shoulder section of the tyre allows the water to escape fully (Gill, 2001:13).

3.4.6 Continental air suspension system

It is no secret that modern light-construction vehicles are at a disadvantage when it comes to comfort. Continental's Air Suspension System (CASS), an electronically controlled system, compensates for this loss of comfort by individually adjusting the amount of air in each telescopic structure and automatically compensating levels at the rear axle. CASS increases comfort under all load conditions. In addition, the shock absorber responds to varying loads, and is automatically reset in relation to the internal pressure of the pneumatic springs. Four-corner and rear-axle systems are both available.

The CASS also automatically adjusts vehicle ride height and ground clearance based on vehicle mode and speed (Gill, 2001:13).

3.4.7 30-metre car

The knowledge and development behind these technologies combine to create what Continental calls the 30-Metre Car. This does not refer to a car with a length of 30 metres (or 98 feet), instead, it refers to a car with a 30 metre stopping distance from 100 kph (62 mph) at full brake application. Today, depending on the vehicle, braking distance from 100 kph ranges between 35 and 48 metres, or between 115 and 157 feet. Continental intends to decrease that distance. The key is to integrate Continental's technologies and products to improve vehicle comfort, traction, and safety (Gill, 2001:13).

In addition, Continental is looking at the entire process of bringing a vehicle to a stop - from hazard detection to vehicle standstill. This goes beyond tyre and brake hardware to include factors like ergonomics, motion detection, and radar. The overall goal is to shorten the time between a potentially dangerous event and the time it takes a vehicle to stop. Ultimately, by combining brake, tyre, and other technologies, Continental will produce better tyres, better brakes, and better vehicle dynamics (Gill, 2001:13).

3.5 Benefits of the impact of science and technology on traffic safety

3.5.1 *Moving sights*

Mobility, an essential part of our everyday lives, is at a critical juncture. As traffic densities continue to increase, movement is becoming more and more restricted. *Indeed, studies show that in many major cities around the world (including Johannesburg and Pretoria), traffic moves even more slowly than in times of antiquity.* There is also the ever-present danger (despite our motor vehicle being safer than ever before) of major accidents (Höfflinger, 2001:142; Deen, 2004:38-40).

Vision technologies are part of the solution and these have made great strides in recent years. But it is only now that we are able to give our digital intelligence 'sight'. On-chip systems with compatible vision sensors offer entirely new levels of performance. Empowering mobility with vision offers the potential to assure future mobility and increase safety. Vision requirements on the vehicle and the roadside are very demanding in terms of speed, complexity, environment, availability and reliability. Public and legal pressures to keep traffic moving safe, and the regional and brand competition in vehicle and traffic technology drive the provision of vision technology (Höfflinger, 2001:142; ; Deen, 2004:38-40; Höfflinger, 2004:112-114).

According to Höfflinger (2001:143) the challenges and opportunities are formidable but the time-scale is very tight by automotive standards. The following problems and challenges have been identified:

- The number and diversity of critical features;
- The speed and change in road scenes;
- Detection and tracking of regions of interest;
- Blinding sun;
- Headlights (particularly main beams);
- Reflections from shiny car bodies and parts;
- The simultaneous presence of extremely bright surfaces and dark shade;
- Rapid and extreme variations of light levels;
- Low light levels in tunnels and at night;
- The high spatial resolutions needed and at night;
- The high spatial resolutions needed for signs, signals and licence plates.

Houston (2001:2) and Höfflinger (2001:143-144) indicate that the resulting requirements for vision sensors and processors able to handle these vision tasks are difficult in all the above cases. With sensors meeting these requirements it will be possible to over or underexpose; white saturation; black-saturated objects; the lack of objects and faces in backlit scenes; and colour distortion because of local light levels. These sensors offer:

- Robust edge and feature detection of objects irrespective of whether they are brightly illuminated, hidden in shade or a combination of both;
- Low- light visibility, colour content and speed better than the human eye;
- Correct, robust colour representations of objects independent of local light conditions;
- Visual display of scenes and colours similar to how they are perceived by the human/drivers' eyes;
- High-speed acquisition and identification of objects and events, substantially improving measures to avoid accidents.

On the basis of the foregoing, one can assert that empowering mobility with vision offers the potential to assure future mobility and increase safety. However, in South Africa in spite of pollution that affects visibility, especially, during cold winter mornings there is no evidence of these vision sights being utilised. It is therefore; in view of the advantages or benefits of vision sights technologies important to acquire these and to use them to improve safety on our roads.

3.5.2 Traffic and vehicle safety use

According to Sartori (2001:148), neural networks have been extensively used in pattern recognition tasks such as image classification and optical character and speech recognition was integrated into an automotive system. *Research is*

underway to achieve effective in-car speech recognition in the noisy car environment.

Other established applications are engine control and adaptive signal filtering. Predictive analysis of sequences of signals, hitherto used very successfully for financial analysis, could usefully be exploited for traffic flow predictions on existing historical data.

Another interesting use of neural networks is *noise reduction* in sensor systems. The network is trained to extract typical signals from the background noise, thus increasing the effective signal: noise ratio of the system. This technique was used in a disdrometre (an instrument designed to measure the sizes of raindrops). The drops are made to fall under gravity in a vertical slit. As they fall, they interrupt a light beam. The resulting signal has the shape of an inverted hat in time. Large drops fall fast and cause a large signal for a short time. As the drops become smaller (and slower) they cause a flatter signal, which lasts longer. For very small drops at the limit of detestability, the signal is so small that it gets lost in the noise ratio of the system (Sartori, 2001:149).

3.5.3 *Toll Collect*

Stever (2002:84) asserts that Toll Collect is the largest, internationally applicable telematics project in the Public-Private Traffic Management area. As the need for efficient toll systems increases around the world, Toll Collect,

developed by DaimlerChrysler Services, provides effective, accurate and precise debiting function while offering information to channel traffic preventing jams and protecting the environment. Toll collect operates in a way that is precise, reliable, economical and modern, and it is easy to use. Our system also helps the freight-forwarding sector to operate more efficiently.

Toll Collect is based on the combination of two proven technologies: mobile communications and GPS, which have been used successfully in Mercedes-Benz navigation systems for years. Unlike a toll ticker valid for a certain period of time, Toll Collect charges on the basis of the precise number of kilometres driven. The technology needed for the system was successfully used and tested during a two-year trial run. The system can be used anywhere at any time (Stever, 2002:84). In South Africa, toll fee does not depend on the number of kilometres travelled but is rather fixed amounts that are collected from road users depending on what category of vehicle you are using. Again, due to economic reasons (for example, poverty) such strategies are not needed in South Africa. The study contends that even with the few tollgates in the country, not all people are really happy with paying toll fees.

3.5.4 Congestion reduction

In another partnership with the public sector, DaimlerChrysler Services is helping state and city government lighten traffic congestion. Commuters

increasingly are faced with long waits in traffic jams, leading to higher risk of accidents and increased harm to the environment. Under these circumstances, the need for more secure transportation can be met only by improved use of all means of transportation. Therefore, DaimlerChrysler Services is establishing Traffic Management Centres (German abbreviation: VMZ) in conjunction with governments. The goal of the VMZ is to optimise the existing traffic infrastructure, to secure the mobility of individuals and to increase the attractiveness of the municipalities as business centres. All of this is accomplished without any additional costs to taxpayers (Stever, 2002:85; Wachs, 2002:43-50; Anon, 2003:1; Anon, 2003:9; Deen, 2004:38-40).

One example of efficient traffic management already established is the VMZ Berlin. After a Europe-wide tender, the State of Berlin commissioned a consortium consisting of DaimlerChrysler Services (Iad) and Siemens AG with the establishment and operation of traffic management centre. The essential task of VMZ Berlin is the collection and evaluation of data on Berlin's traffic. On the basis of the collected data, traffic information is generated that helps the management to make decisions on how to improve Berlin's traffic situation (Stever, 2002:85; Wachs, 2002:43-50; Anon, 2003:1; Anon, 2003:9; Deen, 2004:38-40).

3.5.5 *Vehicle management*

Vehicle Management allows the carrier to monitor the operating status of his vehicle by means of telediagnosis. This means that the Fleet manager always has an overview of which vehicles are available and when they need to be dispatched for maintenance (Stever, 2002:88). In South Africa, un-roadworthy vehicles is but one of the major traffic safety problems and does contribute to the road accidents as statistically indicated in section 1.1.

3.5.6 *Navigation and driver services*

Dynamic navigation is a great benefit to drivers. This can safely guide the track to its destination, avoiding traffic congestion, either using an onboard screen or via the dispatching office. The driver can request information all along the route, for example, where to get a motel room, where he can buy the cheapest diesel fuel, or whether the food at a service station is any good (Stever, 2002:88).

Telematics saves effort of both forwarding agents and drivers but the transport industry is not the only one that can be used to control traffic flow and relieve the pressure on locations where traffic chronically backs up. More efficient planning reduces the number of unloaded journeys, easing the strain on roads and the environment (Barnes, 2001:59; Deen, 2004:38). Precise

location of a vehicle that has broken down facilitates the prompt arrival of repair personnel or emergency services. This means accidents can be cleared more quickly, which also helps the traffic flow. Last but not least, the system's efficiency and reliability will give the German freight forwarding industry a clear advantage over foreign competitors.

3.5.7 *Telematics on the move*

At the moment, telematics is seen as a luxury technology, only fitted to the top of the range cars. This could be about to change, with better services on offer and economies of scaling driving prices down. Telematics hardware providers are hoping that their systems will go the way of the ubiquitous mobile phone (Houston, 2001:1, Schnabel, 2002:102).

The drop in mobility caused by the dramatic increase in the global volume of traffic, produces enormous economic problems-especially for industries-which are, by definition, permanently in motion. An effective use of technology might resolve these problems. Even today, there are a great number of systems and would-be systems for navigation or supposedly optimised freight and fleet management. However, due to all sorts of limitations, their attractiveness and use are still rather doubtful. By contrast, telematics do not provide an isolated solution but a special form of wireless

data communication – without being a technological rush job (Houston, 2001:1; Schnabel, 2002:102; Barnes, 2001).

3.5.8 *Wanted: In-vehicle IT*

Experts fear a total breakdown of the stretched traffic infrastructure in densely populated Europe within the next 10 years. Statistically, each individual already spends about 600 hours in traffic jams a year – and this in Germany alone, which has emerged as a central traffic junction following the opening of the Eastern European borders. A state of affairs, which adds to the prevailing down beat mood in the automotive industry. On top of the economic decline, image problems arise. The attractiveness of cars has always been defined by mobility and not the time spent in traffic jams. It is no wonder that, at the international motor shows in Frankfurt and Detroit, the industry has increasingly focused on conveying the ‘fun driving’ to their esteemed customers through new technologies in the vehicle. Moreover, the arrival of IT in the vehicle will generate new value added in order to compensate for the low growth rates. The great majority of the notable car manufacturers presented their own navigation systems, in combination with all kinds of additional features tailored to the customers in their target groups (Schnabel, 2002:102).

In the transport industry, too, the growing volume of traffic plus a great number of legal conditions (truck toll, rest periods for drivers, hazardous materials, etc.) add to the high pressure caused by delivery dates and costs. Fleet operators, too, increasingly try to resolve these problems by the efficient use of information technologies. A great number of solutions propagating an optimised freight and fleet management is already to be found on today's market. Their efficiency, though, appears doubtful, as some of the most serious problems remain unsolved. The considerable proportion of fleet vehicles running light, for example, which industry experts estimate 25 to 40 per cent, which indicates that logistics centres are still not up-to-date with regard to the load factor and status of their fleet vehicles. Once the vehicles are on the road, communication and dynamic data interaction fall by the wayside. Control centres thus remain inflexible as far as so-called ad hoc online orders via Internet freight exchanges are concerned. An effective and fleet wide short-term resource scheduling is practically unthinkable (Schnabel, 2002:102).

3.5.9 The next big thing

However, telematics are not restricted to traffic applications. Both experts and analysts are convinced that this technology will open up virtually unlimited uses in the mobile sector, for the industry as well as the individual business travellers and private users. As a matter of fact, telematics do not

only enable the in-vehicle access to road maps and traffic information but also the mobile calling-up of all kinds of information. On the road, the users can download office documents or news, they may also call up e-mail and Internet services as well as standard IT applications or industry solutions implemented in their respective companies. Future uses include remote control of home electronics- for instance garage door, burglar alarms, video recorder, coolers, etc...and, last but not least, mobile entertainment (music and video downloads). Its new mobile radio protocols enable a smooth transmission, even of huge data volumes (Schnabel, 2002:105).

3.6 The future of traffic safety and traffic environment due to the impact of science and technology

3.6.1 *Electronic Vehicle Identification applications in the road transport*

The next decade will undoubtedly see an *increase in the application of electronic systems to vehicles in order to reduce vehicle crime, improve road safety and reduce congestion*. Electronic Vehicle Identification (EVI) is a *future means* of uniquely identifying and communicating electronically with road vehicles and its application could, for example, verify vehicle ownership, help enforce traffic regulations and provide journey time data for traffic management systems. EVI also provides the opportunity for introducing a wide range of commercial and driver-related services that benefit users (Stevens & Stoneman, 2002:152).

Vehicle identification is often undertaken using optical imaging of the vehicle followed by either manual or automatic reading of the registration plate (Nelson, 2001:as quoted in Stevens & Stoneman, 2002:152). The concept of electronic vehicle identification (EVI) is not new. One form of EVI, the electronic licence plate, was envisaged nearly 20 years ago. An example is the Heavy-vehicle Electronic Licence Plate (HELP) project, which began in 1984 in the USA and used 'electronic licence plates' to monitor vehicles' movements and enable the enforcement of weight limitations. More recently, the EVI concept has been demonstrated in road user-charging applications, with unique information stored electronically within the vehicle and, on request, transmitted to roadside infrastructure (Stevens & Stoneman, 2002:152; Vis, 2001).

The EVI has the potential to exchange a wider range of information than just the registration mark. This information could include: vehicle identification number (VIN), vehicle dimensions (e.g. length, width, height, axle wheel base(s), fuel type, engine characteristics, the maximum permissible weight and vehicle classification category. These data could in turn potentially support and enable a much broader set of transport applications and services (Stevens & Stoneman, 2002:152; Vis, 2001).

According to Koster and Van Haperen (2001), freight management systems are also in use and enable goods vehicles entering a freight yard to be identified electronically with the vehicle directed to the appropriate loading bay. Perhaps *one of the most worthwhile applications of EVI will be in combating vehicle crime where disguising the identity of vehicles is a major activity*. Two of the main 'scams' are:

- Ringing- giving the identity of legitimate vehicles which have been seriously damaged or written-off to stolen vehicles; and
- Cloning- using the identity of an existing vehicle to disguise another.

Another fundamental means of vehicle-identification is the vehicle identity number (VIN) that has been standardised by ISO 3779. EVI could provide a third line of defence in terms of vehicle identity if incorporated within all newly manufactured vehicles. Registration tags, integral with the vehicle, could be read at highway speed in the blink of an eye with no hassle to the law abiding motorists whilst those on the stolen vehicle register could be automatically identified despite deliberate changes to their outward appearance. Of course, the same identification capability could also be employed to assist in identifying vehicles that are engaged in road traffic offences such as illegal use of road space, speeding, red light running, etc. and all much more efficiently than using cameras. Also, the system has the capability of communicating information that includes the VIN, registration

plate, classification category, vehicle type, colour, number of axles and weight to a roadside unit (Koster & Van Haperen, 2001).

3.6.2 Further application of the EVI

A number of applications can be used with this architecture with the addition of suitable software. They include the following:

- Vehicle recognition in packing application;
- Car counting, lane speed and queue detection in traffic control equipment;
- Lateral control (overtaking sensors and blind spot detectors) in vehicles;
- Lane tracking;
- Stereo determination of distance and object shape;
- Car occupancy and passenger height determination;
- Biometrics recognition including fingerprint' face and iris recognition;
- People counting in buses.

Other applications such as number plate recognition require higher-resolution optical sensors and faster processors but could in principle be tackled with simple extensions of the same architecture (Sartori, 2001:144).

3.7 Further challenges for science and technology to improve traffic safety and traffic environment

According to Mole (2002:14) implementing specific road engineering measures and safety schemes can cut accident rates and reduce the severity of traffic related injuries. One of the lower cost techniques is to use road-marking techniques to influence driver behaviour.

Traffic engineers must seek adaptive solutions that take full account of the vulnerabilities and mis-judgements made by all road users. Safer highways can be accomplished by decreasing traffic. Reducing traffic volumes can be achieved by various pricing scenarios; such as higher taxes on fuel, vehicle ownership, insurance, and congestion charging. These schemes are naturally unpopular with drivers. Also, they require long-term planning and significant investment in alternative public transport if governments are to ensure that mobility demands are optimised. Implementing more safety-related road engineering programmes, which influence driver behaviour is another more immediate solution (Mole, 2002:14).

3.7.1 *Visibility and control at night*

Driving at night, of course, brings an additional set of difficulties. Visual perception is critical to night -time driving and enhanced delineation using

Intelligent Road Studs (IRS) is one of the most important factors in achieving a more controlled driving regime. IRS installed in the pavement (in the driver's direct line of vision) enables the driver to rapidly interpret the road architecture. IRS significantly extends preview times and provide high-contrast datum to assist drivers, awareness, and alertness to potential hazards. Preview, incidentally, is a measure of distance, expressed in time (seconds) or length, at which the road marker must be visible in order for a vehicle manoeuvre to be completed without endangering the driver or other road users (Mole, 2002:14-15).

Mole (2002:15) further states that this important factor takes into account both sight distance and vehicle speed, which are calculated by dividing the sight distance by the driving speed. IRS provide up to 10 times more visibility and offer significant additional benefits by providing enhanced visual guidance both by day and at night, particularly in adverse weather when traditional road marking performance is more limited. The installation of IRS is very effective on road sections where the prevailing conditions or the accident risk is less apparent or where higher vehicle speeds may occur. Increased preview times offer a higher level of driving control when encountering unexpected hazards. The benefits of IRS can be summarised as follows:

- Reduction in accident risk;
- Increased driver visibility, alertness and awareness of potential hazards;

- Better lateral vehicle positioning, avoidance of sudden braking and last second vehicle manoeuvres;
- Improved delineation particularly in poor weather conditions;
- An alternative to expensive street lighting.

An Astucia IRS guidance installation allows the driver up to 900 m of visible road layout, irrespective of headlight efficiency. This significantly extends the preview time, provides conspicuous, and legible reference points at ground level, and focuses delineation in the driver's direct vision. This improved highway delineation encourages a more controlled driving regime, up to 30 per cent less use of main beam headlights and better lateral positioning of the vehicle. By increasing driver reaction time, the driver is less likely to make sudden changes to the vehicle speed or direction and avoid sudden braking (Mole, 2002:15).

3.7.2 *Brighter- pedestrian crossings*

In many countries, action to protect vulnerable road users is well advanced, including systems to increase safety at pedestrian crossings and crosswalks. In the USA and Canada, innovative solar powered and hardwired systems are making life considerably safer for both motorists and pedestrians. Though in South Africa these kinds of systems are not in use but there is a growing campaign and efforts to improve pedestrian visibility and safety in order to

reduce road accidents. The systems include a series of high-visibility Astucia Intelligent Road Studs installed in the pavement, the full length of the crosswalk, and along the centre line of approaching traffic. The approach studs ensure a safer sight distance to warn drivers of crossing pedestrians; light-emitting diode (LED) studs placed directly in the pavement are very effective in attracting drivers' attention, compared with signage at the sight or over the highway (Mole, 2002:15; Forster, 2004:108).

The Astucia flush stud uses high performance LED's housed in a low -profile plastic lens, which is less than 4 mm above the ground. This avoids any trip hazards and risks to motorcycle traffic. Equally important, it is currently the only truly snow ploughable stud. The Astucia crossing system is capable of many future upgrades, including automatic vehicle speed detection in the flush stud, preventing the crossing activation if the vehicle were unable to stop safely. Another option is the use of passive infrared (PIR) detectors, which automatically activate the system when pedestrians approach the crossing. A major benefit is that the system encourages people to use the crossing, rather than just cut cross the street at any point (Mole, 2002:17; Forster, 2004:108-110). In South Africa, there is emphasis on the wearing of brighter colours and reflective materials by pedestrians, especially, during the night in order to improve their visibility and safety.

3.7.3 *IRS at controlled intersection*

Astucia has recently installed an innovative road-level illumination system at traffic light intersections in Malaysia. The local authority has identified several intersections, which are particularly hazardous and exhibit poor accident records due to low levels of lighting, persistent queue jumping and high-speed approaching traffic. Installed into a conventional T-junction intersection, the IRS illuminates both across the junction and also in a line toward the approaching traffic. The hardwired Intelligent Road Flush Studs are fitted with five bi-colour red and amber ultra-bright LED's linked to a control unit and are activated by signals received from the intersection controller (Mole, 2002:17; Forster, 2004:108-110).

The high-performance LED's provide valuable extra information to drivers. During the red phase, the studs across the junction show constant red and studs along the extended approach line flash at a frequency of 2Hz. The stud colour changes to amber during the amber and the red /amber phase. During the green phase all the studs are deactivated. The Astucia control unit is equipped with a sensor to detect ambient light and control the stud system, illumination levels are also modulated during the night-time period to reduce the possibility of glare (Mole, 2002:17; Forster, 2004:108-110).

3.7.4 *Level crossing can be safer too*

Most of all vehicle-train collisions are vehicles running into the side of the train. Drivers, therefore, must be able to see or hear the train in time to take the necessary avoidance action. Alerting drivers to passing trains in advance of the crossing is the primary function of the Astucia Level Crossing System. The LED studs are placed across and along the centre lines on the road facing approaching vehicles. Train detection sensors trigger the studs to flash and strobe toward oncoming traffic. Since many railways are already installed with train detection systems, integration with the existing infrastructure is all that is required. Should this not be the case, several classes of sensor systems are available from Astucia. Although essentially designed for uncontrolled crossing, the Astucia system not only offers a very effective solution, it is also significantly less expensive than the traditional gates and lights approach (Mole, 2002:17; Forster, 2004:108-110).

3.7.5 *Alternatives to street lighting*

Continuous developments in light-emitting diode technology offer new possibilities to specify more efficient systems and to reduce light pollution to the environment. These new alternative lighting techniques can be applied selectively or complementary to conventional lighting schemes. Either as

solar or hardwired systems, they offer the benefit of cost-effectiveness in terms of capital acceptance (Mole, 2002:17; Forster, 2004:108-110).

Increasing road safety at locations where no main power is present is of significant benefit. Independent trials carried out in the Netherlands have shown that such systems represent real alternatives to conventional street lighting. Results underline the cost-effectiveness, energy efficiency, improvement in road safety, reduced light pollution, and related CO₂ emissions when compared with incandescent or gas discharge lighting tube systems. It has been determined that 100 street lighting columns produce on average 260 tons of CO₂ every year (Mole, 2002:17).

3.8 Negative impact of science and technology on traffic safety

3.8.1 *Do cell phones cause collisions?*

Wireless phones are everywhere. Businesses depend on them. Family members call each other to keep in touch. People use them in public places and *when driving* (Canadian Safety Council, 2001b:1; Halladay, 2001:8; Abernethy, 2004:28). The down side is that all those beeping noises and loud conversations are downright annoying, and *drivers who pay more attention to the phone than the traffic create a hazard to other drivers. This is one of the social ills that science and technology have impacted on the society. This holds true in South Africa as well. The Government has enacted traffic laws that prohibit the use of cell*

phones whilst driving. Transgressors are liable for punishments by fine or jail sentences.

Canadian Safety Council (2001b:1) state that as more drivers use wireless phones, there are more collisions where an at-fault driver was on the phone. Today, drivers have a very high exposure to cell phones.

- ◆ Concerns that use of wireless phones can cause collisions have led to calls to ban or regulate their use in the cars. Moreover, a study done with 699 Toronto drivers, all of who had a cell phone and all had been involved in a collision. If a driver talking on the phone drives through a red light or misses a stop sign, the driver – not the phone – is at fault.

In Canada and as well as in South Africa, careless driving laws are already in place to prosecute drivers who do not make the driving task their top priority when using a wireless phone. For example, Ontario drivers caught talking on cell phones, eating, reading or applying makeup are subject to a \$325 fine and six demerit points (Canadian Safety Council, 2001b:1; Halladay, 2001:9).

A mobile phone ban would undoubtedly be flouted. In addition, regulation could negate the safety benefits of having a phone in the car. When you are stuck in traffic, calling to say you will be late can reduce stress and make you less inclined to drive aggressively to make up lost time. There are over three

million 911 calls per year from mobile phones to report emergencies and dangerous situations. Indeed, many people want a cell phone in their vehicle specifically for safety reasons (Canadian Safety Council, 2001b:1; Halladay, 2001:9).

The Canadian Safety Council (2001b) sees a need for more public awareness and education, and strict enforcement of the existing laws. This situation is a reflection of what is happening in South Africa.

3.8.2 Distractions and multi-tasking

The inappropriate use of cell phones by drivers is part of a serious traffic safety problem - distractions can be dangerous behind the wheel. A study released by the American Automobile Association in May 2001 reported that distracted drivers account for about nine per cent of serious crashes. Of that number, 1.5 per cent were using or dialling a cell phone at the time of the crash. In comparison, 11.4% distracted by adjusting a radio, cassette or CD, and almost 30% distracted by an outside person, object or event. Our society has to a great extent condoned multitasking while driving. Most vehicles have cup holders. Many also have complex radios and sound systems. Omnipresent drive-through(s) did encourage drivers to pick up food and beverages. Drivers eat, discipline their kids, use cell phones and even shave or apply make-up on the road. It is also a fact that many drivers perform

personal or work-related tasks while driving and this keeps the mind in motion – occupied and pre-occupied with many things thereby leading to different options for distractions. These kinds of actions lead to traffic crashes and should be avoided (Canadian Safety Council, 2001b:1; Halladay, 2001:9; Gullon, 2004:60-64). Also, the type of road environment – stuffed with road furniture including advertising boards and active road management assisted by satellite as a system of road charging, could be distractive (Hook, 2004:50-51).

Programmes to help drivers understand their capabilities and limitations behind the wheel should be put in place to suggest ways to ensure safety is always the focus. These kinds of programmes are needed in South Africa to educate road users about the dangers of using cell phones without hands-free kits while driving. The educational programmes could be developed by TSE/education experts within the South African context to provide the necessary education on this distractive practice/behaviour on the roads.

In their study focusing on the personal characteristics of drivers and their comprehension abilities of posted road signs, Al-Madani and Al-Janahi (2002:1) found that education is needed to help drivers improve their understanding capabilities and personal characteristics. In order to achieve this, educational programmes need to be developed and utilised accordingly. To this effect, Galley (2003) dedicates an entire conference paper urging for

better driver education for all drivers and this call had been earlier on raised by Steinberg (1997). Notwithstanding the foregoing, Tip and Wittebols (2004) advocate that the key to driving success is education. These evidences point to the significance of education in promoting safety on the road and as such needs urgent attention.

Driver distraction is becoming one of the biggest problems on roads and a growing concern of automakers who are pushing a new array of electronic devices that have the potential to let a person's eyes stray from the road. In South Africa the technological impact regarding advertising with flashing or moving text often found along the road is another big distractive element. The statement above is just one indication of the growing problem of technology and the driver. As gadget after gadget makes its debut in the car, the driver will either have to be *educated* into responsible use or legislated. We will, of course, end up with some balance of the two, but, as *educators*, we should be thinking about how we want to influence that balance and in what way (Houston, 2001:4; Anon, 2000:6).

Cell phone use in cars is a good example. We know that cell phones can be dangerous distractions, but we also know that it depends on how drivers use them. It is easy to jump on the legislation bandwagon – make it illegal to use a telephone while driving, period. But that is a tough one to sell publicly. After all, we all enjoy and benefit from using phones wherever we go, and

enforcement will be extremely difficult, especially in the case of hands-free phones. What it really boils down to is the driver, and that means that the driver needs to understand the danger of distraction, which in turn implies a more sophisticated understanding of the driving task itself (Halladay, 2001:9; Anon, 2000:6).

However, the impact of technology on traffic safety/environment is so big that cell phones are just one of the potential distractions and the whole issue of new technologies stirred some interesting debate recently at the Canadian International Auto show in Toronto as well as in South Africa where radio shows on South Africa Frequency Modulation (SAFM) are held to address this problem and create an awareness. On the one hand, it is argued that consumers want value and safety rather than gadgets. On the other hand is the view that consumer insights argued that consumers want all the toys they can get (Houston, 2001:4).

On the future front, BMW plan to introduce an all – in - one touch -screen control centre on their 7-series sedans. This will bring all the buttons normally featured on the dashboards of current cars on to one screen and combine them with controls for devices such as CD changers, sound systems, satellite navigation systems, anti-theft alarms, climate controls, cellular phones with wireless Internet and e-mail access (Anon, 2000:6).

This invasion of technologies presents huge challenges for the driver training industry. It is reasonable to assume that the drivers who understand little of the complexities of driving will likely be more susceptible to distraction. A driver who is unable to be critical of his or her own driving habits and skills is likely to be more easily seduced from attention to the roadway. Also, s/he would become involved in an engaging conversation on a cell phone or an attempt to use a navigation tool while negotiating busy traffic (Anon, 2000:6).

One of the worst and most dangerous distractions, they pointed out, is an infant crying in the back seat. This is a distraction a parent in the car often cites as a cause. The development of airbag-safe front seats for infants is therefore necessary. For the training/education community, a strategy for dealing with attention allocation is obviously needed. This is part of most programmes already, but technological demands on the driver and the increased danger of distraction at inappropriate times add a new dimension (Anon, 2000:6).

3.8.3 Electronic Etiquette Enforcement: a possible solution to the problem of using mobile phones while driving

Without doubt, wireless phones can be annoying. That is why industry Canada recently announced it would consider legalising cell phone silencers or jammers. These devices are capable to block signals within a certain radius

by preventing phones from contacting cellular radio towers. A recent survey found that nearly 70 per cent of respondents supported the use of jammers in places of worship, libraries and movie theatres. But when it comes to malls, nightclubs and restaurants, about the same number oppose them (Canadian Safety Council, 2001b:8).

In noisy malls or bars, a discreetly used phone does not disturb other patrons. On the other hand, in a church, library or theatre, people are expected to respect the need for quiet. Beeping phones and needless talking are poor etiquette. Limiting the use of certain technologies to security and military applications is an accepted convention (Canadian Safety Council, 2001b:8).

3.9 Chapter summary

In this chapter, the impact that science and technology has on traffic safety, and traffic environment was dealt with. The nature of science, the scientific method, and the technological process were outlined as a way of creating an understanding of what these concepts are as well as how they are practised.

The impact of science and technology on society in general was also enumerated. It was stated that technological developments are going far too fast ahead than what the members of the global society could cope with.

Change has taken place so rapidly that people need to learn strategies of how to handle and or cope with change. Change has become a norm in society. These changes are facilitated and brought about by scientific and technological developments. In the traffic arena too, science and technology have exerted enormous pressure on vehicle technology; road environment; road user knowledge, skills and attitudes required in surviving the ever-becoming complex traffic environment.

This change however, does not yield only good results, but it also does bear some negative consequences. The advantages and disadvantages of the scientific and technological developments impacting on traffic safety and traffic environment have been discussed in sections 3.2 to 3.8.

It was finally stated that these changes implicate the education of road users in order for them to live up to scientific and technological expectations in traffic situations.

It is in light of this that the need to introduce traffic safety education in schools in the learning areas of natural science and technology becomes necessary.

In the next chapter (chapter 4), integration strategies have been extensively discussed as the basis on which an integration model is developed in chapter 7 for integrating traffic safety education in the learning areas of natural science and technology.

CHAPTER FOUR

4. INTEGRATION STRATEGIES: A DISCUSSION WITHIN THE OUTCOMES BASED EDUCATION FRAMEWORK

4.1 Introduction

Outcomes-Based Education (OBE) as defined in section 1.5.4 is an educational approach that is relevant to the world of today, which is dominated by change. At this time when change is a norm in society, OBE is one type of education framework that can prepare people for today and future challenges. Within this wind of change, even education programmes shift primary attention from students' concerns to subject matter acquisition, to social problems and back again (Vars, 1991:15). This is exactly the situation in South Africa as our education strategy and programmes now move to the OBE approach. The philosophy of OBE hinges around the thinking that given enough time, every learner can learn, do something or achieve outcomes just like any other person.

Teaching and learning within the OBE framework is about integration. Integration of knowledge, skills and information, creating of links or relationships among knowledge and skills in the different learning areas is therefore central in curriculum 2005. The basis of integration as utilised in OBE is the view that nothing in this world exists in isolation from other things. Drake (1991:22) advocates that there are

more and more natural connections across the curriculum. This indicates that there are even more natural connections across different elements in creation. That is, in one way or the other, there must be some kind of natural relationship(s) between or among different elements in creation (Drake, 1991:22). This makes integration the key element of the OBE approach to teaching and learning. The beauty of OBE is the fact that one can teach a topic intensively and extensively! As one decides on what to teach, one is free to relate any relevant information or knowledge to what one is dealing with. It is in this regard that Traffic Safety Education, though not a learning area, is being positioned to make its way into the classroom through the various learning areas.

In the next sub-headings (4.2 & 4.3) a discussion is made of the different forms of integration, which educators can use to integrate traffic safety education in learning areas.

4.2 Integration within learning areas

4.2.1 Prologue

Because no learning programme currently exists within Curriculum 2005 in which traffic safety education themes are covered, it is inevitable that learners will be taught about traffic safety by means of integration in a range of learning programmes. Integration offers the proverbial golden means to inculcate facts of life in learners with particular reference to traffic safety during the teaching of the entire spectrum of

learning programmes. Vars (1991:14) states that all-school themes, interdisciplinary teams, and block time are three alternative ways to effectively deliver a core curriculum.

It is consequently essential in this regard for aspiring educators and in-service educators to fully comprehend this concept (integration) and what it means in order to be able to apply it in their particular learning programmes. However, the integration of knowledge in different fields applies to the entire sphere of life and consequently it would equip the educator on multiple levels. In the next sub-headings (3.2.2 to 3.3), different forms of integration are discussed.

4.2.2 Forms of integration

There are a number of ways through which one can integrate knowledge and skills, however, for the purpose of this study only three main forms of integration are discussed. These forms are:

4.2.2.1 Multidisciplinary form of integration

Multidisciplinary form of integration refers to a kind of integration whereby the educator or educator selects a theme or “programme organiser” and gleans from all eight learning areas and links different aspects of knowledge that relate to them. In a Multidisciplinary approach, the subject boundaries are well maintained, however,

interrelationships are created among aspects that overlap between or among subjects/disciplines (Drake, 1991:20).

With this form of integration, it is clear where the contents of the different subjects/fields fit into the bigger picture or framework. For example, a particular theme is selected and integrated during the teaching of the different learning areas.

The multidisciplinary form of integration is illustrated in figure 4.1 below.

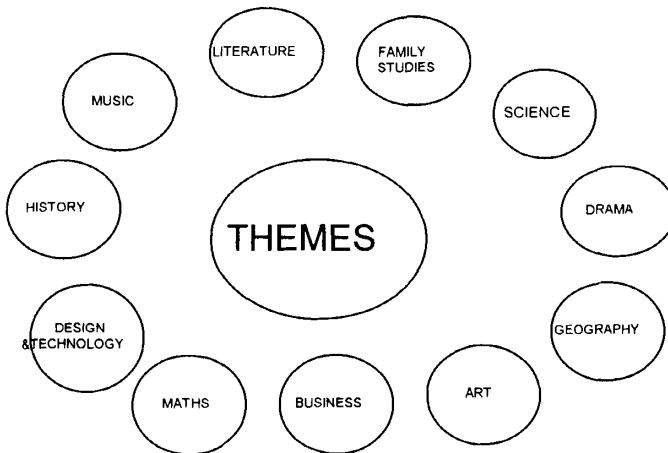


Figure 4.1: Multidisciplinary form of integration. (Adapted from: Drake, 1991.)

4.2.2.2 Interdisciplinary form of integration

In the interdisciplinary form of integration, the subject boundaries are maintained to a certain extent as well as disappear or overlap one to another. It gives room for the teaching and learning of certain kinds of knowledge and skills, for example, thinking skills/research skills, which are applicable in different disciplines. However, room is also made for certain aspects, which remain typical of specific disciplines.

The contents of the different learning areas overlap with each other. There are however, fewer differences between learning areas/fields because the contents largely correspond. Certain facts are now taught at particular levels. Each activity is labelled by breaking it down into the learning area/fields concerned. In this form of integration, a particular activity is divided into different fields (Drake, 1991:21). The interdisciplinary form of integration is illustrated in figure 4.2 below.

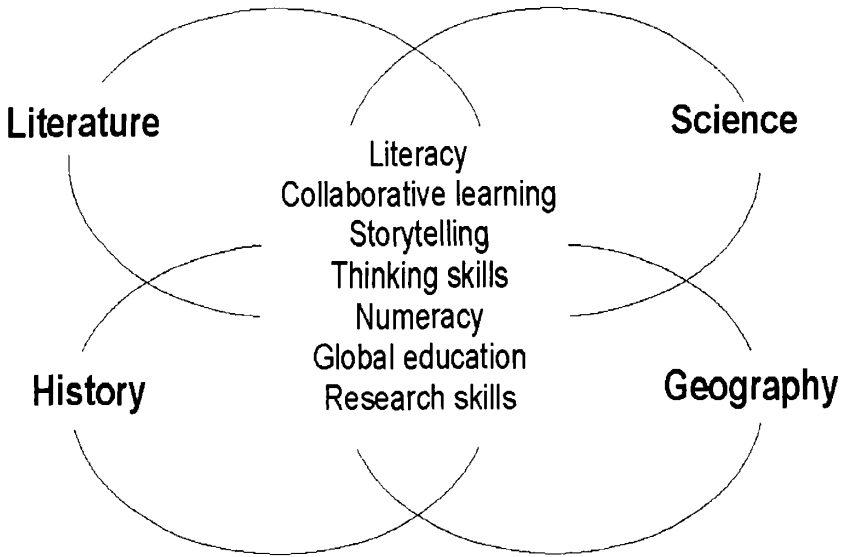


Figure 4.2: Interdisciplinary form of integration. (Adapted from: Drake, 1991.)

4.2.2.3 *Trans-disciplinary form of integration*

As the name “trans-disciplinary” implies, this form of integration spares no subject or disciplinary boundaries. It permeates disciplinary boundaries and focuses on common themes, strategies and skills, which are useful in any field of life in which one finds oneself. Berlin and White (1992:340) writing about the integration of science and mathematics in the American science educational endeavours state that science provides mathematics with interesting problems to investigate; and mathematics provides science with powerful tools to use in analysing data. Science

and mathematics are both trying to discover general patterns and relationships and in this sense they are part of the same endeavour.

Often in the teaching situation a particular theme is chosen and used as a strategy to explain facts. Similarly, a particular theme is taken from the traffic safety educational perspective to instil certain facts in learners about a particular learning area. Common themes or strategies are selected according to the Trans-disciplinary approach to teach facts related to any learning area (Drake, 1991:21-22). This approach therefore involves the fading of particular learning programme boundaries with the result that the chosen theme becomes central in the teaching events. The Trans-disciplinary form of integration is shown in figure 4.3 below.

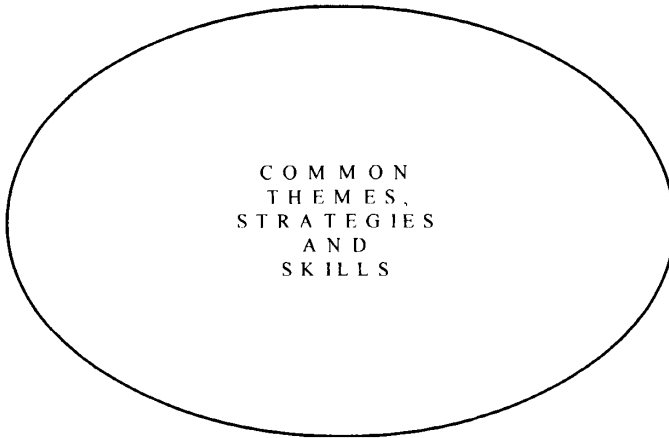


Figure 4.3: The Trans-disciplinary form of integration. (Adapted from: Drake, 1991.)

4.3 Other forms of integration

According to Vars (1991:14) all-school themes, interdisciplinary teams, block time, and individualised instruction programmes (Ornstein & Lasley II, 2004:371-372) are alternative ways to effectively deliver a core curriculum. Organising the school staff to deliver a core curriculum takes essentially different forms, such as:

4.3.1 Entire-staff approach

The **entire-staff approach** where all members or most of the school staff agree on a theme, then present it for a fixed period in an integrated fashion. Or they agree to deal with some aspect of an all-school theme or topic for a brief period of time. This could be done during each school term and educators and learner together could select different themes. This kind of arrangement or agreement could pave the way for effective integration of TSE in other learning areas.

4.3.2 Inter-disciplinary team approach

With the **inter-disciplinary team approach**, educators of different learning programmes agree to teach learners by means of a range of themes. That is, education of several different aspects/disciplines/learning areas come together and assign one group of learners (e.g. Grade 10A) and are encouraged to correlate at least some of the teaching around a series of themes (for example, the themes on Table 1 in *Appendix G*) (Vars, 1991:14).

4.3.3 Block-time and self-study classes

Another approach is the using of **block-time** and **self-study classes** where one educator is responsible for instructions in a range of learning programmes during an extended period of time. For example, TSE can be taught with technology during a block of a double period. The degree to which the two fields are integrated varies

from educator to educator depending on among other aspects, their roles (Wellhousen & Crowther, 2004:78-79). This signals that proper training and coaching of educators is needed in this regard to bring about an in-depth or significant integration (Vars, 1991:14).

4.3.4 A topic at a time

Certainly the simplest approach is where educators of different learning programmes treat particular aspects of **one topic at a time**.

4.3.5 Fusion approach

The fusion approach: where the contents of two or more subjects can be presented in a combined manner with a new name. A good example of this approach is the learning areas we now have in South Africa, which is basically a combination of different subjects that used to be. (For example, geography and history are now grouped as Human and Social Sciences - learning area.)

4.3.6 Structured core and unstructured core curriculum approaches

A **structured core curriculum approach** contends that learners and the community in which they live are taken as the point of departure for curriculum development. Common problems and needs are identified that support the approach. *This approach is learner-centred* (Vars, 1991:15).

The **unstructured core approach** refers to a situation where educators and learners together identify units, themes and aspects thereof that will be used during the teaching. These units and themes must be at the level of the learners intended for (Vars, 1991:15). (*This approach is also essentially learner-centred.*)

4.3.7 Thematic approach

The **thematic approach** differs in many ways from the traditional approach that is found at most schools. The traditional approach treats each class as an isolated unit with little or, in many cases, no integration between classes. Often, teachers seem to wear blinders, remaining unaware of what is happening beyond their own classrooms, and the students learn to view each class as an unrelated, separate entity. If any connections are found between subjects, they are most likely considered irrelevant. The result is that students often miss the meaning of information and lack the ability to apply what they do learn (Peters *et al.*, 1995:633).

Peters *et al.*, (1995:634) state further that the thematic approach, on the other hand, encourages a holistic study of a subject. With the school immersed in a theme, the connections between classes are recognised and cultivated. The students learn the basic subjects through activities that are based on the theme. By actually applying the skills that they learn in these subjects, they come to see how and why the skills are meaningful. Real events require people to integrate different areas of knowledge.

Peters *et al.*, (1995:634) further maintains that a thematic approach also reflects the most recent research on how the brain comes to know. There are two ways that we remember new information. The traditional classroom emphasises one method, which is the memorisation of isolation facts and concepts. A second method that educators and researchers have recently recognised is the approach based on the theory that our minds organise pieces of related information into complex webs, called schemata. New information becomes meaningful when it is integrated into our existing schemata. In this way, knowledge builds on itself, and the schemata grow exponentially. A thematic approach takes advantage of this process by having all the subjects revolve around a central theme, thus enabling students to develop complex webs of interconnected information.

The integration of TSE in natural science and technology needs to utilise the thematic approach, which is evident in the multidisciplinary, interdisciplinary and trans-disciplinary approaches of integration, which are explained in sections 4.2.2.1 to 4.2.2.3.

4.4 General discussion of the forms of integration

The educator should use whichever of these integration forms that he/she finds comfortable in facilitating learning towards the achievement of learning outcomes. It should be noted that some of the Learning Outcomes (LO) might require a specific integration strategy or form in order to reach them. It is therefore of utmost

importance that educators are introduced to all forms of integration so that they can select and use comfortably with respect to any given LO.

Berlin and White (1991:340) warn that integration of knowledge in any given subjects should not be a product of the nature of the activity but rather of conscious design and involvement of isolated activities in an organised programme. On this note, it would be said that these forms of integration as discussed above are applicable to all learning areas. This means, educators can use any one of them to consciously design/plan and integrate knowledge with other learning areas using a programme organiser from any learning area. An example is given in *Appendix G*.

However, since the study's focus is integrating Road Safety into learning areas, an example is with a programme organiser from traffic safety to illustrate how to integrate knowledge from various learning areas in section 4.6. It is important to note that as one does what is indicated in *Appendix G*, one is:

- *Integrating Traffic Safety Education into the learning areas, and*
- *Integrating knowledge from one learning area to another.*

To help educators integrate Traffic Safety Education conveniently into the eight learning areas; the LOs and AS (Assessment Standards) have been arranged in "grids" under phase organisers as they relate to specific learning areas (*see Appendix F*). An example of a learning experience (lesson) is given (in *Appendix G*) regarding how traffic safety education can be integrated in the learning areas of natural science and technology among others. Berlin and White (1992:341) maintain that integrating

traffic safety education into other learning areas will greatly help students understand the value of the knowledge that they are learning and its connections with other aspects of their knowledge.

4.5 Chapter summary

In this chapter, the concept of integrating traffic safety education with science and technology has been discussed. The different integration approaches were outlined. An example of a learning experience (lesson) was given in *Appendix G* for the integration of traffic safety education in the learning areas of natural science and technology. It is proposed that the example of a learning experience given in *Appendix G* would help educators in integrating TSE in school.

In the next chapter, the proceedings of the qualitative study through interviews will be presented and discussed. These discussions will pave the way for the drawing of conclusions of the study and subsequently the making of recommendations.

CHAPTER FIVE

5. RESEARCH DESIGN

5.1 Introduction

In chapter four, a discussion was made of the integration of traffic safety education in science and technology within the OBE framework. The chapter rounded up the series of literature surveys on the topic, concepts and sub-concepts, which were central to the study.

The purpose of chapter five is to outline the methodology that was applied to obtain and utilise information/data from both primary and secondary sources towards attainment of the aims (see section 1.3) of the study.

In section 1.4, the methodology of the study was highlighted. In this chapter an outline of what transpired during the implementation of the methodology is given. Also, a report on the precise procedures undertaken in carrying out the study as well as the shortcomings experienced during the study is presented.

This chapter therefore presents the reality about methodological aspects and procedures, which prevailed during the course of the study. The main questions

viz.: how, where, when and why certain procedures were followed and decisions made, are all answered directly or indirectly in this chapter. In this way, explanation or clarity is given for the actions (e.g. information gathering, classification, analysis, interpretation and application of data to answering the problem questions of the study) taken in carrying out the study.

Furthermore, the chapter covers the following aspects that are presented under sections 5.2 to 5.10 below: research design which includes instrument, population and sample, validity and reliability, focus group interviews, pre-testing of the interview schedule, the *modus operandi* of interviews or administration procedures of the instrument; and the methodology for interpretation of data.

5.2 Aims of the research design

The aim of any research design is to select or choose and utilise the methods and techniques that the researcher considers imperative to yield a better attainment of the aims and objectives of the study being conducted. There are numerous research methods in literature, which researchers employ for specific nature and kind of research to be undertaken (Qualitative Research Consultants Associations, 2003:1 & Hoepfl, 1997:1-2). It is difficult to find one single research method being suitable for carrying out every type of research problem at all times. There are clusters of other factors that implicate the choice of research

methods for any given research problem such as, the nature and dynamics of the problem being researched, costs, and time (Oppenheim, 2001:81 & Hoepfl, 1997:1-2) to mention only a few. As such, it is mandatory that a specific research problem be solved through relevant research methodology (Qualitative Research Consultants Associations, 2003:1 & Hoepfl, 1997:12). For these reasons researchers have to consciously and purposefully select and utilise only those research methods that would permit better, convenient and successful attainment of specific research aims (Hoepfl, 1997:5). This study is not an exception and therefore the research method and techniques considered by the researcher to be relevant are utilised as presented in sections 5.3 to 5.10.

5.3 Qualitative Research

5.3.1 Aims of qualitative research

De Bruyn (2003:210), Hoepfl (1997:2-3) and Hughes (2003:23) indicate that qualitative research is multi-method or mixed-method in nature and focus. It involves an interpretative naturalistic approach to its subjects matter. By this statement it implies that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. This study therefore seeks primary data from people who are directly involved with the subject matter in focus.

The primary sources of data used in this study as stated in section 5.8 were Government officials (in the Departments of Transport and Education) who were in managerial positions.

The 28 persons (see section 5.8 for why 28 persons) were interviewed in their natural settings and the data collected was described and interpreted with the following aims:

- To establish whether or not the policies of Government regarding integration of TSE in the mainstream school curriculum by 2005 are being achieved.
- In the event where the above aim is not performed, then to determine what possible hindrances might have militated against the implementation of the policy decision to integrate TSE in the mainstream school curriculum by 2005.
- To document what practitioners in the field of TSE perceive the relationship among science, technology and traffic safety to be. As this would shed some light onto their understanding of the importance of teaching/learning TSE in schools.

The research method utilised for the collection of data was the interview, which included 7 focus group interviews and 5 individual interviews. The individual

interviews were considered as pre-testing of the interview schedule (see section 5.9.4 for the pre-testing of the instrument).

5.3.2 *Focus group interviews*

Purpose of the interviews

According to Richter and Peu (2004:31), the term focus group interview is a qualitative technique, using discussion among a group of 4 – 12 people, in a comfortable, non-threatening environment, to explore topics, or obtain perceptions about a given problem or topic of interest. The technique makes use of group interaction, to provide insight and data, which is not accessible without the stimulus of the group discussion. Such an interview is conducted with the limited group of persons who have been brought together for the same and specific purpose.

The use of focus group interview (FGI) technique or method of research is suggested in literature by Oppenheim (2001), Leedy (1997), Gall *et al.* (1996:307), De Vos (2002:306), Leedy and Olmrod (2001:159), Coleman and Biggs (2002:150), and De Bruyn (2003:211). From these studies, the aims/purpose with focus group interviews are hereby formulated as follows:

- To collect data within limited time.
- To supplement data that was collected by means of questionnaires.

- Ideas, views and perceptions of participants are verified and synthesised through the discussions.
- Focus groups provide insights into the attitudes, perceptions and opinions of participants.
- To confine the role of the interviewer to that of initiating discussion rather than playing the directive role. In this way participants take major responsibility for stating their views and drawing out the views of others in the group.
- The interactions among the participants stimulate them to state feelings, perceptions and beliefs that they would probably not express if interviewed individually.

It was with the above in mind that the qualitative interview method of focus groups was opted for in this study.

5.4 Aims of the interview

The use of interviews in research has been recommended by different authorities in the field including in the works of Mouton (2001:105); Mouton (1998:66, 144-145, 151 & 175) ; Tight (2003:192) and Oppenheim (2001).

The aim of the interviews was to obtain primary information from the subjects who were selected (see section 5.8 for discussion of the sampled population) to participate in the study. Due to the nature of the study, the researcher wanted to:

- ❖ ask numerous open-ended questions (Nolan & Hoover, 2004:18), or open-ended probes.
- ❖ record verbatim the answers given by the respondents.
- ❖ accord responders opportunities to say what they think and to do so with great richness and spontaneity.
- ❖ generate or attain an improved response rate by interviewees and by so doing enhance the quality of the study. These aspects concur with the advantages of interview schedule stated by Oppenheim, (2001:81) and Sciarra (2004:63).

Furthermore, the researcher wanted to gain first-hand-in-depth information from the subjects on the items of the interview schedule (see Appendix B). Not only was the researcher interested in what the subjects had to say, but also in how and why they said it. Such depth of involvement and observation was required to enable the researcher to form a holistic view/picture on the feelings and desires of the subjects, which were critical regarding the items of the interview schedule.

5.5 Construction and description of the interview schedule

The instrument used in this study is an interview schedule (refer to Appendix B). As stated in section 1.4.3, semi-structured interviews were conducted. To that effect the interview schedule was constructed as described below. Due to the nature and quality of inputs expected for a study like this one, it was opted that the interviews would be conducted with leading persons in the field of traffic safety in the ranks of academics, directors, and managers in the Departments of Transport and Education (see sections 1.4.3 & 5.8 for details).

The interview schedule consisted of 11 key questions (see Appendix B). These questions were formulated strategically and specifically to address the five research questions posed in sections 1.2 leading to the attainment of the aims of the study stated in 1.3.

The question-distribution per research aims is shown on Table 5.1 below.

Table 5.1: Interview items related to specific aim(s) of the study

Sections under which the research aims of the study were stated	Distribution of interview items per research aim(s)
<u>Research aim 1</u> (see paragraph 1.3.1): Determine the relationship that exists among science, technology and traffic safety that can warrant their integration.	Interview items 3, 4, & 7.
<u>Research aim 2</u> (see paragraph 1.3.2): Outline the impact of science and technology on traffic safety.	Interview items 3 & 4.
<u>Research aim 3</u> (see paragraph 1.3.3): Discuss strategies that could be used for integrating traffic safety education in the learning areas of natural science and technology.	Interview items 5, 6, 8, & 11.
<u>Research aim 4</u> (see paragraph 1.3.4): Establish whether or not there are hindrances to the integration of traffic safety education in the mainstream school curriculum.	Interview items 1, 2, 3, 4, 7, 9, 10, 8, & 11.
<u>Research aim 5</u> (see paragraph 1.3.5): Develop an integration model, which indicates how traffic safety education should be integrated in the learning areas of natural science and technology.	Interview items 3, 4, 5, 6, & 11.

Four of the eleven questions had a structured follow-up question each. These questions were question number 2, 3, 4, and 11. Also, for questions number 1, 7, and 9, interviewees had to justify or motivate their answers.

Due to the nature of the themes of the study, the interview items on the interview schedule were formulated from the content of the policy documents of the South African National Departments of Transport and Education respectively namely: “the Road to Safety strategy 2001 to 2005” and the National curriculum policy and statements 2005”. Amongst other aspects, the policy outlines the inclusion of road safety education in the mainstream school curriculum by the year 2005 (NDOT, 2001:28). These questions were not directly copied or adapted from these documents but were rather formulated from policy statements which lay the requirements, contents, and stipulations regarding issues that inform the problem of this study. As such, questions 1, 2, 4, 5, 9, 10, 8, 11.1 and 11.2 were formulated on the basis of these policy documents.

Furthermore, from the study of literature – a table of curricular elements of the three fields (Science, Technology and Traffic Safety) was compiled – as shown on Table 2.1 in Chapter two of the study. It should therefore be noted that questions 3.1, 3.2, 4.1, 4.2, and 6 as raised in the interview schedule emanated from the information on the very Table 2.1.

Finally, questions 5 and 6 were formulated/raised on the basis of the literature study (Drake, 1991; Vars, 1991; Peters *et al.*, 1995; Berlin & White, 1992) in chapter

four under sections 4.3.2 to 4.4. The aim of raising these questions in the interview was to compare the views of subjects with the information in literature in order to design the multi-lateral integration model presented in chapter 7 (see Figure 7.1).

Oppenheim (2001:144-148) contends with regards the validity and reliability of interview questions that questions chosen or formulated by the researcher need to be compared with questions on standardised instruments, which are widely used in the field being researched. Keeping in line with this principle, the researcher surveyed literature for the purpose of identifying any such standardise instrument against the questions of the interview schedule (in Appendix B) would be compared but to no avail. As such, it is hereby mentioned that to the best of the researcher's knowledge the items of the interview schedule constructed for this study have only been used in this study. That is, the researcher did not find any evidence in literature at his disposal of these questions being used in other researches.

5.6 Modus operandi of interviews

Lists of subjects were compiled per province and as explained in section 5.8, the first top officials in rank were selected to participate in the study. The researcher obtained the contact details of the subjects and contacted them telephonically and via electronic mail (e-mail) to notify them of their selection as well as to request for their participation in the study. The researcher outlined and discussed with each interviewee what expectations s/he was to meet regarding the interviews. On their acceptance to participate in the study as subjects, appointments were arranged with them on dates that suited all subjects within the given/specific province.

After the appointments were made, the interview schedule (see Appendix B) was then sent to the subjects either via e-mail or fax as the case was; this was to afford them an opportunity to familiarise themselves with the content of the interview schedule before the meeting time.

On the appointed date and time, the researcher met with the interviewees and conducted the interview. There were instances where the interview did not start on the stipulated time due to several factors, for example, unforeseen issues or matters in the workplaces of subjects.

In many of these cases, both parties met for the first time at each such interview meeting which started with introduction of selves, then the purpose of the interview (repeated). During the interview, the questions on the interview schedule were used as primary questions and depending on the answers of the respondents, follow-up questions were raised by the interviewer. The purpose of the follow-up questions was to gain clarity and more information or understanding on the responses of the subjects on the matter(s) being discussed.

The follow-up questions such as: “motivate your answer” were raised depending on the kinds of responses given by the interviewees. This technically means some interviews lasted longer than others did. The approximate time allocated per interview was one hour.

Though, there is an overriding perception that the presence of recording devices in an interview session may deter respondent(s) from expressing their opinion freely, Gall *et al.* (1996:320) maintain that the interviewer should sufficiently explain the purpose of the recording to the respondent. Consequently, a pocket tape recorder was used to capture the proceedings of the interviews with the interviewees’ permission. (The fact that recording devices would be used in the interview was made known to the subjects whilst briefing them about the procedure of the interviews.)

At the beginning of the interview session(s), the researcher affirmed the purpose of the interview and gave assurance that all the views gathered from the subjects would be respected and treated confidentially. Interviewees were given an opportunity to ask any questions regarding the procedure and conduction of the interviews. After every uncertainty was clarified, then the researcher started asking the questions on the interview schedule in a chronological order from questions 1 to 11. The interview meetings ended with expression of thanks and appreciation for the interviewees' participation and contribution to providing answers to the problem(s) of the study. Finally, the researcher would bless the interviewees with blessings from the God and Father of Jesus Christ.

5.7 Decoding of the data

The interview data was recorded on audio-cassettes. As such, the researcher had to make time to:

- Play back each tape in chronological manner as the interviews had been conducted,
- listen to all the tapes very carefully and
- write down the information on the tapes.

The researcher decoded the data by writing verbatim on paper what was contained on the tapes. However, in cases of grammatical mistakes in the sentences and the use of in-appropriate terms/language, the researcher corrected

with (own) suitable words. *This means that the data was presented as exact as the subjects gave it.* On the basis of the foregoing, the interpretation of the data was made (see section 5.10) accordingly towards achieving the aims of the study.

In order to ensure validity and reliability of the accuracy of the data decoding, the triangulation by person technique was used. The researchers used two other academics experienced in research and in the field of study to verify the accuracy of data decoding. This was done for the purpose of ensuring that the decoding of data done by the research is valid. Hughes (2003:64-65) and Oppenheim (2001:146-7), among others uphold this research technique in literature.

5.8 Population and sample

As stated in section 1.4.2, four persons per province participated in the study. Focus group interviews (FGI) were conducted in 7 of the 9 provinces of South Africa with 4 members from each province ($N = 7 \times 4 = 28$ persons). As indicated in 1.4.2, the 28 people were selected from the Departments of Transport and Education with 14 interviewees from each department. The selection of the sample was based on seniority in their ranks. That is, the first top four officials in rank were selected per province (2 officials per department). The decision to use the non-probability sample technique (Leedy, 1997) was motivated by the nature of the study which required people with in-depth knowledge and experience

with regards policy around which the interview questions were based. It was contended that such decision would add value to the quality and outcomes of the study.

❖ *Why only views of seven provinces were used in the study:*

The study intended to use all nine provinces of South Africa (see Table 1.1 for list of the provinces). However, focus group interviews were only possible in 7 provinces as shown on Table 5.2 below. The two provinces namely Northern Cape (province number 7 on Table 5.2) and Western Cape (province number 9 on Table 5.2) could not grant the focus group interviews. 6 attempts were made over a period of one and half (1½) months (through telephone calls and electronic mail) to hold focus group interviews but to no avail. Though no reason was given by Western Cape, the research associates a possible reason to the fact that because the target group was top management, they could not get a common date and time on which the FGI could be held. Consequently, due to pressure of the time factor, the researcher had no choice but to leave these two provinces out of the study.

Table 5.2 List of the provinces of South Africa, which granted focus group interviews (FGI) and those that did not

<i>S/No</i>	<i>Name of province</i>	<i>Granted FGI?</i>	<i>S/No</i>	<i>Name of province</i>	<i>Granted FGI?</i>
1	Eastern Cape	√√	6	Mpumalanga	√√
2	Free State	√√	7	Northern Cape	xx
3	Gauteng	√√	8	North West	√√
4	KwaZulu Natal	√√	9	Western Cape	xx
5	Limpopo	√√			

Key:

√√ Signifies that the province in question granted the FGI.

xx: Typifies that no FGI did take place in the province in question.

5.9 Validity and reliability

In this paragraph, a justification is provided for the validity and reliability of the research:

5.9.1 Interview questions

Concerning reliability of the questions, which form the interview schedule, a number of aspects were considered such as:

- i) the questions were formulated on the basis of policy documents as indicated in section 5.5.
- ii) The questions were pre-tested (see section 5.9.4) with 2 renowned individuals/academics/researchers in the field of traffic safety who did not constitute or form part of the subjects of the study.
- iii) another measure of reliability was to interview respondents for the second time (Oppenheim, 2001:146 & Walker *et al.*, 2004:93), however, respondents were not interviewed twice in this study due to time and cost factors. However, the researcher feels (no matter how subjective this could sound), that the information obtained from subjects was sufficient grounds for addressing the problem investigated.

5.9.2 Interview schedule

Validity of interview schedule: The validity of the interview schedule constructed for the study is founded on the basis that the interview questions were raised from policy issues and decisions made by Government Departments with regards integration of knowledge among learning areas and the pinpointing of TSE to be integrated in the mainstream school curriculum by 2005 (NDOT, 2001:28). The fact that the interview questions are based on the Governmental policy statements ensures their validity – for gathering data that would address the problem questions of the study.

Another point that affirms the validity of the interview schedule is the fact that the subjects of the study are the people who are responsible in whole or in part for the implementation of these government policies.

5.9.3 Interpretation of data

To ensure validity of the interpretation of the interview data, the triangulation (O'hanlon, 2003:42, 72, 76-77, 84, 87) by person technique was used. The researcher used two other academics that are well experienced in research and the field of study to verify the accuracy of data well experienced in research and the field of study to verify the accuracy of data decoding and interpretation. This was done for the purposes of ensuring that the interpretation of data done by the research is valid. Also, the answers or responses were analysed against data from literature. The limitations of this research method are found in literature (Hughes, 2003:64-65; Oppenheim, 2001:146-7), and the researcher cannot claim that these interpretations were absolute.

5.9.4 Pre-testing of the interview schedule

The interview schedule was pre-tested with 5 individuals with the following aims (Gall *et al.*, 1996:317):

- To identify possible communication problems and this would lead to rephrasing of the questions where necessary.

- To establish whether or not some of the questions were ambiguous and could lead to different interpretations by different participants.

Based on the results of the pre-test of the interview schedule, questions 1, 2, 3, and 4 were rephrased and questions 6, 7, 8, 9 and 10 were rearranged.

5.10 Data analysis and interpretation

Due to the fact that focus group interviews were held separately in each of the seven provinces (see Table 5.2 above), the data was captured and presented in table format according to province by province. As such, data collected and decoded as explained in sections 5.6 and 5.7 were therefore analysed and interpreted province by province in Chapter six. Discussion of the data was made by way of quoting verbatim the information given by the subjects as presented in chapter 6.

Furthermore, data was organised question by question according to the question-sequence on the interview schedule. For every question on the interview schedule, the views of all seven provinces were presented – province-by-province – in table form for the purposes of analysis and interpretation of the data.

5.11 Chapter summary

In this chapter, the research design for the qualitative research was presented. An interview schedule was developed with 11 questions, which was used in the semi-structured interviews.

The qualitative research method utilised focus group interviews comprising of 4 persons in each of the seven provinces of South Africa that granted the FGI.

Data from the interviews were recorded, decoded, structured, analysed and interpreted in chapter six.

CHAPTER SIX

6. RESULTS OF THE INTERVIEWS: INTERPRETATION AND DISCUSSION

6.1 Introduction

In chapter five, the methodology that was applied to obtain and utilise information/data from both primary and secondary sources towards attainment of the aims (see section 1.3) of the study was outlined.

In this chapter, the focus is on the presentation of data collected from *interviews*, which were conducted with leading individuals in the field of traffic safety, and the learning areas of natural science, technology and life orientation. The results of the interviews were interpreted and discussed, with the necessary weighting to meeting the aims of the study as stated in 1.3.

The review of literature as in chapters 1 to 4, provided parts of solutions or answers to the research questions posed in 1.2.1 and 1.2.2. However, other parts of the answers or solutions to the research questions had to come from the empirical aspect of the study to create a balance and a broad basis on which suggestions would be made and a remedy would be consolidated for the problem(s) under investigation in this study.

To conduct the interviews, an interview schedule (see Appendix B) was constructed (refer to section 5.5) and used in all the interviews. Leading individuals in the field from seven provinces (see Table 5.2 for list of provinces) were interviewed. The interviewees were in the ranks of directors, subject advisors, and managers.

The proceedings of the interviews are presented in section 6.4. Note should be taken that the responses are grouped and presented in an integrated manner (like in the case of questionnaires), especially, in cases where the responses were the same or similar. Only in cases where there is significant differing of opinions, which offer crucial insights to the problem of study that such responses are treated individually or separately. Of course, treating such a large number of responses from the interviewees individually would have (unnecessarily) thickened the volume of this document.

It is important to keep in mind that the interview schedule was designed to investigate the problem questions of the study (see sections 1.2.1 to 1.2.5) towards integration of Traffic Safety Education in the *learning areas* of (natural) science and technology in (Grades 6 to 9) South African Schools.

6.2 Codifying provinces with their responses in Appendices

On Table 6.1 below, a list of provinces and Appendices on which their responses are presented (see Appendices H to N) verbatim and discussed in section 6.4 below.

Table 6.1 List of provinces linked with Appendices on which their views are presented verbatim

Provincial focus group interviews (FGI)	Code assigned for the Provincial FGI	Appendix containing data of provincial FGI
Eastern Cape	(FGI: 1)	H
Free State	(FGI: 2)	I
Gauteng	(FGI: 3)	J
KwaZulu Natal	(FGI: 4)	K
Limpopo	(FGI: 5)	L
Mpumalanga	(FGI: 6)	M
Northern Cape	-	No FGI results
North West	(FGI: 7)	N
Western Cape	-	No FGI results

The codification given in Table 6.1 above is done for the purposes of making data discussion and interpretation more manageable.

6.3 Proceedings of interviews: presentation and integration of responses

6.3.1 *Prologue*

The responses obtained from focus group interviews with provinces are presented in Appendices H to N and discussed in section 6.4. Due to the fact that data obtained from the focus group interviews is presented in Appendices (H to N), a summary of the responses from all 7 focus group interviews is given in this section (6.3).

6.3.2 *Relationship among aims of the study, interview schedule and chapter divisions of the study*

Table 6.2 shows the distribution of interview items according to the aims that they were designed to address and the chapters in which the aims were achieved.

Table 6.2: Interview items related to specific aim(s) and chapters of the study

Sections under which the research aims of the study were stated	Distribution of interview items per research aim(s)
<u>Research aim 1</u> (see paragraph 1.3.1): Determine the relationship that exists among science, technology and traffic safety that can warrant their integration. (<u>Dealt with in Chapter 2.</u>)	Interview items 3, 4, & 7.
<u>Research aim 2</u> (see paragraph 1.3.2): Outline the impact of science and technology on traffic safety. (<u>Addressed in Chapter 3.</u>)	Interview items 3 & 4.
<u>Research aim 3</u> (see paragraph 1.3.3): Discuss strategies that could be used for integrating traffic safety education in the learning areas of natural science and technology. (<u>Addressed in Chapter 4.</u>)	Interview items 5, 6, 8, & 11.
<u>Research aim 4</u> (see paragraph 1.3.4): Establish whether or not there are hindrances to the integration of traffic safety education in the mainstream school curriculum. (<u>Dealt with in Chapter 6.</u>)	Interview items 1, 2, 3, 4, 7, 9, 10, 8, & 11.
<u>Research aim 5</u> (see paragraph 1.3.5): Develop an integration model, which indicates how traffic safety education should be integrated in the learning areas of natural science and technology. (<u>Designed in Chapter 7.</u>)	Interview items 3, 4, 5, 6, & 11.

Responses to these interview items (see Appendix B) are summarised in 6.3.3 and discussed in section 6.4 with a view to attaining the aims of the study.

6.3.3 Summary of responses to interview items from the focus group interviews

6.3.3.1 Interview item 1

Interviewer asks:

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

- It is important that our children are taught to survive in life.
- Though it is primarily their responsibility, parents do not teach TSE at home due to lack of time and (even) knowledge.
- As such, the school needs to take-over the responsibility from parents. So it is good for the school to teach TSE.
- The media should cater for the youth that are outside school.
- It will create a safer atmosphere on the roads.
- In the past (before 1995), TSE was part of the school curriculum and the roads were safer. Let us move back to its inclusion in the school curriculum. The foundation must laid in Grade R and Primary school.

Driver education should be introduced in Grade 11 when learners are of age.

6.3.3.2 Interview item 2

Interviewer asks:

2.1 *Should traffic safety education form part of the school curriculum?*

Interviewees responses:

Yes. TSE needs to be included in the curriculum.

Interviewer asks:

2.2 *How do you see or feel that it should be incorporated in the school curriculum?*

Interviewees responses:

TSE should preferably be a fulltime subject in school. However, since it's not possible now, it should be integrated in other learning areas. The emphasis in the integration should however, be on "Safety" rather than "Transportation" as it is the case currently.

Assignments should be given to learners to do in TSE, just like it happens in the UK where learners are given assignments based on real life situations and are urged to carry out the assignment as such.

6.3.3.3 Interview item 3

Interviewer asks:

3.1 *To your mind, is there any relationship among road traffic safety, science and technology?*

Interviewees responses:

Yes. TSE is a science – a multidisciplinary science in which many people are working.

Interviewer asks:

3.2 *How would you describe the relationship among road traffic safety, science and technology?*

Interviewees responses:

Aspects like friction, traction, and different types of forces all apply in Traffic and give good ground for integration.

Everything in the world (including TSE) needs to keep pace with technology. Information Technology (IT) infiltrates the road environment, traffic engineering, law enforcement, and technology in vehicles, just about everything.

The use of tools, products, services, procedures and concepts is a technological element, which is found in TSE as well. In Traffic Safety, one can use technology to check vehicle speed, test people against the use of

drugs and alcohol, and improve the functioning of traffic signals. All this is technology.

6.3.3.4 Interview item 4

Interviewer asks:

4.1 *Do you think that traffic safety education can be integrated in the learning areas of (natural) science and technology?*

Interviewees responses:

Yes.

Interviewer asks:

4.2 *In your opinion, how should these be integrated?*

Interviewees responses:

It should be done “thematically”. That is by making use of themes that are common or share common aspects in these fields like Traction, Force of gravity etc. Worked-out lessons should be given to educators to use. The Internet and or computer programmes could also be used. These aspects would need the involvement of the NDoT and NDoE.

- One could ask learners to do measurements in the road environment (when it is safe). Measurements such as the length of vehicles, size of tyres and tyre prints to mention a few.
- Give learners assignments.
- Do structured lecturing to equip learners with knowledge and skills.

6.3.3.5 Interview item 5

Interviewer asks:

What forms of integration models are currently being used in schools to integrate knowledge, attitudes and skills among the learning areas?

Interviewees responses:

There are a number of integration models that can be used. Though, they prefer:

- Multidisciplinary approach
- Interdisciplinary approach
- Total staff approach

These approaches were explained in chapter four.

6.3.3.6 Interview item 6

Interviewer asks:

In your opinion, what other methods could be employed to teach road traffic education in schools?

Interviewees responses:

- Make use of campaigns in which educators and learners are fully involved.
- Also, involve students' councils in the promoting of traffic safety education.

Simulated traffic situations e.g. learning how to drive should be used. The instructor observes and makes valid decisions.

Organise a "road safety day" for a specific Grade (at a time) at school with the involvement of the local Traffic Department. Get the school involved. Distribute posters and other relevant material/information. The Municipal Hall could be made available for use in this regard. Give the Municipality the topic of the day and challenge their Department of Arts and Culture to assist with the organisation.

Follow-up question: Would the principals allow their learners to leave school during hours for this kind of event?

Answer: Possibly, yes. Select pilot schools and give the project a run.

6.3.3.7 Interview item 7

Interviewer asks:

On the basis of the relationships you have outlined between road traffic safety and science as well as between road traffic safety and technology, would you suggest/recommend that these should be taught in an integrated manner in our schools?

Interviewees responses:

Since there is no alternative like TSE being an independent subject, it is necessary to integrate it in other learning areas. The integration could be done in the following manner:

- Use the quality control model. In this model you give tasks to learners like the following: according to the traffic Act, from 18:00 to 06:00 the headlights of vehicles must be switched on. The learner should go and observe and count how many drivers switched on their lights or not, then analyse, conclude, and use the information.
- Send them to observe and count how many people stopped or did not stop at stop signs, traffic signals, or wear seatbelts. Ask questions like: do you think it is right for people to disregard the rules and laws of the road? Why so, or why not?
- Give them something practical to do, instead of only theory or formulae.

6.3.3.8 Interview item 8

Interviewer asks:

The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of traffic safety education in the mainstream school? How far (if you know), are the two Departments with implementation of this strategy?

Interviewees responses:

There was a hand-over of the RSE curriculum (in the Western Cape) from the National minister of NDoT to the one of NDoE a few years ago. After that there is nothing that I heard of that happened again. However, the content of this curriculum laid the focus on Transportation rather than Safety. And this needs to be adjusted.

6.3.3.9 Interview item 9

Interviewer asks:

Are educators trained sufficiently to integrate TSE knowledge, attitudes and skills among the learning areas?

Interviewees' responses:

All the respondents answered that educators are not sufficiently trained to integrate TSE in the learning areas. They gave a number of reasons such as:

- TSE was not included in educators' training programmes.

- Most educators cannot teach TSE and are not teaching it.
- Only two colleges of education in the country and the then Potchefstroom University (now North West University) included TSE in some of the educator training programmes but have stopped it.

There is therefore no evidence that educators across the country are adequately equipped to teach the field of TSE.

6.3.3.10 Interview item 10

Interviewer asks:

Seen that it is important and even necessary to teach road traffic education through the integration strategy, what can be done to bring educators abreast with this requirement?

Interviewees responses:

- Convince educators to have interest in teaching TSE in school.
- Bring the reality of road accidents closer to the educators by way of giving examples that relate to their situations.
- Include it as compulsory in educator training programmes throughout the country.
- DoE and DoT must agree on this and make it policy/legislation.
- Workshops should be held with Subject Advisors to in turn train the educators.

- The DoT should approach the DoE and request to be part of the training programmes/workshops that are on going for the training of the educators in the OBE curriculum like the environmental people are doing.

Follow-up question: Who is sponsoring these workshops?

Answer: The environmental people got sponsorship from the Swedish Government. But one can approach NGOs and the DoT.

6.3.3.11 Interview item 11

Interviewer asks:

11.1: In your opinion, what are the hindrances to the integration of Traffic Safety Education in schools?

Interviewees responses:

- The depth and seriousness of the problem is not well grasped by the community, including educators.
- Time factor, seeing that the school curriculum is loaded and opened to many aspects and applications.
- Inadequate training of educators.
- Lack of active involvement and participation from the country's top management group. For example, president, ministers and premiers.
- Educators are overloaded with work.

Interviewer asks:

11.2 How could these be overcome?

Interviewees responses:

- Through awareness campaigns
- Convince the school community to see the need for teaching TSE and get involved.
- Get educators trained in TSE to cultivate the TSE culture in school? Peer education could also find a place to contribute to solving this problem.
- The country's top management group, for example, president, ministers and premiers should become actively involved and participate in TS matters.

The integration strategy could help in solving the problem of taking TSE into the school classroom.

6.4 Interpretation and discussion of interviewees' responses

6.4.1 General interpretation and discussion of the responses

Responses given to questions 1 and 2 show that TSE is very important to be taught to children/learners and should be included in the school curriculum. Since this would lay a solid foundation on which children will be safe in life, on roads and show improvement in the moral and value degeneration being

experienced in South Africa. This is in line with the position of the Economic Commission for Africa (1997) that it is important that RSE be taught to all our young people so that they can participate safely in traffic situations.

Responses from FGI 3 to question 1 and 2 (see Appendix C) imply that it is the responsibility of parents to lay the foundation for education in the lives of children, however, due to other challenges, they fail to carry out this responsibility adequately. This results into passing or shifting the responsibility to the pre-school and school. By implication, if the school does not fill this gap, the future of our children and country is in danger. It is therefore imperative that the school should teach TSE to learners. This can only be done if TSE becomes part of the curriculum.

According to the International Road Federation (1986:110) in developed countries such as the Netherlands and Australia, the education approach of road safety has already brought about a decline in the rate of road accidents. This implies that if road safety education receives necessary attention in our schools, the benefits thereof would be apparent from one generation to the other. Road safety education is aimed mainly at inculcating proper attitudes that will be translated into proper behavioural patterns needed whenever the safety of the individual is at stake.

In South Africa, we also need to make TSE an independent subject/learning area in school. Integration is only an alternative. As an alternative, integration is viewed as not having the potential to yield the desired results (FGI 7 & FGI 4 responses to interview questions).

From the way the outcome of the FGI 7 sounds, the idea of taking TSE into the classroom would not really work. This is because, they say, the curriculum has been thrown open and there is already so much to be done/covered such that nothing more is to be added. On the contrary, the outcome of the FGI 4 contends that it would be possible to include and even make TSE an independent subject in the curriculum. FGI 7 suggests that all stakeholders together with the DoE and DoT should engage in a discussion to finalise the inclusion of TSE in curriculum as an independent subject.

FGI H highlighted one of the key problems with the Outcomes-Based Education (OBE) as to what hurdles the educators are facing. Namely, due to the fact that the curriculum is being thrown open to “anything”; educators have a problem of not being able to think globally and act locally as it is expected of them. The educators at the moment are not competent to think at the required level. They need help and/or guidance to adapt to the broad thinking required by a curriculum other than the one of their subject discipline. The kind of thinking implied here needs a lot of experience in order to apply it adequately. This agrees with depictions or standpoint of FGI

3 that many teachers are not prepared to venture into the unknown or some new paradigms.

The question regarding the viability of integrating TSE in the learning areas of natural science and technology was met with overwhelming positive response. All 7 FGIs acknowledged the strong link among the three fields and maintained that the linkages would provide for the required integration. This was evident from the responses to questions 3, 4, 5 & 7.

Notwithstanding the foregoing, respondents preferred that TSE should be an independent subject. They argued that integration is not the right plane to take us to the desired destination. As such, synergy should be geared to establishing TSE as an independent and compulsory subject.

Concerning questions 6, 9, 10, 10 and 11; it was indicated that educators are not adequately equipped to integrate TSE in learning areas. As such, efforts should be made to bring educators abreast with the expectations in this regard. This can be achieved by helping/equipping them to overcome the obstacles such as lack of willingness on their side to get involved with the teaching of TSE in school. Subject Advisors need to be trained in TSE so that they can be in a position to coach the educators to deliver the goods.

Regarding question 8, it is worth saying that it is disappointing that the NDoT started something credible and raised people's hopes but to no avail. The five-year strategy is already in the 4th year and most of the people who are

supposed to be implementing it did not hear nor know about it! It is imperative that something should be done as a matter of urgency to get at least part of the strategy implemented within its last two years – 2004/5.

6.4.2 Key points emanating from the interviews

From the interview data presented in Appendices 8A to 8H, and discussed in 6.4, it is clear (among other aspects) that:

- It is vital to teach TSE to our children both in the school environment and outside school.
- TSE need to be included in the school curriculum. In the past (before 1995), TSE was part of the school curriculum and our roads were safer then. This means now that there is so much carnage on the roads, TSE needs to regain its place in the school curriculum.
- There is a close relationship among science, technology and traffic safety education that would warrant sound integration in the school curriculum
- It would be better to have TSE as an independent and compulsory subject/learning area in school (in the long run). However, for now, since it is not even part of the school curriculum, it should be integrated with other learning areas.
- Educators are not sufficiently or at all trained to integrate TSE in the learning areas. But they should be trained to do so. Preferably, TSE should be included in the educator training programmes throughout the country to facilitate TSE becoming an independent learning area in school.

- Educators do not seem to understand the need and importance of teaching TSE in school. This is one of the key hindrances against the integration strategy to materialise in school. As such, there is an urgent need to convince educators to get involved with TSE in their classrooms.
- A number of hindrances exist to the implementation of TSE in the school curriculum, and that these hindrances need to be overcome (see item 11.2 on Appendices 8C & 8H). This implies that we need to come up with ways, strategies, and methods that would facilitate overcoming of all the identifiable obstacles in this regard.

6.5 Chapter summary

In this chapter, the interview guide and how the interviews were conducted were described. It was stated in the introduction of the chapter that its focus was the presentation of data collected through interviews as well as interpreting and discussing of the data.

In section 6.4, the responses of interviewees were interpreted and discussed in an integrated manner. By an integrated manner, it means that the responses, which were the same and or had similar views (either directly or implied) were grouped together and interpreted/discussed as such.

In section 6.4.2, the key points that stemmed from the interviews were highlighted. The information in this chapter has laid a firm foundation on which conclusions and recommendations will be made in chapter 8 with the view of answering the research questions in 1.2.1 to 1.2.5. This would

eventually, lead to the attainment of the set aims of the study as in 1.3.1 to 1.3.5.

In the next chapter (7), a model for the integration of traffic safety education in the learning areas natural science and technology is developed for use in schools. An example is given with planning of a learning experience both in natural science and technology, which educators should use to facilitate the teaching and learning of traffic safety education in school.

CHAPTER SEVEN

7. INTEGRATION MODEL FOR THE TEACHING AND LEARNING OF TRAFFIC SAFETY EDUCATION IN NATURAL SCIENCE AND TECHNOLOGY CLASSES

7.1 Introduction

In the previous chapters (five & six), the interview schedule and how the interviews were conducted were described. It was stated in the introduction of chapter six that the focus of that chapter was the presentation of data collected through interviews as well as interpreting and discussing the data. In section 6.4, the responses of interviewees were interpreted and discussed. The information in chapter six laid a firm foundation on which conclusions and recommendations will be made in chapter 8 with the view of answering the research questions in 1.2.1 to 1.2.5. This would eventually, lead to the attainment of the set aims of the study as in 1.3.1 to 1.3.5.

Notwithstanding the above, in chapter four, a discussion was made of the integration of traffic safety education in science and technology within the OBE framework. Some key issues about outcomes-based education (OBE) such as: philosophy of OBE, change in terminology regarding OBE and the integration options within the OBE framework, were discussed as well.

In this chapter (7), a model for the integration of traffic safety education in the school learning areas is developed for use in schools. Examples of learning experiences (lessons) are given with two learning experiences, both in the learning areas of natural science and technology, which educators should use to facilitate the learning of traffic safety education in school. Educators are encouraged to use these examples and develop or plan other learning experiences in all the 8 learning areas and avail (road safety) life-skills to learners.

7.2 Developed model for integration of traffic safety education in learning areas

In chapter four, a number of approaches to integration were outlined. These approaches include:

- The multidisciplinary approach (discussed in section 4.3.2.1).
- The interdisciplinary approach (described in section 4.3.2.2).
- The trans-disciplinary approach (explained in section 4.3.2.3).
- The entire staff approach (see section 4.4.1).
- The block-time or self-study classes approach (refer to section 4.4.3).
- The interdisciplinary team approach (refer to section 4.4.2).
- Educators of different learning areas treat particular aspects of one topic at the same time approach (refer to section 4.4.4).
- The structured core approach (refer to section 4.4.6), and
- The unstructured core approach (refer to section 4.4.6).

All the above approaches have their merits and demerits. Some are too much time consuming, e.g. the structured core approach and the unstructured core approach (refer to section 4.4.6 for a detailed discussion on these approaches). Some approaches would involve many people who might have difficulty in meeting regularly to prepare and implement, e.g. the entire-staff approach and the interdisciplinary team approach (see sections 4.4.1 & 4.4.2 for a detailed discussion on these approaches). Even the block-time of self-study classes approach would not do justice to many of the weak learners, since they may have great difficulty in attaining the learning outcomes.

In view of the foregoing, after a careful study of these integration approaches (as discussed in sections 4.3.2.1, 4.3.2.2, 4.3.2.3, and 4.4.1 to 4.4.7), the study recommends the multidisciplinary approach (see section 4.3.2.1 for more details on this approach) as being most convenient and suitable for integrating traffic safety education in the learning areas.

This approach is therefore formulated into a model on the basis the integration approaches considered in sections 4.3.2.1, 4.3.2.2, 4.3.2.3, and 4.4.1 to 4.4.7 (naming it the “**multilateral learning areas integration model**”) that could assist educators to integrate desired knowledge, skills, and positive attitudes in traffic safety in the learning areas.

The crux of the model is in the creation of linkages among the relevant learning areas that have common elements to the theme(s) being taught.

The multilateral learning areas integration model that the study has formulated for integrating road safety education in the learning areas is presented in figure 7.1 below. As indicated above (under this section) this model is designed from the knowledge base of literature reviewed (Drake, 1991; Vars, 1991; Peters et al., 1995; Berlin & White, 1992) under sections 4.3.2.1, 4.3.2.2, 4.3.2.3, and 4.4.1 to 4.4.7. An indication of how the multilateral learning areas integration model can be utilised is given in section 7.4.

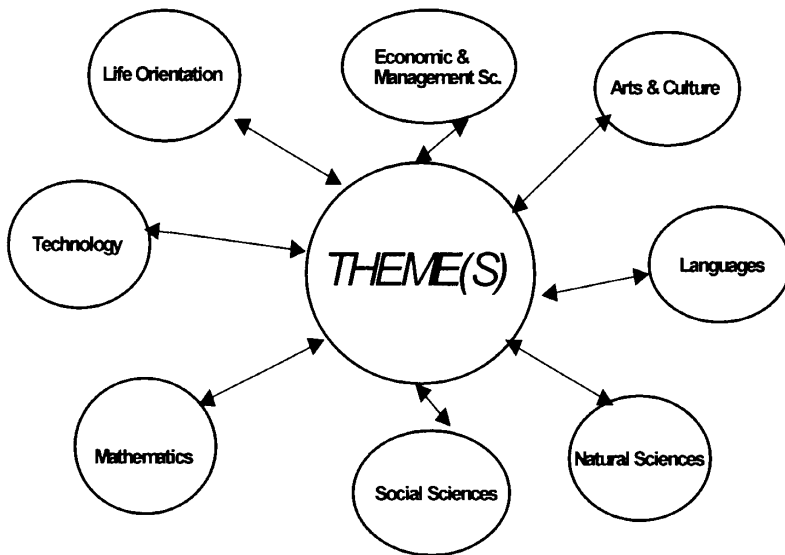


Figure 7.1 *Multilateral learning areas integration model*

{As already shown vividly above, the development of this model was informed by these studies: Drake (1991); Vars (1991); Peters et al. (1995); Berlin & White (1992) as covered in sections 4.3.2.1, 4.3.2.2, 4.3.2.3, and 4.4.1 to 4.4.7 of the study.}

7.3 Application of the multilateral learning areas integration model

An example is given below (in 7.4) as to how educators are expected to use the multilateral learning areas integration model in teaching and learning of road safety education in learning areas. Both examples (one in section 4.6 and the other in section 7.4) are given in the learning areas of natural science and technology since these are the learning areas focused on or zoomed in on in this study. Notwithstanding the above, the examples can easily be adopted for use in any of the eight (8) learning areas.

7.4 Learning experience (Lesson for Grade 7)

7.4.1 Integration grid based on Learning Outcomes (LOs)

Learning areas: Natural Sciences, Technology, Mathematics and Life

Orientation

Context: Understanding movement

Table 7.1: An integration grid for integrating TSE with other learning areas

[Key to the grid: LO = Learning Outcome; AS = Assessment Standard]

Name of Learning Area	LO(s) relevant to TSE	AS(s) relevant to TSE
Technology	LO2	1, 8, 12, 28, 29.
	LO3	6,7.
Mathematics	LO5	1, 3, 9.
Natural Sciences	LO1	5, 7.
	LO2	7, 8.
	LO3	5.
Life Orientation	LO2	3.
	LO3	1, 2, 3, 4.
	LO4	3.

The LO's and AS's are taken from Department of Education (2001:67,69, 71, 77).

7.4.2 Activity 1

7.4.2.1 Theme of activity: Force

Educator refers to a transparency bearing images in figures 1 and 2 under 7.4.2.4 and learners discuss the situation where the truck has broken down and one person is trying to move it to a position of safety. With such discussions, the concept of force is addressed.

7.4.2.2 Resources

- a) Poster
- b) Desk and bookcases.

7.4.2.3 Assignment 1

- Two learners pick up a desk.
- Load bookcases on top of the desk.
- Describe the mass of the loaded desk.

7.4.2.4 Assignment 2

- One learner pushes the desk across the floor.
- Stacks a few cases on top of the desk and pushes the desk.

- Stacks more cases on top and pushes the desk.
- Describes the amount of force needed to push the desk (force in terms of how many learners have to push) to obtain the same effect.

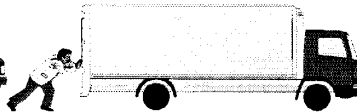
Statement: A parked vehicle is static.

- If you want to change its velocity (i.e. start to move it) the force must increase proportionally to its acceleration (provided that the mass remains constant).
- The heavier a vehicle is, the more force is required to change its velocity.

Fig.1



Fig.2



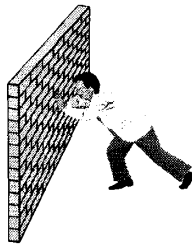
Answer the following questions:

1. Which of the two vehicles (fig.1 and fig.2) needs more force to change its velocity?

2.a. Explain what is necessary to change the position of the wall (see fig. 3).

b. (More learners will have to push the wall and get a feel.)

Fig 3



Use the attached Worksheet (at the end of this learning experience) to apply the knowledge acquired from this activity.

7.4.2.5 Suggested integration

- a) **Natural Science and Technology:** Force, comparing mass, pushing and pulling, effect on freight and passengers.
- b) **Mathematics:** Mass, speed, anticipation.

7.4.3 Activity 2

7.4.3.1 Theme: Friction

7.4.3.2 Resources

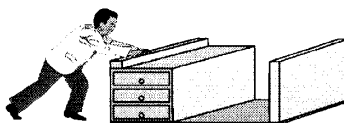
- a) A box with a flat base, or
- b) Table turned over on its top.
- c) A second table.
- d) Book cases.
- e) Broomsticks.

7.4.3.3 Assignment 3

Place the table or the box top down, on a smooth floor.

1. Let a learner push the table, apply force to change the position of the table. (If one learner cannot move the table, use a 2nd learner to help.)

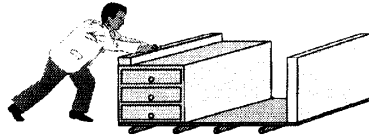
Fig 4



2. Take the table outside and place it on the ground. Let the same number of learners push it.

3. Place the table on broomsticks
on the smooth floor and the
learner should push it.

Fig 5



4. The same number of learners should push.
5. Place one table on the smooth floor and the second one on broomsticks. The same number of learners should stand on the table, which is placed on broomsticks and the other learner on the table, which is placed directly on the smooth floor (as in fig.6).

Fig.6



Observation:.....
.....

Explanation:.....
.....

Use the worksheet at the end of the learning experience to apply the knowledge gained in this activity.

7.4.3.4 *Suggested integration*

- a) **Natural Science and Technology:** Force, comparing mass, pushing and pulling, effect on freight and passengers.
- b) **Mathematics:** Mass, Speed, Anticipation, Estimation.

7.4.4 *Activity 3*

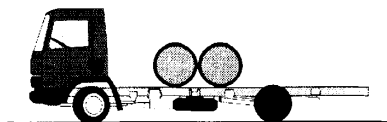
7.4.4.1 *Theme: Inertia*

The educator refers to the transparency containing a truck with barrels on it (see Figure 7 below). Learners discuss the situation and anticipate the possibilities of what could happen should:

- the truck stop suddenly,
- the truck go around a bend,
- the freight move forward,
- the freight shift to the back.

Learners carry out simple experiments to discover the answers.

Fig.7



7.4.4.2 Resources

A carriage, which could be a skateboard, roller skate, a toy truck or any flat object with wheels and a string attached at the front and loose objects to be loaded on top, e.g. blocks, boxes, etc.

7.4.4.3 Additional activities

- a) Put an object on the “carriage” and exert a small force to change the position of the carriage.
- b) Repeat the same actions carried out in 1 above, but the pulling should be sudden and hard.
- c) Tie an object to the carriage and do the same as in 1 and 2 above.

7.4.4.4 Questions to be answered in writing

1. What was needed to change the position of the carriage?
2. a. Tell what happened in activities 2 and 3.
 - b. Why didn't the wheels stay behind in activity 1?
 - c. In what way did the behaviour of the objects differ in activities 1 and 2?
 - c. Predict what will happen to the oil drum(s) when the truck stops.
 - d. Predict what will happen to the oil drum(s) when the truck pulls away.
 - e. How will you make the oil drum(s) part of the truck?
 - f. How close behind the truck will you drive in traffic?
 - g. What happens to a passenger in a car when it pulls away with speed?
 - h. What happens to a passenger in a car when it stops suddenly?

7.4.4.5 Suggested integration

- a) **Natural Science and Technology:** Force, comparing mass, pushing and pulling, movement, and inertia.
- b) **Mathematics:** Mass, speed, following distances, anticipation.

7.4.5 Activity 4

7.4.5.1 Test for momentum

The educator facilitates the discussion of the phenomenon of momentum and motion. Learners discuss aspects that influence momentum, such as mass and speed.

7.4.5.2 Resources

- a) A carriage, e.g. skateboard, roller skates, toy truck, etc.
- b) Small glass marbles.
- c) Large iron marble (roller bearing).
- d) Ramp (plank and bricks).
- e) Lawn with very short grass/ground without pebbles.
- f) Measuring tape.
- g) Two types of markers (for small and large marbles).

7.4.5.3 Experiment

Set up the ramp as illustrated in Figure 9. Place a brick at the bottom of the ramp. Use a carriage for the marbles. Do not push the carriage – only release the carriage from the top for each test. Change the size of the marbles for each test.

Fig. 9



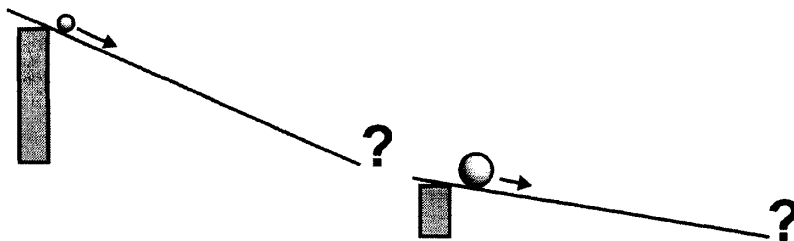
7.4.5.4 Questions to be answered in writing

- a. How do the test results for the large and small marbles differ?
- b. How do the results differ when you use two bricks instead of four to raise the ramp?
- c. What would you attribute your observation/answers to b to?

- d. Compare results for a small marble and steep-angle ramp with a large marble and slight-angle ramp as in Figures 10 & 11.

Fig. 10

Fig.11



Statement: Momentum causes an object to remain in motion.

Additional questions

Why:

- Is it harder for a person to stop suddenly if he had been running than if he had been walking?
- Why does a long jumper run a distance to build up speed?
- A baby and its mother, sitting in the front seat of a car, are not buckled up by a seatbelt when the car stops abruptly in an accident. Who of the two would be flung against the dashboard the harder?
- Which of the two (i) a glass coke bottle, and (ii) a plastic baby bottle would cause serious injury to the head of a driver involved in a car accident? Motivate your answer.

- Anticipate which of the two taxis will use the longer distance to stop when the driver applies brakes: a taxi with 10 passengers or a taxi with 20 passengers? Motivate your answer.

7.4.5.5 *Suggested integration*

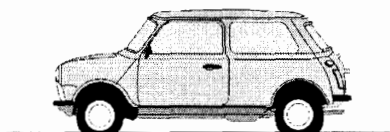
- a) **Natural Science and Technology:** Force, comparing mass, pushing and pulling, inertia, cause and effect, relate to cyclists carrying a passenger, overloading of vehicles.
- b) **Mathematics:** Mass, speed, comparison of mass.
- c) **Life Orientation:** Safety, seatbelts, and responsibility.

Use the worksheet below to apply the knowledge that you learnt from this learning experience.

WORKSHEET

1. Why do you think the motor car in fig. 1 would not move?

Fig.1

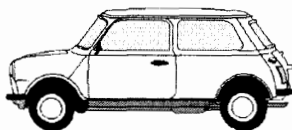


2. Which of the motor cars in fig. 2 & 3 will move easier?

Fig.2



Fig.3



Explain:.....

.....

.....

3. Which of the three wheels will have the best grip on the road?

Fig.4

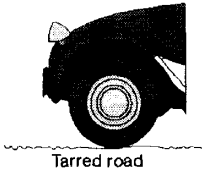


Fig.5

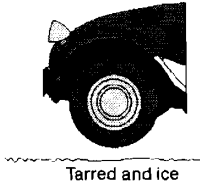
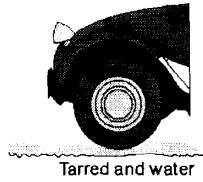


Fig.6



Explain:.....

3a. Why will the other two not have a good grip on the road?

Explain:.....

3b. Which wheel will have the best grip to steer the motor car:

a) Fig. 4

b) Fig. 5

c) Fig. 6

3c. Which wheel will have the best grip (best resistance) to brake the motor car?

a) Fig. 4

b) Fig. 5

c) Fig. 6

7.5 Chapter summary

In this chapter, a model for the integration of Traffic Safety Education in the school learning areas was developed for use in schools. An example of a learning experience (lesson plan) was given in the learning areas of Natural Science and Technology, which educators should use to facilitate the learning of Traffic Safety Education in school. Educators are encouraged to use this example and develop or plan other learning experiences in any of the eight learning areas they are involved with and avail (road safety) life-skills to learners.

In the next chapter, efforts will be made to answer the research questions of the study, draw conclusions on the basis of the literature study and empirical study. Recommendations will also be made from the conclusions reached in the chapter.

CHAPTER EIGHT

8. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary of the study

This study was conducted for the purpose of fostering the integration of traffic safety education in the teaching and learning of natural science and technology in schools. This emanated from the fact that there is a need to teach and learn TSE in South African schools due to its potential to reducing the high number of carnage on our roads. The problem arose from the scenario that our roads are not safe to the extent that many people are killed, injured and traumatised in road accidents/collisions annually. It was found in literature that there are lesser road accidents occurring in countries in which TSE is taught in schools as opposed to countries where TSE is not taught in schools (International Road Federation, 1986:110). South Africa is one of the countries where TSE is not part of the school curriculum. However, due to its importance, it became imperative to find ways of teaching this vital field of knowledge to learners in our schools through the integration option.

In order to solve this problem, five research questions were formulated on critical aspects of the problem so as to direct the course of the study to providing solutions to the bigger problem. These research questions posed in paragraph 1.2 were:

- What relationship exists among science, technology and traffic safety upon which integration of traffic safety education could be based?
- What impact has science and technology on traffic safety?
- Which strategies could be used to integrate traffic safety education in the learning areas of natural science and technology?
- Are there any hindrances to the integration of traffic safety education in the mainstream school curriculum? and
- How and why should traffic safety education be integrated in the learning areas of natural science and technology?

These research questions were in turn formulated into the aims of the study (stated in paragraph 1.3) as:

- Determine the relationship that exists among science, technology and traffic safety that can warrant their integration.
- Outline the impact of science and technology on traffic safety.
- Discuss strategies that could be used for integrating traffic safety education in the learning areas of science and technology.
- Establish whether or not there are hindrances to the integration of traffic safety education in the mainstream school curriculum, and

- Develop an integration model, which indicates how traffic safety education should be integrated in the learning areas of natural science and technology.

In order to attain these aims, a research methodology comprising of *literature study* and *interviews* was utilised. Also, an analytical *study of the curriculum*, that is, school curricula for natural science and technology were studied to ascertain whether or not they provide room for the integration of road/traffic safety education in classroom/laboratory.

Furthermore, in chapter one the orientation to the study was given in details. In Chapters two, three and four, a study of relevant literature and of the syllabi was done. A detailed account of the research methods used and the events that prevailed during the cause of undertaking the study was presented in chapter five. In chapter six, the proceedings of the interviews were presented, interpreted and discussed. In chapter seven, *a model for the integration of TSE in the learning areas of natural science and technology was developed. This model is called "Multilateral learning area integration model". (See section 7.2 for the model.)*

In this chapter, a discussion is made to the effect of whether or not the research questions set for the study were answered and the aims of the study achieved.

A presentation of the conclusions reached on the basis of information from literature study and interviews is made in section 8.3.

Also, recommendations are made in section 8.4 on the basis of the conclusions reached.

8.2 Answering of research questions

It is imperative to conclude this study by giving indications as to whether or not the research questions raised from the onset in paragraphs 1.2.1 to 1.2.5 were answered. This will in turn clarify whether or not the aims of the study, which directly stemmed from the research questions, were achieved. It is only then that the study would be considered to have done justice to its aspirations. In view of this, the four research questions are discussed in the subheadings 8.2.1 to 8.2.4.

8.2.1 *Research-question one (as in 1.2.1): What relationship exists among science, technology and traffic safety upon which integration of traffic safety education could be based?*

The whole of chapter two was devoted to addressing this research question. It was found in the literature reviewed in chapters two and three that there is a relationship among science, technology and traffic safety, which is undisputed. Not only in literature that is there evidence of this relationship but also from the responses of all eight focus group interviews have pointed

to the fact that these three concepts and fields are closely related. Questions 3, 4 and 7 of the interview schedule were directed to solicit information that would answer this research question. The results or responses of the eight provincial focus group interviews are presented on Appendices H to N.

The study of literature resulted in the construction of Table 2.1 that outlines the nature of the relationship that exists among the three fields upon which integration of traffic safety education in the mainstream school curriculum could be based. This relationship is such that without science and technology traffic safety would have not reached what it is today (refer to section 3.2 & 3.3 for details).

With the discussions in chapters two and three and as well as the results of the focus group interviews describing the relationship among the three fields, the study hereby contends that justice has been done to the answering of the research question stated in 1.2.1.

8.2.2 Research-question two (as in 1.2.2): What impact has science and technology on traffic safety?

It will not be out of place for the researcher to over-emphasise the importance of science and technology in our lives. We all enjoy the good fruits of science and technology: we use motorcars, trains, aeroplanes, and ships for transportation. Radio and television sets, and telephones for communication. We get pipe borne water and electricity through scientific and technological methods. The impact that science and technology has on traffic safety has

been shown considerably in chapters two and three (sections 2.4 & 3.2 to 3.8) of the study.

The study highlighted in section 3.3.1 the major areas in which science and technology have impacted on traffic safety. Some of these areas are:

- Traffic engineering: better traffic calming and channelling strategies are being used, and improved road network towards addressing the problem of traffic congestion on the roads.
- Law enforcement: more efficient digital tools like the camera for speed control and tracking down other traffic violations. There are many electronic devices with information about vehicle owners and vehicles themselves that are stored together with any traffic offence that either of the two might have contravened.
- Road environment: improved ways of displaying traffic information, traffic signs, road furniture which includes different facilities for road users, bill boards and other advertising boards to mention a few.
- Traffic information dissemination like weather news, and other traffic news or information regarding accidents, which could lead to temporary closure of the road requiring the use of alternative routes.
- Improved in-vehicle technology by making them more comfortable and luxurious.
- Faster, lighter and more comfortable cars, aeroplanes, trains, and ships
- Better traffic noise reduction strategies.

- Better solutions to the problem of traffic pollution due to noise and air pollution caused by fuel, fumes etc.
- More protection devices in cars like airbags, crash helmets, shatter proof glass or windscreens.

These evidences of the impact of science and technology on traffic safety, traffic environment and TSE (highlighted above) were discussed in details in sections 3.2 to 3.8.

On the basis of the foregoing, the study affirms that this research question has been adequately answered.

8.2.3 Research-question three (as in 1.2.3): Which strategies could be used to integrate traffic safety education in the learning areas of natural science and technology?

Four items out of 11 that constituted the interview schedule were directed to soliciting solutions from the interviewees for answering the research question stated in section 1.2.3. In addition to the eight focus group interviews, the whole chapter four was devoted to addressing this research question. It was found from literature and interviews that there are a number of strategies, which could be used by educators to integrate TSE in science and technology. These strategies were enumerated and discussed in section 4.2 and 4.3 respectively. It ought to be mentioned that the responses of interviews of the

academics focus group interview (see Appendix C) co-related with what is found in literature. These strategies informed the multilateral model for integrating TSE developed in chapter 7 as also discussed under section 8.2.5.

On the basis of the foregoing, it could be maintained that this research question has also been answered.

8.2.4 *Research-question four (as in 1.2.4): Are there any hindrances to integration of traffic safety education in the mainstream school curriculum?*

From the proceedings of the interviews conducted with leading individuals in the field of Traffic Safety and Learning Area/Subject Advisors in-charge of Technology and Life Orientation, Lecturers, Directors, and Managers in the National and Provincial Departments of Transport and Education; it became apparent that educators currently in-service are not adequately equipped to integrate TSE in the respective learning areas (see responses to item 9 in Appendices H to N).

The foregoing is a point of concern, especially, with regards to the Road to Safety Strategy 2001 – 2005 of the National Department of Transport, which aspires that TSE should be integrated in the mainstream school curriculum by the year 2005. In the face of teachers not being equipped to deliver on this expectation, how would the strategy be implemented and its intended

benefits realised? There is therefore a dire need to address the problem as a matter of urgency. Attempted answers to this question are given in the form of recommendations in section 8.4.

Other hindrances to integration of TSE in the mainstream school curriculum were highlighted in responses of all eight FGI to items 7, 8, 9, 10, and 11 of the interview schedule as presented in Appendices H to N.

With the above information and discussion, the study considers that this research question has been sufficiently answered.

8.2.5 Research-question five (as in 1.2.5): How and why should traffic safety education be integrated in the learning areas of natural science and technology?

This research question was appropriately answered in section 7.2 by the development of a model “the multilateral learning area integration model” for integrating road safety education in the different learning areas. Examples of how the multilateral learning area integration model would be applied have been given in section 7.3 and with a sample lesson in Appendix G.

Educators should use these examples (which are focused on the learning areas of natural science and technology) - across the country - to yield the expected

results with taking TSE into school, and thereby reducing road accidents in South Africa.

Regarding the aspect of why should traffic safety education be integrated in the learning areas of natural science and technology; it is hereby addressed as follows:

The South Africa education system has spelled out *eight learning areas* (as highlighted in section 1.5.3) of which Traffic Safety Education is not one of them. Literature study (see section 1.1) has shown that the teaching and learning of TSE in any country contributes immensely to the reduction of road accidents and the road environment becomes safer. This information was found to hold true for every country that includes TSE in education of its citizens. Also, the results of the interviews point to the fact that in the past (before 1996) when TSE was taught in schools, the South African road environment was safer than what it is now.

To the effect that the learning areas do not include TSE versus the need for it to be taught in school, leads one to considering that TSE should be integrated in the existing learning areas. As such, as a professional in the field, one is bound to design strategies, which would successfully take TSE into the classrooms. It is in the light of this that the study has developed an integration model (in chapter 7 and section 7.2) to serve us this purpose.

The development of this integration model therefore answers this research question proficiently.

The datum source of teaching TSE to children emanated from the realisation that lesser number of road accidents occur in countries where TSE is taught in schools as opposed to countries where TSE is not taught in schools. Seeing the importance of TSE in the reduction of road accidents, it becomes imperative to advocate - through a study of this nature - its inclusion in the school curriculum. This is because too many accidents are happening on our roads with millions of people being killed and injured in the country. The knowledge, skills, and attitudes inculcated in our learners in TSE will equip them in no small way in preparing them for **useful and safe living** in traffic situations particularly, and in the society generally. The view that traffic safety education being essential to enhancement of safety on the road is supported in literature by Johansson and Drott (2001); Pucher and Dijkstra (2000), Liabo *et al.* (2003), and Giummarra (2003).

The rationale for teaching TSE in schools is summarised in point form with reference being made to the above quoted sources (Johansson & Drott, 2001; Pucher & Dijkstra, 2000; Liabo *et al.*, 2003; Giummarra, 2003) as to:

- i) Reduce the high numbers of road accidents/collisions, which are claiming thousands of lives in South Africa annually.
- ii) Equip learners to use the road safely and effectively in the modern age of science and technology.

- iii) Give an introduction to professional studies in traffic engineering, law enforcement, TSE, psychology and other related disciplines.
- iv) Enable our young men and women to have an intelligent understanding of the increasing complexities of the traffic environment, traffic situation and traffic technology.
- v) Give training and impart on children the necessary knowledge, skills, and attitudes leading to the production of good, law abiding and safe drivers, passengers, pedestrians, cyclists and other categories of road users.
- vi) Train people who can apply basic scientific, technological and TSE knowledge to prevent or avoid road accidents and provide solutions to the various traffic-related problems for the safety and convenience of all road users, and
- vii) Inculcate in our youths the habit of seeing TSE as what they need to acquire in their lives towards improving the road accident statistics of our country and not as what is achievable only in developed countries.

In a nutshell, the knowledge of traffic safety education will help our youth to make use of their brains and hands to acquire suitable knowledge, skills and attitudes required for safe participation in traffic situations. Such an achievement would ensure a high degree of safety on our roads and thereby provide solutions to the multifaceted problem of traffic accidents in the country. Acquiring such skills, knowledge, attitudes will make them become productive, inventive, innovative and functional members of the South African society.

It is therefore mandatory that TSE should be taught in South African schools.

The research question (discussed in 8.2.5) is therefore favourably answered.

8.3 Conclusions based on the results of qualitative study

The following conclusions were drawn from the proceedings of the interviews conducted and literature studied in the various chapters of the study:

- 8.3.1 It is vital to teach TSE to our children both in the school environment and outside school.
- 8.3.2 TSE needs to be included in the school curriculum. In the past (before 1995), TSE was part of the school curriculum and our roads were safer by then. This means now that there is so much carnage on the roads, TSE needs to regain its place in the school curriculum.
- 8.3.3 There is a close relationship among science, technology and traffic safety education that would warrant sound integration in the school curriculum.
- 8.3.4 It would be better to have TSE as *an independent and compulsory subject/learning area in school* (in the long run). However, for the time being, since TSE is not even part of the school curriculum, it should be integrated with other learning areas preferably according to the multilateral learning area integration model developed in this study. (The integration model is presented in figure 7.1 under paragraph 7.2, and its application in sub-section 7.4).

- 8.3.5 Educators are not sufficiently or at all trained to integrate TSE in the learning areas. It would be good to train them to do so. Preferably, TSE should be included in the educator training programmes throughout the country to facilitate TSE becoming an independent learning area in school.
- 8.3.6 Educators do not seem to understand the need and importance of teaching TSE in school. This is one of the key hindrances against the integration strategy to materialise in school. As such, there is an urgent need to convince educators to get involved with promoting TSE in their classrooms.
- 8.3.7 A number of hindrances exist to the implementation of TSE in the school curriculum, and these hindrances need to be overcome (see item 11.2 under section 6.4). This implies that we need to come up with ways, strategies, and methods that would facilitate overcoming all the identifiable obstacles in this regard.

8.4 Recommendations based on the results of the qualitative study

8.4.1 *Prologue*

The recommendations made hereunder are drawn directly from the results of the literature studied and the proceedings of interviews. These are made as solutions or parts thereof with a view of addressing the research questions in

1.2.1 to 1.2.5 and the aims of the study 1.3.1 to 1.3.5 respectively. It is contended that implementation of these recommendations would fulfil the aims of this study in yielding positive results to the problem of road accidents in South Africa.

The following recommendations were therefore made from the conclusions reached in section 8.3:

- 8.4.2 TSE must be taught to our children both in the school environment and outside school.
- 8.4.3 TSE needs to be included in the school curriculum due to the fact that it has a potential to reducing the carnage on the roads.
- 8.4.4 TSE should be integrated in the leaning areas of natural science and technology, since, they have so much in common that warrant sound integration in the school curriculum.
- 8.4.5 TSE should be incorporated in the school curriculum as *an independent and compulsory subject/learning area*.
- 8.4.6 Since at present TSE is not even part of the school curriculum, it should be integrated with other learning areas.
- 8.4.7 Educators should be sufficiently trained to integrate TSE in the learning areas. The in-service educators should be given workshops and refresher courses in this regard whereas those still undergoing training should have TSE included in their training programmes throughout the country to facilitate TSE becoming an independent learning area in school.

- 8.4.8 Educators should be made to understand the need and importance of teaching TSE in school so that they can get involved with teaching TSE in their classrooms.
- 8.4.9 A number of hindrances exist to the implementation of TSE in the school curriculum, and these hindrances need to be overcome (see item 11.2 under section 6.4). This implies that we need to come up with ways, strategies, and methods that would facilitate overcoming all the identifiable obstacles in this regard.
- 8.4.10 Educators should be encouraged to use the examples of the learning experiences given in section 7.4 and develop or plan other learning experiences in any of the eight learning areas they are teaching and avail (road safety) life-skills to the learners.
- 8.4.11 It is imperative that the National Department of Education (NDoE) and Provincial Departments of Education (PDoE) see the need for including TSE in school curriculum, and as such, issue a directive requiring all educators to get involved with TSE. (It is only then that TSE would be taken serious in education and training.) If this does not happen, educators may always see the integration of TSE as an optional and unnecessary added load, and may avoid it.
- 8.4.12 All Subject Advisors must be made to see the need for TSE through workshops in which they are exposed to statistics and be convinced to promote it in school. The principals and educators should subsequently be involved in the promotion of TSE in school.

8.5 Recommendation for further research

The study hereby strategically recommends that the following aspects should be researched:

8.5.1 A study should be done to recommend other strategies of taking TSE to the percentage of the citizens outside the school community.

8.5.2 In paragraph 8.3.7, it was concluded that a number of hindrances exist to the implementation of TSE in the school curriculum, and these hindrances need to be overcome (see item 11.2 under section 7.4). It was then recommended in paragraph 8.4.9 that we need to come up with ways, strategies, and methods that would facilitate overcoming all the identifiable obstacles in this regard.

On the basis of this finding, the study recommends that *a follow-up study should be conducted to come up with solutions that would assist in overcoming these hindrances.*

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APPENDIX A

PERMISSION LETTER TO CONDUCT INTERVIEWS IN NW DoE

North-West University
Potchefstroom Campus
Private Bag X6001
POTCHEFSTROOM
2520
24 October 2003

Dr. A.M. Karodia
Superintendent General
Department of Education
North West Province
MMABATHO

Dear Sir,

**SOLICITION OF PERMISSION TO CONDUCT INTERVIEWS WITH
DIRECTORS AND SUBJECT ADVISORS IN YOUR DEPARTMENT**

The above subject matter refers.

I am a lecturer at North-West University and am researching for a Ph.D. thesis. The topic of my study is "the integration of traffic safety education in the learning areas of science and technology".

The study has been motivated by the "Road to Safety Strategy 2001 to 2005" of the National Department of Transport in which it is stated that Road safety education would be integrated in the main stream school curriculum. This study plans to find out how far both Departments (of Transport and of Education) are in the implementation of this strategy as well as to determine how road safety education can be taken into schools through the learning areas.

I have already interviewed Subject Advisors in KwaZulu Natal and would like to do the same in other provinces including North West Province.

I will be glad if you grant me the request.

Thank you very much.

Kenneth

APPENDIX B

**INTERVIEW SCHEDULE DESIGNED TO INVESTIGATE:
INTEGRATION OF TRAFFIC SAFETY EDUCATION IN THE LEARNING
AREAS OF NATURAL SCIENCE AND TECHNOLOGY IN SCHOOLS**

Question 1

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? *Justify.*

Question 2

- 2.1 Should Traffic Safety Education form part of the school curriculum?
- 2.2 How do you see or feel that it should be incorporated in the school curriculum?

Question 3

- 3.1 To your mind, is there any relationship among Traffic Safety, Science and Technology?
- 3.2 How would you describe the relationship among Traffic Safety, Science and Technology?

Question 4

- 4.1 Do you think that Traffic Safety Education can be integrated in the learning areas of Science and Technology?
- 4.2 In your opinion, how should these be integrated?

Question 5

What forms of integration models are currently being used in schools to integrate knowledge, attitudes, and skills among the learning areas?

Question 6

In your opinion, what other methods could be employed to teach road safety education in schools?

Question 7

On the basis of the relationship(s) you have outlined between Traffic Safety and Science as well as between Traffic Safety and Technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? *Motivate.*

Question 8

The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of road safety education in the mainstream school. How far (if you know), are the two Departments with implementation of this strategy?

Question 9

Are teachers trained sufficiently to integrate knowledge, attitudes and skills among the learning areas? Justify.

Question 10

Seen that it is important and even necessary to teach Traffic Safety Education through integration strategy, what can be done to bring teachers abreast with this requirement?

Question 11

- 11.1 In your opinion, what are the hindrances to the integration of Traffic Safety Education in schools?
- 11.2 How could these be overcome?

APPENDIX C

BRANCHES OF SCIENCE EXPLAINED IN DETAILS

The scientific subjects can be grouped under systematic classes, or branches. Each separate subject can be thought of as belonging to a particular branch, although some science may belong to two or more branches at the same time. Here is the list of the chief branches of science and the main subjects each branch contains:

- 1 The *Earth Sciences* include geology, meteorology, mineralogy, oceanography, and palaeontology. Geology covers the study of the Earth's structure and includes the study of rocks and rock formation. Meteorology is the study of the Earth's atmosphere and weather. Mineralogy is the study of all aspects of minerals including their properties, composition, structure, occurrences and origin. Oceanography is the study of the sea, its currents, waves, and tides. Palaeontology is the study of fossils and is linked to biology (Sales, 1994a:272).
- 2 The *Life Sciences* include biology and the medical sciences. Biology, the study of all living things, is itself broken down into botany, the study of plants, and zoology, and the study of animals. The medical sciences, which are those related to the profession of medicine of healing, include anatomy, pathology,

and physiology. Anatomy deals with the structure of the human body; pathology is the study of diseases and the changes they produce in bodily tissues; and physiology is the all-embracing study of physical, chemical, and biological processes that go on inside the body. Another important life science is psychology, the study of the human mind. Sometimes the life sciences and the Earth sciences are grouped together and called the natural sciences (Sales, 1994a:272).

- 3 The Physical sciences include physics, the study of matter and energy; chemistry, the study of the properties and behaviour of substances; astronomy, the study of stars, planets, and other objects in outer space; metallurgy, the study of metals; and engineering, one of the most important of the applied sciences. Engineering can be broken down into a whole range of related subjects, all of which deal with the application of scientific principles to industry (Sales, 1994a:272).
- 4 The Social Sciences are subjects, which deal with aspects of human society. They include sociology; the study of the form or structure of societies; history and archaeology; the studies of human communities in the past; political science, the study of government; geography, the study of the Earth's surface; and the relationship of the human race to it; and economics, the study of how a society or country manages its resources and finances. Anthropology is the general study of human beings and the way in which they live and act. Other social sciences include linguistics, the study of language and communications

among human beings; and philosophy, the subject dealing with the ways in which human beings try to understand the Universe and their experience of it (Sales, 1994a:272).

Subjects that overlap various branches of science often have names that indicate this overlapping. For example, astrophysics is the study of the physical behaviour of objects in outer space. Another way of looking at it is to say that astrophysics is the application of physics to the subject of astronomy. In the same way, biochemistry combines biology and chemistry; geophysics combines geology and physics; and socio-economics combine sociology with economics (Sales, 1994a:272).

- 5 Mathematics is for some as much an art as a science. But although mathematics can be studied for its own sake, most scientists use it as a tool. The mathematical sciences, which include statistics and computing, are constantly used in almost every branch of science (Sales, 1994a:272).

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APPENDIX D

DIFFERENCES AND SIMILARITIES BETWEEN SCIENCE AND TECHNOLOGY

1. Differences between Technology and Science

The explosive development of technology, which came at the instance of its close relationship with science and industrial enterprise, has changed the scope of technology. For example, it was originally a human handicraft done at home for satisfaction of immediate and local needs; now it has become a thing on a wide scale. With the influence of science, technology has become an outstanding cultural power to which we are deeply indebted. However, due to the misconception that people hold about technology; it has become necessary to apply philosophical considerations to the core of these two pre-eminent disciplines to clarify these misconceptions (Schuurman, 1995; Ellul, 1976).

However, their separation to some extent cannot be done successfully without causing injury to one another. That is to say, on the other hand they are connected to the extent that it will not be possible to separate them unless by sentimental position or certain philosophical approaches.

The differences between science and technology are presented in the following sub-headings (Ellul, 1976; Schuurman, 1995):

- Teleological differences.
- Points of departure.
- Falsifiability and verifiability.
- Definitions.
- Roles, and
- Applicability of these fields.

1.1 Teleological differences

In teleological considerations (explanation by purpose) one can stress that science is the study of nature with the aim of getting or gaining knowledge while technology is concerned with culture and aimed at forming to satisfy human needs. Science studies the physical universe, structure, composition, and behaviour of materials (matter). For example, it will say every object is made up of matter; matter is classified into three states (solid, liquid, gaseous). The atoms of matter in solid-form are so packed together and fixed, those in liquid are loosely apart and can move or flow, while those in gaseous state are completely loose and can move freely. Technology looks into the possibility of using each

state of matter according to its structure and behaviour to form objects, chemicals, and fuel (assorted types) to satisfy the needs of man in specific terms. Schuurman (1995:4), writing about the aims of science and technology stated, "the aim of science is always to gain knowledge of reality, while the goal of technology is to change reality. In like manner we speak of "discovery" in science and of "invention" in technology, science is the power of knowledge; technology is the power of formation. In other words, in science it is a matter of knowing, in technology a matter of making or forming".

1.2 Differences on the basis of points of departure

The points of departure of science and technology are not the same. Science relies on the regularity of nature while technology relies on the manipulation of nature in a predictable way. As implied here, "regularity in nature" refers to the fact that everything in nature exists according to its own uniform principles, arrangement or order, following a set of rules. As such, science propounded theories, laws or rules for most natural phenomena to explain the regularity of nature. For example, Newton's first law of motion, states that a body continues in its state of motion or rest unless if otherwise acted upon by certain forces. Also we talk of the law of gravity that acts on bodies pulling them towards the centre of earth (Schuurman, 1995; Ellul, 1976).

Technology contends that nature can be used, controlled, or influenced skilfully and predictably for one's own advantage. The use of solar energy for electrical and other forms of energy is one example. We can see that the rays of the sun are collected by specially made-devices, which are converted or transformed into various forms of energy to serve many purposes in human life. The extraction of iron ore from the ground, its procession and use for the production of valuable consumer and producer goods is another example. All these materials mentioned are natural given things; technology therefore manipulates them predictably (trial and verifiably) to fulfil its purpose (Schoorman, 1995; Ellul, 1976).

Schoorman (1995:38), writing on the points of departure of science and technology, stated "physics seeks knowledge about the physical facets of things while in technology physical subjects are the starting point for technological formation". One can agree from this point that where science stops or ends technology begins. One can also say that science is the base of modern technology. That is technology uses the knowledge of science to begin its depth search into the possibility of manipulating nature. The recipe of technology also considers the human-needs concept before any response or productive activities are advanced. Unlike in the science the human-needs concept is not necessary considered in its operations.

Science is a private matter, not a normative activity; while technology is a public, and a normative matter. For example, if there has been a slump in the practice of science, it will mostly be known only by those involved in it. Also not much publicity of the flop will be made like in terms of technology where such a flop can affect a very large domain (Schuurman, 1995).

The operation of science is based on laws, while that of technology is by norms, which make technology more significant in this way than science. The normativity of technology is based on the fifteen-modality aspects (of Dooyeweerd) and the biblical principles hinged on Gods' great commandment of love. The norms also bring about accountability in technological activity. For example, when a problem occurs, those concerned are held responsible for it.

Because of the normatively cultural nature of technology; a society can also advocate for what sort of function or nature of solution technology should provide for its problems. For example, building of a bridge, provision of electricity; so the involvement of the public in technological activities becomes clearer, and for one to say that it's a public matter unlike science (Schuurman, 1995).

In a similar way we can talk of technology creating a social impact due to change, or the provision of solutions to problems that can have impact on the

social lives of people. Technology therefore enhances social interactions of people unlike in science, nature remains unchangeably - operating on laws - it does not change the world.

1.3 Differences in terms of falsifiability and verifiability

In science, all scientific claims made must be falsifiable, while in technology all innovations and discoveries must be verifiable (Schuurman, 1995:64). *The falsifiability of scientific claims means; such claims must be in principles, to be proved correct or wrong (true or false). Any scientific claim that fails to be falsifiable is rejected. Also the verifiability of technological innovations and discoveries means, such must be tested in practice to ascertain their functions.*

Schuurman (1995:64), writing about falsifiability and verifiability of science and technology, stated that "Natural science claims must, with an eye to attaining universality be falsifiable. The innovations and discoveries of the technological sciences have to be tested in practice, using specific designs, to see if they are actually going to be fruitful for technological practices". This makes yet another good difference between science and technology in the sense that falsifiability and verifiability differ significantly. They are different processes; the former aiming at truth or false, the later at functionality of their claims.

In philosophical considerations, this point alone is big a difference. With particular attention on the functions of technological objects; if any product and services fail to serve the purpose for which it is made then, of what value is such a patent? It becomes a waste in terms of material, time, and otherwise. It is therefore necessary for each of the two disciplines to fulfil its expectations.

1.4 *Differences on the basis of definitions*

Schuurman, (1995:5) states that true science as “a human activity that critically and systematically forms theory in a definite field of study through the application of the method of modal analysis resulting in supported, coherent, objective and repeatable knowledge”. This means science (a human activity) must analytically apply the modality aspects objectively in the formation of theories in a given field that can be acceptable by other sciences applicable to it.

Technology as defined by Schuurman (1995:5) is the human formation of nature with the help of tools for human purposes. This means the processes, techniques, and skills of forming or manipulating nature is only possible with tools in doing technology. This means even though, tools are no longer the centre of technology, they are still important.

1.5 Contextuality of technology versus universality of science: a major difference

Regarding universality and contextuality of application, science is universal (that is, it focuses on what is universally true everywhere, even when its universality is abstract and caused tension with the fullness of reality); while technological applications are contextual rather than universal; that it focuses on what can be operational, and suiting in given circumstances. Nature resists the universality attempts of technological methods. A method that works excellently in society A may not work at all in society B. What make it so are the variations in natural materials, energy sources, temperature, humidity and so forth. This makes technological application to be contextual rather than universal like in the case of science. For example, the force of gravity has a universal application while in technology an entirely universal product cannot be made because of natural resistance (Schuurman, 1995; Ellul, 1976).

2. Similarities between Technology and Science

The role of humans in science and technology can be discussed in consideration of their interrelationship, and the two sectors of operation in modern technology namely design and implementation or production.

Schuurman (1995:1) maintains that the engineer is the architect and the builder of technological science. He is both scientist and technician. But because of the computer, humans begin to do participate less and less in the production sector. In the past (before the era of automation and computerisation of the production sector) humans were actively involved in both sectors. However, with new technological and scientific development, human beings are being gradually, replaced by machines, especially, in the production sector.

Even in the design sector, attempts are producing positive results of disengaging humans from it. This is due to the types of equipment used now in the design process like computers among others. The quality of design now depends on computers more than the ability of the designer. Not only that, the designer has distanced himself from the immediate environment within, which technological problems have risen, he rather takes to the scientific attitude or method (Schuurman, 1995).

The interrelationship of science and technology as contained in the above paragraph supersedes all other benefits or reasons one can say about the bond knot of technology and science. The production and use of apparatus, and the support of new discoveries brought about by this unity did not neglect the design process that is based on the ideas, beliefs, knowledge, worldview and scientific methodology that are paramount. As such, this is considered as the

crux of the interrelationship. It is also from here that the problems poised by modern technology as characterised by Ellul originated as a result of the shift in contextuality of technological application to the universality of scientific application to human developmental and wellbeing issues. To justify this position, Schuurman (1995:51) rightly stated “the pivotal point for human work in technology then will be in the design phase in preparing for the process.” Design as used in this context to my understanding is not restricted to shape of an object but also to the planning, methodology, and recipe of tackling any given problem.

The development process of science starts from existing knowledge via hypothesis and reflection, through logic and mathematics to falsifiable deductions, via experiment to confirmation, and via communication to new knowledge. For technology, the process begins with an existing product or process via recognition of needs or market research to new innovation or invention, via feasibility study to adequacy of the design; testing, via prototype and development to production, and via public acceptance to new product or process. Technological development is a recycling process that brings about changes in human society (Schuurman, 1995).

The interrelationship of science and technology cannot be over emphasised. It lies in the role that science plays in modern technology. For example, Schuurman (1995:1) states that "science analyses nature with an eye to its possible technological functions". Scientific methodology can solve many problems quickly and effectively.' Schuurman's (1995:32) and Ellul's (1976) position on the differences between technology and science is that, originally technology (handicraft) had no dealing with science. It is the bond knot between them that has made modern technology different from handicraft technology; and this brings development as well as more problems to the present world. Technology, its scientific basis, and method are the reasons why modern technology is clearly different from the technology of the craft man. An overestimation of science potential in technology also suggests why so many problems arise in contemporary culture because of technology or along with it'.

Ellul (1976) characterised modern technology by these terms: rationality, artificiality, automation, self-reinforcement, monism, universality, and autonomy. He explained those characteristics as follows:

- Rationality; man feels he can use brain capacity to do anything. As such he does not need God in anything. Instead of a normative activity, technology has become an activity done by logic laws.

- Artificiality technology has gone off rails; that is it has become anti-normative to the extent that nature has been eliminated through technological influence. This was not the original intention for technology.
- Automation refers to the loss of control over technological development. It is steering itself. Self-reinforcement refers to technology becoming a winner in everything and protecting itself; people have nothing to say.
- Monism refers to the absence of ethical and moral considerations in modern technology.
- Ethics are forced to conform to technology instead of technology conforming to ethics. These have given rise to universality of influence in technology.
- Technology is striving to make its methods universal like science. The summation of all these influences has resulted into autonomy of technology.
- Autonomy of technology means, it has become a world of its own, subordinating everything to itself and putting its mark on it.

3. Conclusion

What modern technology has become is amazing. How and where these developments are coming and heading to, remains very questionable. One does not have any say or control over any step of technological development. The imposing forces of technology on the society now are so compulsive to be

accepted or adapted without question. The worst of it all is that it has become a religion technicism, which is emptying the spiritual fonts of people.

In a nutshell, what Ellul (1976) has said about technology according to my view is correct. The interrelationship of science and technology has brought comfort as well as problems to humankind.

Technology uses the knowledge of science but its aims and method of operation differs.

The scope of a technological process is wider than that of science. Technological applications are contextual and resistible by nature making it impossible to attempt a universal approach like in the case of science. The points of departure of science and technology differ. The former aims at knowledge, while the later at manipulation of nature to form and meet needs. Also that, the claims of science must be falsifiable while those of technology must be verifiable.

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APPENDIX E

NEWTON'S LAWS OF MOTION EXPLAINED IN THE TRAFFIC SITUATION:

GOOD EXAMPLE FOR INTEGRATION

From conception, humans are exposed to Newton's Laws of Motion. These laws are fundamental to a basic understanding of and respect for, natural forces. Newton's Laws of Motion can be summarised as follows (White & Spellicy, 2000):

- An object in a state of rest, or in motion at a constant velocity, will remain in that state unless acted upon by an unbalanced external force.
- An external force applied to an object at rest, or motion at a constant velocity, will change the object's motion in the direction in which the force is applied and by acceleration directly proportional to the object's mass. The formula applied to Newton's Second Law is expressed as: $F=ma$, or force equals to mass times acceleration.
- For every action there is an equal and opposite reaction (White & Spellicy, 2000).

The general public may not have a verbatim understanding of Newton's laws, but can appreciate the obvious effect that crash forces have on bodies following a motor vehicle collision. However, most people do not appreciate the complexity of crash force injury. Three collisions occur in a motor vehicle crash and can be summarised as follows:

- **Collision 1.** The vehicle collision represented at this level is the standard vehicle collision where Vehicle A strikes Vehicle B or a solid object.
- **Collision 2.** The human collision represented at this level is Vehicle A's operator or passenger being propelled into the steering wheel, windshield, restraint system, or other structure inside the or outside of the vehicle at a force proportional to the acceleration of the motor vehicle at impact. This impact is analogous to Newton's Second Law.
- **Collision 3.** The internal collision is represented at this level as the operator or passenger internal organs follow Newton's Law of Motion. Internal organs and tissues are subjected to crash forces proportional to those incurred by the vehicle as they are forced into the bony structures inside the body.

From a medical perspective, the second and third collisions are of greatest interest. It is these components of a crash that can produce injury and death. As total mass and speed of the vehicle(s) involved in a MVC increase, there is a proportionate increase in the opportunity for injury to the human body, both externally and internally. Complexity of human injuries often increases, as the

majority of MVC are not directly head-on in nature. The tangential and rotational motions produced from such offset crashes produce injury unique to the combination of varying directional forces.

It is intuitive that increased vehicle speed increases the risk of a crash, and a variety of mechanisms for this can easily be postulated. For instance, higher speeds reduce manoeuvrability, increase stopping distances, and decrease reaction time. At sufficiently high speeds, physical limits of the vehicle or roadway may be exceeded (White & Spellicy, 2000).

Many of these considerations are magnified in adverse conditions, such as poor visibility or on wet or snowy roads. In actual motor vehicle crashes the speed of vehicles immediately prior to the crash is seldom known with any accuracy. Available studies do not generally show a linear relationship between speed and crash incidence. Rather, the relationship between speed and crash likelihood is usually demonstrated via a U-shape curve, where crash probability is lowest at the median speed of the traffic stream (irrespective of speed limit), and rising at speeds above and below the median speed (White & Spellicy, 2000). Thus deviant speeds, both high and low, were said to be associated with higher crash risk, leading some to conclude that variability in speed between vehicles on the roadway was an important factor contributing to the crashes. Conversely, exceeding the speed limit or driving at speeds too fast for conditions has been

reported as a major factor in a large percentage of fatal crashes according to a report released by the National Highway Traffic Safety Administration (U.S. Department of Transportation, 1999: as quoted in White & Spellicy, 2000). However, high vehicle speed may not have been the sole or even major contributing factor in these crashes and fatalities, since there were many confounding factors. Speeding was associated with alcohol consumption, young, male drivers, and failure to wear seat belts (White & Spellicy, 2000). The factors do not withstand the reality.

That increased crash speeds lead to increased crash severity is incontrovertible and follows from basic laws of physics. The kinetic energy of an object in motion varies as the square of its speed so that a vehicle at 60 km/h possesses energy that is four times as great as that at 30 km/h, or an increase in speed from 50 to 65 km/h increases kinetic energy by sixty-nine percent. This energy must be dissipated in a crash; obviously increasing the magnitude of energy potentially transferred to vehicle occupants. This physical relationship appears to translate directly to the chance of injury and fatality in motor vehicle crashes. Early studies found that the severity of injury in crashes increased rapidly at speeds above 62 km/h, and that the possibility of fatality increased rapidly as speeds exceeding 70 km/h (White & Spellicy, 2000). More recently it has been estimated that the possibility of fatal injury increases with the change of speed at impact raised to the forth power (White & Spellicy, 2000). According to this study, a

crash at 50 km/h was 1.5 times as likely to result in fatality as a crash at 25 km/h. Also, it was found that the risk of death in a crash exceeded fifty percent when the change of speed at impact exceeded 60 km/h. Comparison of studies across time suggests that the risk of injury or fatality at any given speed has decreased progressively, possibly reflecting improved vehicle design, improved highway design, and increased safety belt use, although the exponential relationship between vehicle speed and injury severity appears to be maintained.

REFERENCE(S)

WHITE, G.L. Jr. & SPELLICY, M.J. 2000. The physics of motor vehicle injury. *The Chronicle of American Driver and Traffic Safety Education Association*. Vol. 48(4):12-13. Fall.

APPENDIX F

CRITICAL OUTCOMES

- Communicate effectively using visual, mathematical and language skills.
- Identify and solve problems by using creative and critical thinking.
- Organise and manage activities responsibly and effectively.
- Work effectively with others in a team, group, organisation and community.
- Collect, analyse, organise and critically evaluate information.
- Use science and technology effectively and critically, showing responsibility towards the environment and the health of others.
- Understand that the world is a set of related systems.

ACTIVITY OUTCOMES

After completion of the learning experience learners should be able to:

LEARNING AREA OUTCOMES

Language

LO 1. Listen for information and enjoyment, and respond appropriately and critically in a wider range of situations.

LO 2. Communicate confidently and effectively in spoken language in a wide range of situations.

LO 3. Read and view for information and enjoyment, and respond critically to aesthetic, cultural and emotional values in texts

LO 5. Thinking and reasoning. Use language and reason, and access process

ACTIVITY OUTCOMES

Knowledge

- Demonstrate an understanding of the relationship between different surfaces, to lay a foundation for an understanding of force.
- Practically demonstrate the relevance of
 - Force
 - Friction
 - Momentum
 - Inertia
- Apply this to traffic and explain the relevance to safety in traffic.

Skills

language and reason, and access process and use information for learning

Natural Sciences

LO 1. Develop and use science processes and skills in a variety of settings.

LO 2. Develop and apply scientific knowledge and understanding.

LO 3. The learner is able to gain an appreciation of the relationship and responsibilities between science and society.

Technology

LO 1. Demonstrate an understanding of the inter-relationships between technology, society and the environment.

LO 2. Apply technological processes and skills ethically and responsibly, using relevant knowledge concepts.

LO 3. Access, process and use information in a variety of contexts.

Mathematics

LO 5. The learner is able to collect, summarise, display and critically analyse data to draw conclusions and make predictions, and to interpret and determine chance variation

Life Orientation

LO 2. Demonstrate an active commitment

- **Develop perceptual skills to anticipate and estimate.**

Values

- Show consideration for others.
- Demonstrate friendliness.

to constitutional rights and social responsibilities, and show sensitivity to diverse cultures and belief systems.

LO 3. The learner is able to use acquired life skills to achieve and extend personal potential to respond effectively to challenges in his/her world.

LO 4. The learner is able to demonstrate an understanding of, and participate in activities that promote movement and physical development.

APPENDIX G

1. Learning experience (for Grade 7)

1.1 Integration grid based on Learning Outcomes (LOs)

On the Table below, a grid containing Learning Outcomes and Assessment Standards (AS) is provided for the purposes of integrating TSE with the Learning Areas. This grid is prepared to give the educators an indication as to which of the LO's and AS's permit the integration of TSE with the given Learning Area(s).

Table 1: An integration grid for integrating TSE with other learning areas

Learning areas: Natural Sciences and Technology

Context: Movement – seatbelts

[Key to the grid: LO = Learning Outcome; AS = Assessment Standard]

Name of Learning Area	LO(s) relevant to TSE	AS(s) relevant to TSE
Technology	LO2	1, 8, 12, 28, 29.
	LO3	6,7.
Mathematics	LO5	1, 3, 9.
Natural Sciences	LO1	5, 7.
	LO2	7, 8.
	LO3	5.
Life Orientation	LO2	3.
	LO3	1, 2, 3, 4.
	LO4	3.

The LO's and AS's are taken from the national curriculum statement for Grades

R –9 (Schools) (DoE, 2001).

1.2 Comprehension

The educator presents a passage titled Restrained Travelling. The educator may read the questions (given in 1.2.2 below) to the learners beforehand and make them focus on the content for the answers. Learners individually read the passage thoroughly and answer the questions (given in 1.2.2) in writing.

1.2.1 Title of comprehension: Restrained travelling

Travelling at very **high speeds** can be very exciting. Modern man depends on vehicles for transport. A hundred years ago a journey overland by ox-wagon could take months, but now it is a matter of hours or days, depending on the distance. Journeys that took months by sea can now be made in a few hours by air.

Journeys inland can be completed during a few hours travelling by car.

Unfortunately travelling at high speeds presents a number of problems. As speed increases the risk and damage to the vehicles and the occupants increase. A collision between two cars travelling at a fairly low speed can be fatal for all involved. This is also called the **first impact**. Upon visiting an accident scene one often finds that the occupants have been thrown out of the vehicles. *This indicates that the vehicles came to a stop but the occupants did not - this is called inertia.* The occupants keep on moving at the same speed that the car travelled at until something stops them (Newton's first law). This could be anything in the car,

such as the dashboard, or something outside, like a tree or a lamppost or the road surface. This is called the **second impact**, which is in most cases much more dangerous than the first impact.

You may ask: "What about the windscreen?" A windscreen does not stop the person rather it slows him or her down and injures him/her. If a child hits a windscreen, it could cause his/her death. Young children should never travel in the front seat of a car, but rather in the back seat and must be strapped in. Young children should be strapped in a child restraint, which is a special seat for young children.

To prevent all this from happening, seatbelts were developed. We say that the seatbelt "**restrains**" the person, or it keeps the person fastened to his seat and it stops him from keeping on moving and being injured against the dashboard. **Seatbelts** prevent the **second impact**-taking place thereby preventing the person from being seriously injured. Although seatbelts do not prevent a collision from taking place, they do prevent serious injuries and have saved many lives.

Seatbelts prevent passengers from being flung around in the car or from being thrown out of the car. They very often only have a few cuts and bruises, and especially, head injuries are less. They are definitely prevented from flying through the windscreen.

The seatbelt is fastened over the stronger parts of the body, namely the chest and the hips. These parts can endure great pressure without being seriously injured,

while the head and the neck are very easily injured. The seatbelt takes the force of the body when it moves forward at great speed.

Travelling without wearing a seatbelt may result in being knocked unconscious against the inside of the car, whereas wearing a seatbelt often ensures that the person remains conscious. A seatbelt takes seconds to unclasp and a person would be able to get out of the car in case of a fire.

If you do not wear a seatbelt the chances are five times higher that you may be killed if you are thrown clear of the car. Although, people argue that in case of a collision they will be thrown clear of the vehicle and will not be injured by the vehicle, but the opposite is true. The result of the second impact is often much worse. People also protest against wearing seatbelts by saying that people wearing seatbelts are also killed in collisions. In as much as this is true, but the fact remains that great numbers of people, who do not wear seatbelts, are killed in collisions more than those who do are.

In South Africa it is compulsory to wear seatbelts. In certain developed countries overseas the law for wearing seatbelts has been lifted. People wear seatbelts of own free will because they realise the need for wearing them.

In conclusion, one could say that modern technology has allowed us to travel at high speeds, but has also helped to reduce fatalities through the use of seatbelts. The two are inseparable.

1.2.2 Questions to be answered about restrained travelling

After reading the above passage (**restrained travelling**), answer the following questions in full sentence format.

- List three important benefits of wearing seatbelts.
- Conclude what the price is that has to be paid for travelling at high speeds.
- Explain what causes serious injuries to unrestrained passengers.
- List three arguments against wearing seatbelts.
- Suggest three facts countering these arguments.
- Why did certain developed countries lift laws enforcing the wearing of seatbelts?
- Why were seatbelts invented?
- Do you feel that authorities have the right to make the wearing of seatbelts compulsory? Give a reason for your answer.

1.2.3 *Group work*

Learners discuss the questions (given in 1.2.2) in-groups and offer solutions.

Answers are recorded and placed into their portfolios.

1.2.4 *Suggested integration*

- **Natural Science and Technology:** Comparing mass, inertia, cause and effect.
- **Life Orientation:** Rules, necessity of rules, safety, seatbelts, responsibility.

1.3 *Activity 1*

Learning outcomes

After completing the activity the learners will be able to:

- Demonstrate an understanding of the effect of inertia and momentum by being able to explain and describe these terms with the aid of experiments done in activity 1.
- Explain the necessity of seatbelts.
- Explain the necessity of learner restraints.

1.3.1 *Experiment 1*

This experiment is carried out on a flat surface. Learners will experiment under supervision of the educator.

- The first experiment is carried out outside the classroom.

The educator takes the learners outside. Each learner makes a ball of clay mixed with water, and presses it well together. They hold it at arm's length away and as high as they can. They let it drop and observe what happens to the ball of clay. Learners relate the results to traffic situation.

1.3.2 *Experiment 2*

- A cricket player from the school is asked to demonstrate bowling. The cricket player runs, swings his arm and lets the ball go. He stops running, but the ball keeps on travelling, resisting to come to a stop. What is it called?

INERTIA.

Demonstrate what will happen to a ball of moist clay thrown in the same manner. Discuss the phenomenon in relation to traffic.

1.3.3 Experiment 3

This experiment should be carried out on a ramp.

Demonstrate this by placing a number of empty boxes in a go-cart, on a skateboard or toy vehicle. Use *Worksheet 1*, to carry out all the actions listed, and to record the results thereof.

- Method

Learners bring a go-cart with four wheels to school. They may also use a skateboard or toy vehicle.

They borrow two wooden scaffold planks, ± 3 metres long, from a builder.

The launching end must be lifted at various heights for more than one experiment - make use of a stepladder.

They construct a ramp, with its crash end against a wall.

Use a rubber doll, stopwatch, and whistle.

Learners construct a ramp with the launching end of the ramp on the bottom rung of a stepladder.

The crash ends against a wall.

Position the go-cart with the doll seated inside.

At the blow of the whistle the go-cart is given a slight push/launched and the stopwatch is activated.

Press the stopwatch at impact.

Record the gradient of the ramp, time and result.

Repeat the experiment raising the ramp another rung.

Record the gradient of the ramp, time and result each time on *worksheet 2* (provided at the end of this learning experience).

- Questions

Explain the position of inertia in both situations:

- Stability.
- Speed.

What helped to create speed in each experiment?

What helped to increase the speed in each experiment?

What factor(s) had an effect on the speed of the go-cart?

What happened to the doll each time?

How would these affect passengers in a vehicle?

What would the influence of speed be?

What might happen to a passenger who is not fastened?

Learners discuss the outcome of the experiment under the supervision and guidance of the educator. Apply the results to traffic situations.

What counteractions can be taken regarding the:

- car?
- doll?

1.3.4 *Suggested integration*

- **Natural Science and Technology:** Force, comparing mass, inertia, cause and effect, motion, relate to seatbelts, airbags, learner restraints, front seat passengers, rear seat passengers.
- **Mathematics:** Mass, Speed, Comparison of mass.
- **Life Orientation:** Rules, necessity of rules, safety, seatbelts, decision-making skills, problems solving skills, responsibility.

1.4 *Assessment*

It will be evident that the outcomes have been achieved when the learners:

- Have completed the worksheet and supplied meaningful explanations.
- *Practically demonstrate and explain the interaction between the concepts of inertia, movement and momentum.*
- *Demonstrate and explain the value and necessity of the use of seatbelts.*
- *Demonstrate the ability to solve problems.*

WORKSHEET 1

What happens to the boxes?

What happens to the go-cart?

Actions	The boxes	The go-cart
<i>Slowly drive forward and increase speed gradually</i>		
Drive off suddenly		
Drive slowly and accelerate suddenly		
<i>Reverse slowly and increase speed gradually</i>		
Reverse slowly and increase speed suddenly		
Drive forward slowly, increase speed gradually and brake suddenly		
Reverse slowly and brake suddenly		

WORKSHEET 2

Record the nature of content of the go-cart

Content	Gradient/cm	Time	Result
Boxes			
Doll			

CONCLUSION-----

Explain inertia-----

Explain momentum-----

Explain force-----

APPENDIX H

EASTERN CAPE PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS OF THE INTERVIEW SCHEDULE	
ITEM 1	<i>Question 1</i> <i>Interviewer asks:</i> Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify. <i>Interviewees responses:</i> Teaching Traffic Safety to our learners is vital because it contributes to promotion of respect to other road users and also equips learners to set better examples and be good generation.
ITEM 2	<i>Question 2</i> <i>Interviewer asks:</i> 2.1 Should Traffic Safety Education form part of the school curriculum? <i>Interviewees responses:</i> Yes <i>Interviewer asks:</i> 2.2 How do you see or feel that it should be incorporated in the school curriculum? <i>Interviewees responses:</i> It should be incorporated through integration into various learning areas. This will give learners an overall picture of how multifaceted and vitally important. Traffic Safety is.

ITEM 3**Question 3**

Interviewer asks:

3.1 To your mind, is there any relationship among Traffic Safety, Science and Technology?

Interviewees responses:

Yes

Interviewer asks:

3.2 How would you describe the relationship among Traffic Safety, Science and Technology?

(No response was given)

ITEM 4**Question 4**

Interviewer asks:

4.1 Do you think that Traffic Safety Education can be integrated in the learning areas of Science and Technology?

Interviewees responses:

Yes

Interviewer asks:

4.2 In your opinion, how should these be integrated?

Interviewees responses:

Traffic Safety can be integrated in Science for example when teaching on Air- If a balloon is inflated too much, it will burst same applies to the wheels of a bicycle and vehicle. Another example is Friction: When objects like hands are rubbed against other, friction occurs. Friction is also necessary for the vehicle to grip the road.

Traffic Safety and Technology: Vehicles are more powerful and luxurious with

	anti lock braking system, which assists if brakes are applied suddenly, the Anti lock Braking monitor the wheel speed and when the wheel reaches the lock position the brake pressure will be eased. This eases the excess pressure applied to the brakes by the driver and enable the driver to steer the vehicle. There are many safety facilities like seat belt, child restraint etc which indicates that Traffic Safety can be integrated in Technology. Question 5 <i>Interviewer asks:</i> What forms of integration models are currently being used in schools to integrate knowledge, attitudes, and skills among the learning areas? <i>Interviewees responses:</i> Outcome Based Education (OBE) is the current model Question 6 <i>Interviewer asks:</i> In your opinion, what other methods could be employed to teach road safety education in schools? <i>Interviewees responses:</i> Non – Formal approach, Radio and Television, Print media, quiz questions and Community Based Project
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ITEM 7	Question 7 <i>Interviewer asks:</i> On the basis of the relationship(s) you have outlined between Traffic Safety and Science as well as between Traffic Safety and Technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? Motivate. <i>Interviewees responses:</i> Yes because SAQA requirements which stipulate that each Learning Area should meet certain Units Standards e.g. 32 or 40.
ITEM 8	Question 8 <i>Interviewer asks:</i> The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of road safety education in the mainstream school. How far (if you know), are the two Departments with implementation of this strategy? <i>Interviewees responses:</i> The two Departments are engaged into discussions and consultations to bridge the gap of Traffic Safety in the Curriculum.
ITEM 9	Question 9 <i>Interviewer asks:</i> Are teachers trained sufficiently to integrate knowledge, attitudes and skills among the learning areas? Justify. <i>Interviewees responses:</i>

	No. Teachers have been using the old approach for years hence it is not easy to change overnight. Therefore 3-4 day workshops with much information. They end up being confused.
ITEM 10	Question 10 <i>Interviewer asks:</i> Seen that it is important and even necessary to teach Traffic Safety Education through integration strategy, what can be done to bring teachers abreast with this requirement? <i>Interviewees responses:</i> Personally, inclusion of Traffic Safety as a module at College or Tertiary level and continuous workshop can be of assistance
ITEM 11	Question 11 <i>Interviewer asks:</i> 11.1 In your opinion, what are the hindrances to the integration of road safety education in schools? <i>Interviewees responses:</i> Lack of understanding on how the integration into Learning Areas by educators. Redeployment of educators to different schools also have a negative effect. <i>Interviewer asks:</i> 11.1 How could these be overcome? <i>Interviewees responses:</i> Inclusion of TSE as a module at Tertiary level as well as workshops and seminars.

APPENDIX I

**FREE STATE PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS OF
THE INTERVIEW SCHEDULE**

ITEM 1

Question 1:

Interviewer asks:

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

It is important that traffic safety Education be taught to our schools, hence the Traffic Safety Education becomes initiated in children's minds and they grow Traffic Safety literate.

ITEM 2

Question 2

Interviewer asks:

2.1 Should Traffic Safety Education form part of school curriculum?

Interviewees responses:

It is inevitable that Traffic Safety Education form part of school curriculum.

ITEM 3

Interviewer asks:

2.2 How do you see or feel that it should be incorporated in the school curriculum?

Interviewees responses:

When traffic Safety Education forms part of the school curriculum it enforces education to regard it as equally important like other learning areas, and learners also will regard it as important.

Question 3

Interviewer asks:

3.1 To your mind, is there any relationship among Traffic Safety, Science and Technology?

Interviewees responses:

There is a great existing relationship among Traffic Safety, Science and Technology.

Interviewer asks:

3.2 How would you describe the relationship among Traffic Safety, Science and Technology?

Interviewees responses:

Traffic Safety has to do among others: Road Engineering, data capturing and analysis, communication and evaluation procedures which require a vast science and technological approach.

ITEM 4**Question 4**

Interviewer asks:

4.1 Do you think that Traffic Safety Education can be integrated in the learning areas of Science and Technology?

Interviewees responses:

Traffic Safety can be integrated in the learning areas of science and technology.

Interviewer asks:

4.2 In your opinion, how should these be integrated?

Interviewees responses:

They can be integrated in modules, which cover pedestrian safety, vehicle safety and general vehicle operation skills, for advanced learners in higher grade.

ITEM 5**Question 5**

Interviewer asks:

What forms of integration models are currently being used in schools to integrate knowledge, attitudes, and skills among the learning areas?

Interviewees responses:

Schools are currently using various learning areas to integrate knowledge, attitudes, and skills in road safety programmes such as STEP and Child in Traffic. Which is a good move towards a right direction.

ITEM 6	STEP and Child in Traffic. Which is a good move towards a right direction. Question 6 <i>Interviewer asks:</i> In your opinion, what other methods could be employed to teach road safety education in schools? <i>Interviewees responses:</i> The use of electronic media, which proved to be effective especially for children of lower grades, and concrete teaching aids such as traffic signs and vehicles especially in higher grades and even in tertiary institutions.
ITEM 7	Question 7 <i>Interviewer asks:</i> On the basis of the relationship(s) you have outlined between Traffic Safety and Science as well as between Traffic Safety and Technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? Motivate. <i>Interviewees responses:</i> It would be advantageous to teach the above in an integrated manner, hence it will enable learners to see the practical connection between Traffic Safety and various life disciplines.

ITEM 8	Question 8 <i>Interviewer asks:</i> The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of road safety education in the mainstream school. How far (if you know) are the two Departments with implementation of this strategy? <i>Interviewees responses:</i> As far as this is known, there are absolutely no developments in that regard, in that the departments of transport itself is still locked into a confusion and crisis of implementing some of its major programmes envisaged for strategy 2001 – 2005 such as RTMC, AARTO, etc.
ITEM 9	Question 9 <i>Interviewer asks:</i> Are teachers trained sufficiently to integrate knowledge, attitudes and skills among the learning areas? Justify. <i>Interviewees responses:</i> Teachers are not trained to teach Traffic Safety Education through integration strategy, they integrate traffic safety haphazardously with themes not clearly defined.

ITEM 10**Question 10**

Interviewer asks:

Seen that it is important and even necessary to teach Traffic Safety Education through integration strategy, what can be done to bring teachers abreast with this requirement?

Interviewees responses:

The department of Education through the influence of political leaders e.g. the ministers and MEC's of Education can be given a presentation which would highlight the importance of traffic safety education in schools. They in turn would enforce implementation in schools.

ITEM 11**Question 11**

Interviewer asks:

11.1 In your opinion, what are the hindrances to the integration of road safety education in schools?

Interviewees responses:

- Lack of support from politicians
- Lack of sufficient knowledge and skills in Traffic Safety of teachers
- De-motivated teachers
- Lack of Traffic policy guides to teachers
- Traffic Safety personnel with no information on how to integrate traffic safety education with education

integrate traffic safety education with education

- Untrained traffic safety officers

Interviewer asks:

11.2 How could these be overcome?

Interviewees responses:

- Train teachers in road safety as a matter of urgency
- Enforce traffic safety education at management level (i.e. Political level)
- Enforce traffic safety education in schools
- Train traffic safety officers
- Provide traffic safety officers with adequate resources
- Ensure compliance with traffic safety guidelines by teachers
- Make traffic safety education in schools a policy

APPENDIX J

GAUTENG PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS OF THE INTERVIEW SCHEDULE

ITEM 1

*Question 1:**Interviewer asks:*

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

Traffic safety education is an important element in nurturing positive minded children because road accidents/crashes are regarded as one of the biggest social problems in the RSA today. In support of the moral degeneration announced by the state President last year (2002) or so; road safety education should feature strongly to add value and maintain better lives for our children by:

- Integrating it with morals and values within the family set up.
- Emphasising their responsibility with reference to road safety.

Learners are facing many challenges as they grow. The fact that they walk from home to school and back is already a challenge as far as road usage and the risks that go with it are concerned.

In the developed countries such as the Netherlands and Australia, the education approach of road safety has already brought about a decline in the rate of road accidents. If road safety education receives necessary attention in our

ITEM 2

schools, the benefits thereof would be apparent from one generation to the other. Road safety education is aimed mainly at inculcating proper attitudes that will be translated into proper behavioural patterns needed whenever the safety of the individual is at stake.

Interview item 2

Interviewer asks:

2.1 Should traffic safety education form part of the school curriculum?

Interviewees responses:

Yes. TSE needs to be included in the curriculum.

It is imperative that road traffic safety should form part of the school curriculum. The child should be *developed in totality from early age and the school curriculum is the best platform to achieve this*. The school is the child's second home and most of the life skills including road safety should be acquired there.

Interviewer asks:

2.2 How do you see or feel that it should be incorporated in the school curriculum?

Interviewees responses:

Road traffic safety can be incorporated in two different ways:

- Formal approach

Before venturing into the hostile traffic environment, learners should be mentally prepared and knowledgeable. The formal approach is the best tool to instil knowledge and ensure that learners do understand the rules, signs, signals and markings of and on the road.

- Non-formal approach

Skills development (in real traffic environment)

Correct reaction to traffic signs, signals and obedience to rules; quickness and adaptability in suiting actions to changing situations are needed to ensure safe road usage.

Road users, pedestrians in particular, must have the willingness and the competence to co-operate with the rest of the traffic. They must be able to behave in difficult traffic situations with unfailing regard for self-discipline and in the interest of fellow road users.

Alternative training

Creation of the traffic training in conjunction with the driving license testing centre, whereby learners will be taken on an excursion to the centre and be trained on how to behave themselves as pedestrians and very important, on how they perceive the pedestrians in their roles as road users in a centre. It is important to have such a centre at a more central venue to ensure that all schools gain access to it.

ITEM 3	<i>Interview item 3</i> <i>Interviewer asks:</i> 3.1 <i>To your mind, is there any relationship among road traffic safety, science and technology?</i> <i>Interviewees responses:</i> Yes <i>Interviewer asks:</i> 3.2 <i>How would you describe the relationship among road traffic safety, science and technology?</i> <i>Interviewees responses:</i> On the one hand, the laws of nature have a strong influence on road usage, particularly the handling of a motor vehicle in various environments. In order to ensure safety on the road, the driver of a vehicle must have the willingness and the competence to co-operate with the laws of nature such as gravity and mass, force of impact, friction, inertia, momentum etc. On the other hand, science and technology play a crucial role in ensuring communication between and amongst various sectors, individuals and above all to ensure safe and correct road usage. Electrical appliances in the vehicle such as indicators and lights enhance communication and visibility respectively, with and in relation to other road users. Traffic control could not be easier without signals, especially, at the intersections. Other examples that ensure the safety of passengers include air bags.
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	examples that ensure the safety of passengers include air bags. ITEM 4 <i>Interview item 4</i> <i>Interviewer asks:</i> 4.1 Do you think that traffic safety education can be integrated in the learning areas of (natural) science and technology? <i>Interviewees responses:</i> Yes. <i>Interviewer asks:</i> 4.2 In your opinion, how should these be integrated? <i>Interviewees responses:</i> Many authors of science books have already tried this and with success.
ITEM 5	<i>Interview item 5</i> <i>Interviewer asks:</i> What forms of integration models are currently being used in schools to integrate knowledge, attitudes and skills among the learning areas? <i>Interviewees responses:</i> There are a number of integration models that can be used. Though, they prefers: • Multidisciplinary approach

ITEM 6	• Interdisciplinary approach • Total staff approach <i>Interview item 6</i> Interviewer asks: In your opinion, what other methods could be employed to teach road traffic education in schools? <i>Interviewees responses:</i> • Non-formal approaches, which can involve school campaigns. • Activities in the form of drama, done during the Arts and Culture learning area.
ITEM 7	<i>Interview item 7</i> <i>Interviewer asks:</i> On the basis of the relationships you have outlined between road traffic safety and science as well as between road traffic safety and technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? <i>Interviewees responses:</i> <i>I would prefer it as stand-alone. It is an important life skill with serious consequences when it does not receive the necessary attention.</i>

ITEM 8*Interview item 8**Interviewer asks:*

The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of traffic safety education in the mainstream school? How far (if you know), are the two Departments with implementation of this strategy?

Interviewees responses:

There was a hand-over of the RSE curriculum (in the Western Cape) from the National minister of NDoT to the one of NDoE a few years ago. After that there is nothing that I heard of that happened again. However, the content of this curriculum laid the focus on Transportation rather than Safety. And this needs to be adjusted.

Although the strategy has not been marketed aggressively with the Department of Education, there is a good and sound relationship between the two Departments. The Department of Education is satisfied that the policies have been put in place after being revisited by the Ministerial Review Committee in 2001.

ITEM 9	<i>Interview item 9</i> <i>Interviewer asks:</i> Are educators trained sufficiently to integrate TSE knowledge, attitudes and skills among the learning areas? <i>Interviewees responses:</i> Educators are not sufficiently trained to integrate TSE in the learning areas. They gave a number of reasons such as: • TSE was not included in educators' training programmes. • Most educators cannot teach TSE and are not teaching it. • Only two colleges of education in the country and the then Potchefstroom University (now North West University) included TSE in some of the educator training programmes but have stopped it. There is therefore no evidence that educators across the country are adequately equipped to teach the field of TSE.
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ITEM 10***Interview item 10***

Interviewer asks:

Seen that it is important and even necessary to teach road traffic education through the integration strategy, what can be done to bring educators abreast with this requirement?

Interviewees responses:

Aggressive educator development / training and joint ventures with relevant stake holders that include NGO's, pressure groups, youth, unions and above all, the political will.

Many educators are road safety illiterate and are therefore not prepared to venture into the unknown. We are aware that most educators do not have a driving licence and if they have, they use a negative attitude like most drivers do on the road. How do we expect such people to plant better seeds, in their quest to nurture a positive generation of road users? *It will be wise to invest in educator development and training by offering driver education and defensive driving skills' courses to all educators.* It reminds me of a saying "send a thief to catch a thief". The second stage would be evaluation of schools, circuits, municipalities and provinces, on any road safety initiatives undertaken. Once interest has been created, the basics, that is, leading learners to a better life regarding road usage would be embraced without items. Educators will have enough vocabulary, polished skills and correct attitudes to teach the subject and make sense out of it. If this is

ITEM 11	correct attitudes to teach the subject and make sense out of it. If this is achieved, integration will be bread and butter; i.e. road safety will become enjoyable. <i>Interview item 11</i> <i>Interviewer asks:</i> 11.1: In your opinion, what are the hindrances to the integration of Traffic safety education in schools? <i>Interviewees responses:</i> Educators are not well trained or conversant with this approach. They have a choice in the Life Orientation learning area and this depends on their field of expertise (see 's answer to item 8 for more on this topic). Other or most schools use one prescribed textbook for Life Orientation wherein only one aspect of road safety e.g. Seatbelts is addressed. <i>Interviewer asks:</i> 11.2 How could this be overcome? <i>Interviewees responses:</i> • Educator development and training in TSE should be given a priority. Is it necessary for individual institution or role players to produce their own material? • Educators are bombarded with bits and pieces from various role
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players and some of which end up not being used.

- There is a need for co-operation, co-ordination and synergy amongst all role players with interest in Life Orientation. This approach will help with common understanding and production of interactive material that includes everybody.

APPENDIX K

**KWAZULU NATAL PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS
OF THE INTERVIEW SCHEDULE**

ITEM 1***Interview item 1****Interviewer asks:*

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

The responses of all those interviewed to this question were "yes". (Emphases were laid with additional words/phrases like: most definitely, absolutely, it must be done.)

TSE need to be given at an early age due to the fact, that accidents are claiming many lives.

ITEM 2***Interview item 2****Interviewer asks:*

2.1 Should traffic safety education form part of the school curriculum?

Interviewees responses:

Yes. TSE needs to be included in the curriculum.

Interviewer asks:

2.2 *How do you see or feel that it should be incorporated in the school curriculum?*

Interviewees responses:

TSE should be a subject/learning area on its own. If not, it should be integrated; to him, integration is a problem in the sense that educators who do not like or enjoy TSE would end up not integrating it at all. As such it would be better to have it as an independent subject/learning area.

Follow-up question: In the position you are serving and with your knowledge of the Department of Education, would you say its possible to have traffic safety education as an independent subject in school?

Answer: It will be possible. However, lessons would have to be prepared for educators to use in time of need. Also, guidelines on how to teach TSE will have to be put into writing.

Again, some lateral thinking (brainstorming) needs to be done with stakeholders concerned of how to do it properly.

Interviewer asks:

2.2 *How do you see or feel that it should be incorporated in the school curriculum?*

Interviewees responses:

TSE should be a subject/learning area on its own. If not, it should be integrated; to him, integration is a problem in the sense that educators who

integrated; to him, integration is a problem in the sense that educators who do not like or enjoy TSE would end up not integrating it at all. As such it would be better to have it as an independent subject/learning area.

Follow-up question: In the position you are serving and with your knowledge of the Department of Education, would you say its possible to have traffic safety education as an independent subject in school?

Answer: It will be possible. However, lessons would have to be prepared for educators to use in time of need. Also, guidelines on how to teach TSE will have to be put into writing.

Again, some lateral thinking (brainstorming) needs to be done with stakeholders concerned of how to do it properly.

ITEM 3

Interview item 3

Interviewer asks:

3.1 To your mind, is there any relationship among road traffic safety, science and technology?

Interviewees responses:

Yes. One can use the scientific process to prove many things in TSE.

Interviewer asks:

3.2 *How would you describe the relationship among road traffic safety, science and technology?*

Interviewees responses:

There is quite much to integrate among the three, for example, communication, designing of things.

ITEM 4

Interview item 4

Interviewer asks:

4.1 *Do you think that traffic safety education can be integrated in the learning areas of (natural) science and technology?*

Interviewees responses:

Yes.

Interviewer asks:

4.2 *In your opinion, how should these be integrated?*

Interviewees responses:

(No response was given.)

ITEM 5

Interview item 5

Interviewer asks:

What forms of integration models are currently being used in schools to integrate knowledge, attitudes and skills among the learning areas?

ITEM 6	<i>Interviewees responses:</i> Four of the six respondents gave these answers: I am not sure, and I don't know. Interview item 6 <i>Interviewer asks:</i> In your opinion, what other methods could be employed to teach road traffic education in schools? <i>Interviewees responses:</i> Integration is the only way to teach TSE in schools at this stage. However, there must be worked-out lessons and materials for use by educators. ITEM 7 Interview item 7 <i>Interviewer asks:</i> On the basis of the relationships you have outlined between road traffic safety and science as well as between road traffic safety and technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? <i>Interviewees responses:</i> (No response given.)
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ITEM 8**Interview item 8**

Interviewer asks:

The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of traffic safety education in the mainstream school? How far (if you know), are the two Departments with implementation of this strategy?

Interviewees responses:

I have no knowledge of anything materialising in this regard.

ITEM 9**Interview item 9**

Interviewer asks:

Are educators trained sufficiently to integrate TSE knowledge, attitudes and skills among the learning areas?

Interviewees responses:

Educators are not sufficiently trained to integrate TSE in the learning areas.

They gave a number of reasons such as:

- TSE was not included in educators' training programmes.
- Most educators cannot teach TSE and are not teaching it.
- Only two colleges of education in the country and the then Potchefstroom University (now North West University) included TSE in some of the educator training programmes but have stopped it.

ITEM 10	There is therefore no evidence that educators across the country are adequately equipped to teach the field of TSE. <i>Interview item 10</i> <i>Interviewer asks:</i> Seen that it is important and even necessary to teach road traffic education through the integration strategy, what can be done to bring educators abreast with this requirement? <i>Interviewees responses:</i> • A team should be put in place to coach Subject Advisors to in-turn coach the educators in TSE. The educators shall then teach the learners as desired. • Educators must be made to see the need for teaching TSE in Schools, especially, given the statistics of accidents in South Africa. Expose educators to the accident statistics. • As a strategy, the DoE should issue a directive that educators must get involved with TSE. • The National Department of Transport (NDoT) should conduct workshops in TSE for educators. • <i>The example of the Department of Environmental Affairs should be followed. They struck a deal with the DoE to include environmental studies in schools,</i>
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ITEM 11

based on the sponsorship they got from the Swedish Government, and the project has been going on smoothly throughout the country.

Interview item 11

Interviewer asks:

11.1: In your opinion, what are the hindrances to the integration of Traffic Safety Education in schools?

Interviewees responses:

- Educators themselves are one of the hindrances. Many do not see the need for TSE in Schools, and they do feel that they are being overworked and underpaid.
- Educators are overloaded with work in the new curriculum.

Interviewer asks:

11.2 How could this be overcome?

Interviewees responses:

- Educators must be made to see the need for teaching TSE in school and should understand it as part of their responsibility.
- Subject Advisors should be involved in promoting TSE in school. As they are the direct supervisors of educators, they would push and follow-up to see to it that TSE is implemented in school.

APPENDIX L

LIMPOPO PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS OF THE INTERVIEW SCHEDULE

ITEM 1

Question 1

Interviewer asks:

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

Yes. It should start from the infant stage i.e. from creche to higher learning, as they all are road users in one way or another.

ITEM 2

Question 2

Interviewer asks:

2.1 Should Traffic Safety Education form part of school curriculum?

Interviewees responses:

Yes

Interviewer asks:

2.2 How do you see or feel that it should be incorporated in the school curriculum?

Interviewees responses:

All divisions in the relevant departments should form part in the preparatory, co-ordination and implementation in the curriculum development process.

ITEM 3**Question 3**

Interviewer asks:

3.1 To your mind, is there any relationship among Traffic Safety, Science and Technology?

Interviewees responses:

Yes

Interviewer asks:

3.2 How would you describe the relationship among Traffic Safety, Science and Technology?

Interviewees' responses:

Traffic Safety is a science that involves technological aspects and engineering.

Question 4**ITEM 4**

Interviewer asks:

4.1 Do you think that Traffic Safety Education can be integrated in the learning areas of Science and Technology?

Interviewer asks:

4.2 In your opinion, how should these be integrated?

Interviewees responses:

Yes. The research units, curriculum development, directorate, department of Transport, municipalities, Public Works and Academic Institution should make a joint venture in the development and implementation of learning objectives at all levels of studies.

ITEM 5	Question 5 <i>Interviewer asks:</i> What forms of integration models are currently being used in schools to integrate knowledge, attitudes, and skills among the learning areas? <i>Interviewees responses:</i> <i>Road Safety Education face to face and through seminars</i>
ITEM 6	Question 6 <i>Interviewer asks:</i> In your opinion, what other methods could be employed to teach road safety education in schools? <i>Interviewees responses:</i> <i>Street lecturing, plays, demonstrations, artistically demonstration, videos and mass communication</i>
ITEM 7	Question 7 <i>Interviewer asks:</i> On the basis of the relationship(s) you have outlined between Traffic Safety and Science as well as between Traffic Safety and Technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? Motivate <i>Interviewees responses:</i> <i>Programmes should cover the areas leading to the realization of road safety objectives not only at school level but in a life long direction.</i>

objectives not only at school level but in a life long direction.

ITEM 8

Question 8

Interviewer asks:

The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of road safety education in the mainstream school. How far (if you know) are the two Departments with implementation of this strategy?

Interviewees responses:

Programmes have been developed and being implemented i.e. step programme, road Safety ABC, ABET and cyclist manual.

ITEM 9

Question 9

Interviewer asks:

Are teachers trained sufficiently to integrate knowledge, attitudes and skills among the learning areas? Justify.

Interviewees responses:

Not yet as programmes need to be tailored to develop skills needed for effective implementation of Road Safety Education programmes at all levels of schooling.

ITEM 10	Question 10 <i>Interviewer asks:</i> Seen that it is important and even necessary to teach Traffic Safety Education through integration strategy, what can be done to bring teachers abreast with this requirement? <i>Interviewees responses:</i> <i>More seminars workshops and accredited skills development providers should be vigorously engaged.</i>
ITEM 11	Question 11 <i>Interviewer asks:</i> 11.1 In your opinion, what are the hindrances to the integration of road safety education in schools? <i>Interviewees responses:</i> <i>Commitment, funding and corporation by those who are expected to support the programmes.</i> <i>Interviewer asks:</i> 11.2 How could these be overcome? <i>Interviewees responses:</i> <i>Managers should be knowledgeable and have the relevant skills to support and lead the process effectively</i>

APPENDIX M

**MPUMALANGA PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS OF
THE INTERVIEW SCHEDULE**

ITEM 1**Question 1***Interviewer asks:*

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

It is important to have Traffic Safety offered in our schools to enable learners to acquire road safety awareness from childhood. This will prepare them to behave positive when they become adults. Learners need to know basic traffic laws, which will provide their safety. This can at the end help our society to be at least 80% literate traffic safety education.

ITEM 2**Question 2***Interviewer asks:*

2.1 Should Traffic Safety Education form part of school curriculum?

Interviewees responses:

Yes. Traffic safety should be part of the school curriculum it can be integrated to all learning areas/subjects taught at schools right from the pre-school up to the tertiary level, if this is conducted in a formal and informal educators end up ignoring it as it is not part of the examination

purpose, one it can form part of the curriculum definitely it will be taken into serious consideration.

- It can also be used ion GETC (General Education and Training Certificate) examinations as an organising theme for CTA.
- It can be taught as a topic in the life orientation (LO) learning area with other topics like sex education. HIV-AIDS, environmental awareness ad etc.
- Life Orientation extends though all the grades from grade 1-12 which makes it early to introduce Traffic Safety Education.

Interviewer asks:

2.2 How do you see or feel that it should be incorporated in the school curriculum?

Interviewees responses:

- Development of study materials to be used in schools
- Conduct workshops to equip educators on traffic safety information
- Conduct process evaluation.
- Take as a pilot project targeting few schools and educators involved in the pilot project would be used as traffic safety representatives within the department of education.

ITEM 3

Question 3

Interviewer asks:

3.1 To your mind, is there any relationship among Traffic Safety, Science and Technology?

Interviewees responses:

Yes, there is a relationship of Traffic Safety, Science and Technology:

- Science: think where by an educator is going to do a presentation about Traffic Safety education and the example in the teaching and learning is an actuating mechanism (Robot) defining all the colours and the function of a robot at an intersection. Also, indicates that the robot will have to be provided with a sensor, which will inform the robot that there are pedestrians or vehicle behind it and it opens, that is science.
- Technology: in the present situation there is a database kept in the police station, which serves as a record of road traffic accidents. At the end the database is used as a tool to identify the increase or decrease of road accident. Education on Television, presentations on power point by educators including road safety practitioners form part of technology. In the past an educator had to draw things on the chalkboard as a means of teaching media and now technology is playing a major role in Traffic Safety Education.

Interviewer asks:

3.2 How would you describe the relationship among Traffic Safety, Science and Technology?

Interviewees responses:

- Traffic Safety Education: Deals with road safety awareness or that special type of education dealing with the three components, namely traffic, which means vehicles operated on a public road including the coming in and out of vehicles.
- Science in this case is involved where a scientific statistics is needed, the usage of electronic equipments which make it interesting for a learning child to understand the subject matter given by the educator or road safety practitioner in a learning environment or situation.
- Technology: Technology plays an important role in Traffic Safety education in the case where it makes it simple, serves time and resources where educational activities conducted on TV and seen worldwide as compared to what was happening before one had to entire from one class to another educating only one class. In the case of road infrastructure to provide road marking for about 50km it takes the contractors for a short period. When you link these aspects with Traffic safety education it makes it to get the relationship among the three aspects

relationship among the three aspects.

ITEM 4

Question 4

Interviewer asks:

4.1 Do you think that Traffic Safety Education can be integrated in the learning areas of Science and Technology?

Interviewees responses:

Yes, Traffic safety can be integrated with science and technology.

Interviewer asks:

4.2 In your opinion, how should these be integrated?

Interviewees responses:

The integration of science and technology with traffic safety education:

- Science: The educator will request learners to make teaching models which are scientific oriented such as a robot, and the educator allows learners to further discuss how the robot functions, where it uses electricity at the same time it serves lives of all road users. This is a scientific integration of traffic safety and the science as a subject.
- Technology: The educator will have to request learners to collect statistics from various service stations and make comparisons as to where road accident are taking place involving pedestrians. In this case the educator will point it out that this is a technological activity, in the past officials from the service stations were using the manual

	records on hand books but now technology makes it easy to keep more information that will be needed without using more papers, resources, performing presentation using power point and etc.
ITEM 5	Question 5 <i>Interviewer asks:</i> What forms of integration models are currently being used in schools to integrate knowledge, attitudes, and skills among the learning areas? <i>Interviewees responses:</i> <i>Forms of integration models used currently in schools:</i> • Junior traffic training centre • Danny cat.
ITEM 6	Question 6 <i>Interviewer asks:</i> In your opinion, what other methods could be employed to teach road safety education in schools? <i>Interviewees responses:</i> • Projects are to be used as methods to integrate Traffic Safety Education • Educators from identified schools should undergo intensive training programme on the road to safety strategy 2001-2005. These educators will then be engaged as cluster leaders when the programme is expanded or extended to other areas.

expanded or extended to other areas.

- Learners from identified pilot schools should be encouraged to engage themselves in design models that can be displayed during regional, provincial, National exposure in this subject.
- Projects to be firstly piloted and evaluation is conducted.
- Successful projects to be extended to other schools for implementation.

Encourage learners to produce designs involving road safety awareness.

ITEM 7

Question 7

Interviewer asks:

On the basis of the relationship(s) you have outlined between Traffic Safety and Science as well as between Traffic Safety and Technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? Motivate.

(No response.)

ITEM 8

Question 8

Interviewer asks:

The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of road safety education in the mainstream school. How far (if you know) are the two Departments with implementation of this strategy?

Interviewees responses:

Nothing has been done by the two departments to implement and there is no link from the national department of roads and transport and department of education. It goes down to the provincial level to carry the document to operational level. This document does exist with department of roads and transport only, with education one can be talking of a MONSTER if you talk about Road Safety Strategy 2001 -2005.

Findings:

- No formal programmes have started to surface.
- No formal programmes have been communicated to circuit managers and principals of the schools regarding the document.
- Indicators are that subject advisors/ C is at regional offices are not even aware or the road to safety strategy 2001-2005 and what the content entails.
- The document is not well communicated to the education department officials.

ITEM 9

- In short, absolutely nothing has happened regarding the implementation of the strategy.

Question 9

Interviewer asks:

Are teachers trained sufficiently to integrate knowledge, attitudes and skills among the learning areas? Justify.

Interviewees responses:

- No, educators are sufficiently trained, but they were trained by CI (curriculum implementers) who in turn did not sufficient capacity to do the training, had no knowledge to traffic safety education to be conveyed to educators for them to integrate with the science and technology
- The department of education should have involved outsourced or other departments such as Department of roads and transport to assist in this matter. This will have to be taken to tertiary institutions that student educators would come out with the necessary traffic safety education information.
- CI do not have a comprehensive follow up programme to check as whether educators are on the right track with Traffic Safety Education integration. Process evaluation must be

conducted by the CI.

- The out-cry from most educators in grade 9, especially during the introduction of the CTA (Common Task Assessment) shows that most educators are still not conversant with the concept of traffic safety integration.

Note: But we are positive that:

- The emphasis on clusters will assist to improve the condition to integrate traffic safety education with existing subjects.
- The introduction of learners-hips will also assist in this regard, although a number of dropouts are high.
- The subject traffic safety education should be incorporated in the curriculum including topics like drug abuse and alcohol from Grade 0 to grade 12 and have it in the policy document of the department.
- More cluster workshops should be encouraged
- Tertiary institutions should find a way of introducing a learner ship dealing specifically with such integration strategies and the subject inclusive.
- CI should be sufficiently capacitated to be in better position to handle the concept of integrating Traffic Safety Education.

ITEM 10	Question 10 <i>Interviewer asks:</i> Seen that it is important and even necessary to teach Traffic Safety Education through integration strategy, what can be done to bring teachers abreast with this requirement? <i>Interviewees responses:</i> To bring educators to these requirements: Engage educators and learners in more traffic safety activities namely, road safety debates, robot, road safety seminars and etc.
ITEM 11	Question 11 <i>Interviewer asks:</i> 11.1 In your opinion, what are the hindrances to the integration of road safety education in schools? <i>Interviewees responses:</i> • Lack of commitment, responsibility form educators and holistic education. • Procrastination (deferring action) • Lack of comprehensive programme. • Lack of knowledge about the integration strategy. • Lack of communication or proper co-ordination. • Lack of understanding of departmental policies.

Interviewer asks:

11.2 How could these be overcome?

Interviewees responses:

Method to overcome this situation:

- Vigorously engaging policy implementers in:
 - Workshops
 - Compilation of programme of action
 - Process evaluation of the programme.
- Coming up with sound monitoring mechanisms.
- Bringing immediate supervisors on board.
- Embarking on awareness campaigns.
- To popularise the strategy and need for integration.
- Engaging other service providers who are well informed to cascade the Road Safety Strategy 2001-2005.
- Embarking on process evaluation in every phase of the process.

APPENDIX N

**NORTH WEST PROVINCE: RESPONSES OF FGI TO THE INTERVIEW QUESTIONS OF
THE INTERVIEW SCHEDULE**

ITEM 1**Question 1***Interviewer asks:*

Is it important to you that Traffic Safety Education should be taught to our children/learners in school? Justify.

Interviewees responses:

Yes. (Emphases were laid with additional words/phrases like: most definitely, absolutely, it must be done.)

TSE need to be given at an early age due to the fact, that accidents are claiming many lives.

ITEM 2**Interview item 2***Interviewer asks:*

2.1 Should traffic safety education form part of the school curriculum?

Interviewees responses:

Yes. TSE needs to be included in the curriculum.

ITEM 3	<i>Interviewer asks:</i> 2.2 How do you see or feel that it should be incorporated in the school curriculum? <i>Interviewees responses:</i> Integration does not give us the desired results. As such, <i>Road Safety Education (RSE)</i> should be an independent subject. <i>Follow-up question:</i> How can we get TSE as a subject in Schools? <i>Answer:</i> Discussion should take place between role players like, DoE, Department of Health, DoT, NGO's and insurance companies. <i>Follow-up question:</i> Do you see this discussion happening and when? <i>Answer:</i> Yes we need to initiate the discussion, the University should start and those on the operational level (FGI N and others people) will support it. The sooner the discussion is held the better.
	Interview item 3 <i>Interviewer asks:</i> 3.1 To your mind, is there any relationship among road traffic safety, science and technology? <i>Interviewees responses:</i> Yes. To us "RSE" itself is science, because the knowledge of "RSE" is based on science. Any road structure that is built has safety and scientific aspects.

science. Any road structure that is built has safety and scientific aspects.

Interviewer asks:

3.2 *How would you describe the relationship among road traffic safety, science and technology?*

Interviewees responses:

There is a relationship among the three. For example, the Swedish model to Road Safety has got IT in the vehicles, which could warn you that you are overstepping the speed limit and or that there is an accident ahead etcetera etcetera. This is technology integrated with Road Safety, helping one to avoid being part of an accident that occurred at point A on the road. Thereby taking an alternative route.

ITEM 4

Interview item 4

Interviewer asks:

4.1 *Do you think that traffic safety education can be integrated in the learning areas of (natural) science and technology?*

Interviewees responses:

Yes.

ITEM 5	<i>Interviewer asks:</i> 4.2 In your opinion, how should these be integrated? <i>Interviewees responses:</i> By identifying key aspects that link among these three and integrating the knowledge and skills about them, for example, road markings/lines and signs. <i>Interview item 5</i> <i>Interviewer asks:</i> What forms of integration models are currently being used in schools to integrate knowledge, attitudes and skills among the learning areas? <i>Interviewees responses:</i> Four of the six respondents gave these answers: I am not sure, and I don't know.
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ITEM 6	<i>Interview item 6</i> <i>Interviewer asks:</i> In your opinion, what other methods could be employed to teach road traffic education in schools? <i>Interviewees responses:</i>
ITEM 7	<i>Interview item 7</i> <i>Interviewer asks:</i> On the basis of the relationships you have outlined between road traffic safety and science as well as between road traffic safety and technology, would you suggest/recommend that these should be taught in an integrated manner in our schools? <i>Interviewees responses:</i> As we stated before, the integration strategy would not give us the desired results, however, as RSE is not a subject/learning area currently in school, one would settle for the integration but only for the time being.

ITEM 8	Interview item 8 <i>Interviewer asks:</i> The Road to Safety Strategy 2001 to 2005 of the Department of Transport stipulates the integration of traffic safety education in the mainstream school? How far (if you know), are the two Departments with implementation of this strategy? <i>Interviewees responses:</i> Nothing has happened. Probably because, the two Departments did not put in place any policy on the matter.
ITEM 9	Interview item 9 <i>Interviewer asks:</i> Are educators trained sufficiently to integrate TSE knowledge, attitudes and skills among the learning areas? <i>Interviewees responses:</i> Educators are not sufficiently trained to integrate TSE in the learning areas. They gave a number or reasons such as: • TSE was not included in educators' training programmes. • Most educators cannot teach TSE and are not teaching it. • Only two colleges of education in the country and the then Potchefstroom University (now North West University) included TSE in some of the educator training programmes but have stopped it

in some of the educator training programmes but have stopped it.

There is therefore no evidence that educators across the country are adequately equipped to teach the field of TSE.

ITEM 10

Interview item 10

Interviewer asks:

Seen that it is important and even necessary to teach road traffic education through the integration strategy, what can be done to bring educators abreast with this requirement?

Interviewees responses:

- Formal training should be given to educators in RSE.
- Educators should be helped to understand the need for teaching RSE in school.
- Workshops in RSE should be organised (for manageable groups).
- Policy should be put in place around the workshops.

ITEM 11	<i>Interview item 11</i> <i>Interviewer asks:</i> 11.1: In your opinion, what are the hindrances to the integration of Traffic safety education in schools? <i>Interviewees responses:</i> • Lack of legislative powers. • Lack of policy and strategic positioning of RSE in school curriculum. • Educators see RSE as an additional work to their actual subjects. <i>Interviewer asks:</i> 11.2 How could this be overcome? <i>Interviewees responses:</i> • A discussion must take place involving politicians, policy makers, and all stakeholders in RSE. • There should be clear-defined policy objectives between the NDoT and NDoE. • Traffic Safety should become a subject/learning area on its own just like the others and should have Continuous Assessment. • RSE should not only be an independent subject in school but should also be compulsory.
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