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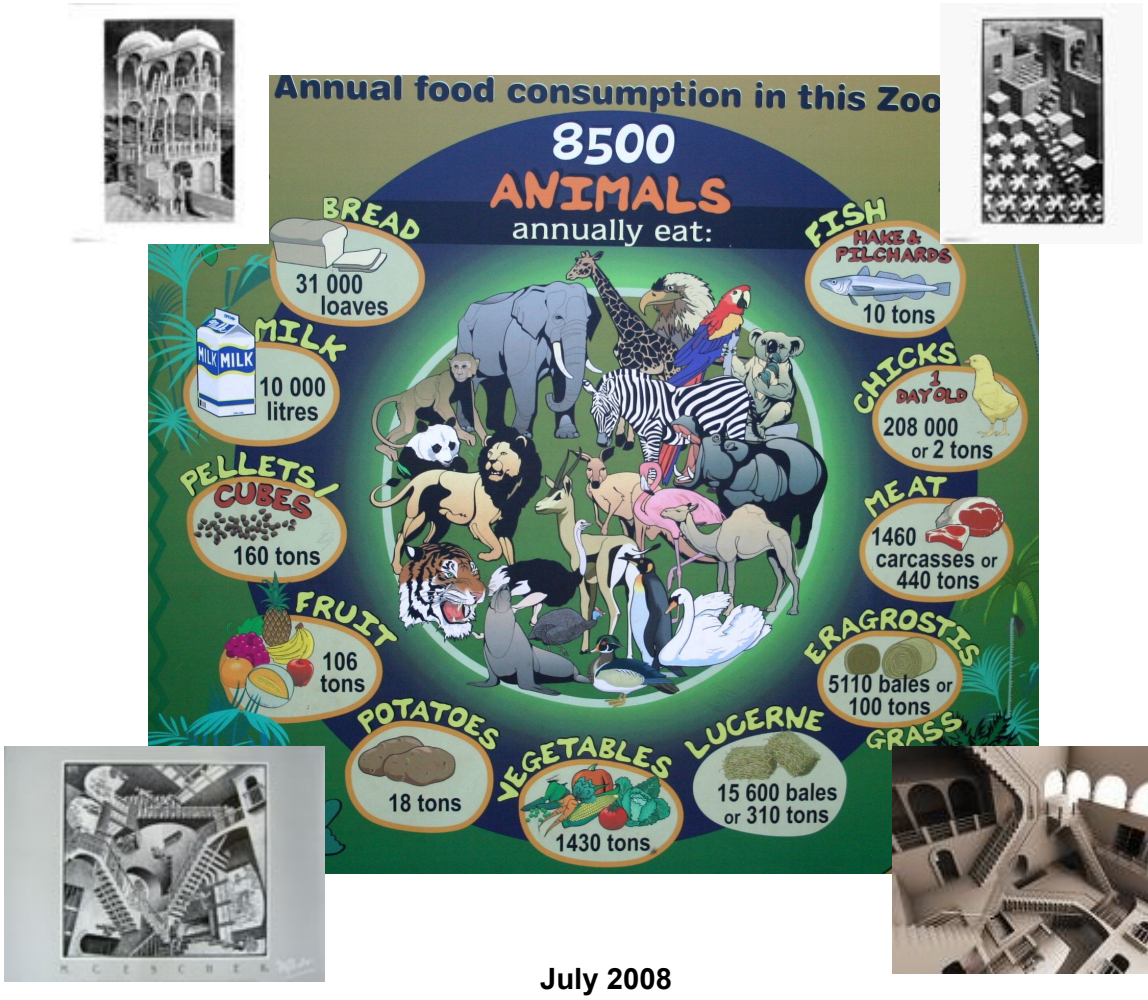
Analytical and communication skills



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Hayley Barnes and Elsie Venter

Centre for Evaluation & Assessment
CEA (Centre for Evaluation & Assessment
AIS Centre, Faculty of Education
Groenkloof Campus Pretoria 0002
Tel: +27 (0) 12 420 4175
Fax: +27 (0) 12 420 5723

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Acronyms

FP - Foundation Phase

RNCS - Revised National Curriculum Statement

LO - Learning Outcome

ESL - English Second Language

ICT - Information and Communication Technology

DoE - Department of Education

AS - Assessment Standard

PBL - Problem-Based Learning

OBE - Outcomes-based Education

LA - Learning Area

PIRLS - Progress in International Reading Literacy Study

TIMSS - Trends in Mathematics and Science Study

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Introduction

1.Background

One of the five areas or themes that the Shuttleworth Foundation (SF) addresses in its funding is analytical and communication skills. These are two of the core skills that the SF has identified as priorities in schools, especially in the African context. Anecdotal evidence within schools, and results from international studies such as the Trends in International Mathematics and Science Study (TIMSS) and the Project in International Reading Literacy Study (PIRLS), indicate that South African learners have not performed well in the areas of analytical and communication skills.

In order to try and improve this issue at the early stages of a learner's education, the SF requested that an analysis of all the learning areas in the Revised National Curriculum Statement (RNCS) in the Foundation Phase (FP) be carried out. The analysis evaluated each Assessment Standard (AS) in every learning area according to the analytical and/or communication skill(s) that it focuses on and the level in Bloom's taxonomy that it attends to. Skills required by the TIMSS and PIRLS frameworks were also mapped onto the curriculum where deemed appropriate, for example the PIRLS skills requirements were mostly regarded in terms of the languages. This was done to ascertain the scope of and potential deficits of analytical and communication skills being covered by the South African FP curriculum.

An assessment framework was compiled for each of the learning areas, for Grades R – 3 indicating the analysis as outlined above. It needs to be fore-grounded that the analysis has only been done on the written curriculum as it is intended to be implemented. However, it is a well-known phenomena in educational literature and research (see for example, Hargreaves, 1989; Fullan & Pomfret, 1977; Fullan, 2001) that there is usually a vast discrepancy between the intended, implemented and attained curriculum.

The intended curriculum is the written document (for example our RNCS) that outlines the standards, outcomes and ideals the curriculum intends to accomplish in each learner. The implemented curriculum refers to the process that occurs when the intended curriculum is interpreted and implemented by teachers and other stakeholders in the schools. The intended curriculum is open to interpretation by material and curriculum developers, teachers,

subject advisers and those in education responsible for drawing up the national assessments such as the Senior Certificate examinations. The curriculum therefore often gets implemented through the use of different philosophies from the one that was used to draw up the intended curriculum. The attained curriculum is basically described as what the learners eventually learn as demonstrated through achievement assessments. As the intended curriculum is the focus of this report, a brief look at the development and context of our RNCS in South Africa is first provided before the approach to the analysis is explained.

2.South African education

In the South African context, the educational philosophy that was used in constructing our current RNCS was Outcomes Based Education (OBE). According to Van Niekerk and Killen (2000), OBE can be viewed as a classroom practice, as a theory of education or as a systemic structure for education. As it embodies and expresses a certain set of beliefs and assumptions, it can also be thought of as philosophy of education. One of the people whose ideas on OBE have had a considerable influence on the approach to OBE that the South African government has adopted is William Spady (Van Niekerk & Killen, 2000). Spady defines OBE as:

> *… clearly focusing and organizing 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 organizing the curriculum, instruction, and assessment to make sure this learning ultimately happens. (Spady, 1994, p. 1)*

Killen expands on this definition and goes on to say that three basic premises underpin OBE (Killen, 2002):

- All students can learn and succeed, but not all in the same time or in the same way.
- Successful learning promotes even more successful learning.
- Schools (and teachers) control the conditions that determine whether or not students are successful at school learning.

Outcomes based education therefore strives to enable all students to achieve to their maximum ability. It aims to do this by setting the outcomes to be achieved at the end of the process. The outcomes encourage a student-centred and activity-based approach to

education and have consequently theoretically redefined the roles of both learner and educator in the process in South Africa. These roles include:

- involving them as participants in the curriculum and learning;
- ensuring that they accept responsibilities for assessment;
- that they become lifelong learners who are confident and independent, literate, numerate, multi-skilled, compassionate with a respect for the environment and the ability to participate in society as a critical and active citizen (Department of Education [DoE], 2002).

According to the policy, learner-centred education also goes beyond only ensuring that all learners achieve the set outcomes and accept their new roles. It also responds to the learning styles and cultures of students and builds on their life experiences and needs. Continuous formative assessment is commended and enables the assessment of competence and complex performances. This means moving beyond the use of simply making use of written tests for assessment purposes so that the assessment of critical outcomes such as teamwork, communication and problem-solving can be done in the context of "real performances" (DoE, 2001).

In summary, the theory of OBE has challenged the traditional authoritarian role of the teacher and passive role of the learner in South Africa, is encouraging the development of defined critical skills that strive to create active and effective citizens who are also lifelong learners. It is an attempt to shift the focus in teaching and learning from a more rote and recall orientated discipline to one which involves acquisition of knowledge, skills and values. Unfortunately this theory or philosophy of OBE that was used to develop our intended curriculum is not necessarily the theory or philosophy that is being used in the actual implementation of the curriculum. The implementation is influenced by the beliefs, attitudes, training and experiences of mainly our teachers who are ultimately responsible for defining and delivering the curriculum at classroom level (Hargreaves, 1989). Any interventions to address an improvement in the education of analytical and communication skills in schools should therefore involve training and re-orientating our teachers where possible to enable them to understand and subscribe to the ideals of the new curriculum and the theory of OBE. This will help to assure that the gap between the intended, implemented and attained curriculum is narrowed.

3.Approach to the analysis

A literature review was first conducted by our information specialist using the search terms “analytical skills” and “communication skills”. From the results the search was expanded to also include the terms: critical thinking skills, higher order thinking and analysis. Literature obtained guided us in determining a definition and categories for coding the assessment standards for the analysis of the analytical and communication skills. Various presentations of the Bloom’s taxonomy were studied and the summary that we draw on for the analysis is included in Section 3.3. For the TIMSS and PIRLS analysis, the documents available for public release from the International Association for the Evaluation of Educational Achievement (IEA) available on their website hosted at http://timss.bc.edu/ were used. A more detailed outline of each component of the analysis is now presented.

3.1 ANALYTICAL SKILLS

The following definitions were considered as the core definitions in drawing up the final coding used for analysing the analytical skills within the Foundation Phase curriculum:

> *Analysis refers to the individual's ability to recognise patterns and divide problems into their constituent parts, solving these elements using familiar tools or arguments and then synthesizing a result from the individual pieces (Shuttleworth Foundation webpage, 2008).*

> *Analytical skill is the ability to visualize, articulate, and solve complex problems and concepts, and make decisions that make sense based on available information. Such skills include demonstration of the ability to apply logical thinking to gathering and analyzing information, designing and testing solutions to problems, and formulating plans (Wikipedia, 2008).*

> *Analysis: In this operation, students divide a whole into component elements. Generally the different part/whole relationships and the parts of cause/effect relationships that characterize knowledge within subject domains are essential components of more complex tasks. The components can be the distinctive characteristics of objects or ideas, or the basic actions of procedures or events (Bloom's taxonomy, 200?).*
>
> *Analytic skill involves identifying the parts of a whole and the relationships of those parts to the whole. It includes the ability to identify the essential components of ideas, events, problems, and processes; to draw logical deductions about those components; and to recognise the limitations of*

these deductions. Since most problems are not isolated from one another, analytic skill includes the ability to establish relationship, where they exist, between problems. Analytic competence also involves the ability to think critically and to solve problems (Bradshaw, 1985, p. 207).

These definitions were sifted through and common terms were tabulated into Table 1 below. The descriptions and keywords used to analyse the analytical skills were not put in any hierarchical or relevant order.

Table 1: Definition and key words used in analytical analysis

Definition	Keyword
Identifies relationships between parts of a whole	Identifying relationships
Identifies patterns	Identifying patterns
Evaluates credibility of sources	Credibility
Gathering data	Data collection
Analysing/interpreting data	Data analysis
Synthesizing data	Data synthesis
Reflective thinking, personal experiences and reflections	Reflection
Make decisions based on available information	Decision
Applying existing principles/knowledge to new situations Moving beyond existing frame of reference	Applying knowledge
Solve complex problems	
Designing and testing solutions Formulating plans Apply systemic design procedures to open-ended problems	Solutions
Identifying/defining parts of a whole/problem Identifying essential components of ideas, actions, events, problems and processes	Parts
Inductive and deductive logical thinking	Logical thinking
Ability to visualise	Visualisation

Using this table, two senior researchers coded each of the assessment standards from one of the Learning Areas from the Foundation Phase together in order to establish inter-rater reliability to ensure that the allocation of codes was agreed upon. This still remains a subjective issue though but an attempt to ensure consistency throughout the exercise was made. One of the senior researchers then coded all the other Learning Areas in relation to analytical skills while the other senior researcher moderated this coding at a later stage.

3.2 COMMUNICATION SKILLS

A similar process as outlined in the approach above was followed. This was an easier set of skills to define (initially) and after studying some definitions (a selection included below) and documents, we decided on using the following codes to analyse the communication skills (Table 2).

> *Communication skills concern the individual's ability to understand what is read, heard and seen while being able to participate meaningfully in dialogue and other interactions (Shutleworth Foundation website, 2008).*

> *Communication skills indicate competence in communication, in a very broad sense, involves all those procedures that allow an individual to express him/herself effectively. Within this broad range two distinct, though clearly related, types of competence may be identified. The first type is verbal competence. It is the ability to speak and write clearly and effectively. The second type is non-verbal competence. Skills in this area are displayed in a variety of non-verbal systems of codification, which range from aesthetic symbols to gesture and digital language systems (Bradshaw, 1985, p. 206).*

> *Communicating involves to send and receive information in a variety of modes (written, graphic, oral, numeric, and symbolic), within a variety of settings (one-to-one, in small and large groups), and for a variety of purposes (for example, to inform, to understand, to persuade, and to analyse) (Bradshaw, 1985, p.206).*

The definition of communication from Wikepedia (http://en.wikipedia.org/wiki/Communication_skills#cite_note-1) has also been included for the purpose of adding detail to the above definitions:

Communication *is the process of conveying information from a sender to a receiver with the use of a medium in which the communicated information is understood the same way by both sender and receiver. It is a process that allows organisms to exchange information by several methods. Communication requires that all parties understand a common language that is exchanged, There are auditory means, such as speaking, singing and sometimes tone of voice, and nonverbal, physical means, such as body language, sign language, paralanguage, touch, eye contact, or the use of writing. Communication is defined as a process by which we assign and convey meaning in an attempt to create shared understanding. This process requires a vast repertoire of skills in intrapersonal and interpersonal processing, listening, observing, speaking, questioning, analyzing, and evaluating. Use of these processes is developmental and transfers to all areas of life: home, school, community, work, and beyond. It is through communication that collaboration and cooperation occur.[1] Communication is the articulation of sending a message, through different media [2] whether it be verbal or nonverbal, so long as a being transmits a thought provoking idea, gesture, action, etc.*

Communication happens at many levels (even for one single action), in many different ways, and for most beings, as well as certain machines. Several, if not all, fields of study dedicate a portion of attention to communication, so when speaking about communication it is very important to be sure about what aspects of communication one is speaking about. Definitions of communication range widely, some recognizing that animals can communicate with each other as well as human beings, and some are more narrow, only including human beings within the parameters of human symbolic interaction.

Nonetheless, communication is usually described along a few major dimensions: Content (what type of things are communicated), source, emisor, sender or encoder (by whom), form (in which form), channel (through which medium), destination, receiver, target or decoder (to whom), and the purpose or pragmatic aspect. Between parties, communication includes acts that confer knowledge and experiences, give advice and commands, and ask questions. These acts may take many forms, in one of the various manners of communication. The form depends on the abilities of the group communicating. Together, communication content and form make messages that are sent towards a destination. The target can be oneself, another person or being, another entity (such as a corporation or group of beings).

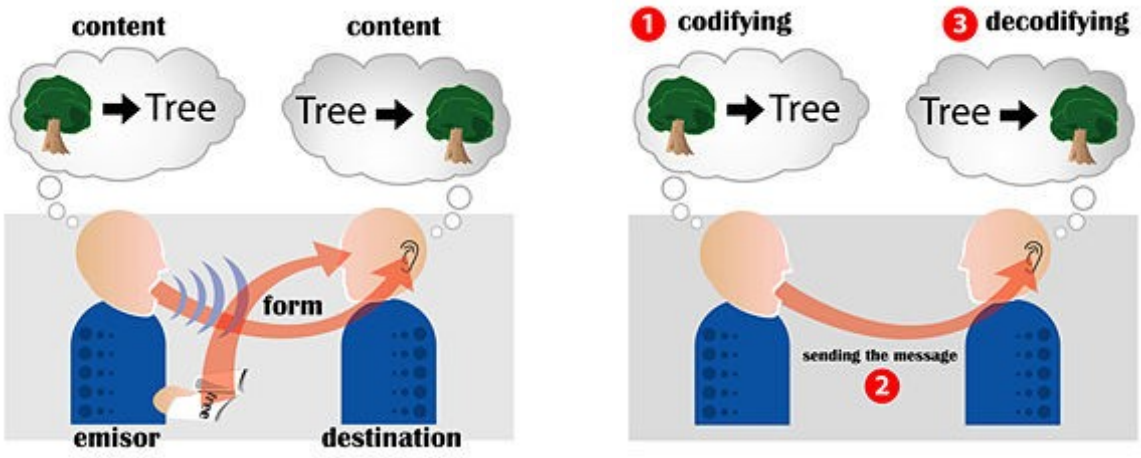
Communication can be seen as processes of information transmission governed by three levels of semiotic rules:

Syntactic (formal properties of signs and symbols),

pragmatic (concerned with the relations between signs/expressions and their users) and

semantic (study of relationships between signs and symbols and what they represent).

Therefore, communication is social interaction where at least two interacting agents share a common set of signs and a common set of semiotic rules. This commonly held rule in some sense ignores autocommunication, including intrapersonal communication via diaries or self-talk.



In a simple model, information or content (e.g. a message in natural language) is sent in some form (as spoken language) from an emisor/ sender/ encoder to a destination/ receiver/ decoder. In a slightly more complex form a sender and a receiver are linked reciprocally. A particular instance of communication is called a speech act. In the presence of "communication noise" on the transmission channel (air, in this case), reception and decoding of content may be faulty, and thus the speech act may not achieve the desired effect. One problem with this encode-transmit-receive-decode model is that the processes of encoding and decoding imply that the sender and receiver each possess something that functions as a code book, and that these two code books are, at the very least, similar if not identical. Although something like code books is implied by the model, they are nowhere represented in the model, which creates many conceptual difficulties.

Theories of coregulation describe communication as a creative and dynamic continuous process, rather than a discrete exchange of information.

Table 2: Definition and key words used in communication skills analysis

Definition	Key word
Pictures, acting, miming, working with graphs, media, etc where the focus is on communicating without speaking.	Non-verbal
Recognising symbols and objects.	Visual recognition

Reading - this can be aloud or silently	Read
Writing. Actual letters of the alphabet are used. This therefore excludes drawing which is captured under non-verbal.	Write
Speak out loud. Forming words and sentences in a recognisable language.	Speak
To listen to a speaker, or through media.	Listen
Singing	Sing
Explicit interaction within a group.	Interaction

In searching for more recent citations of definitions of "communication skills", it emerged from the literature that the above-mentioned definitions of communication are still accepted and "timeless" as frameworks for what communication skills encompass. Researchers have not attempted to re-define this domain, except on a very theoretical level where academics have argued for it to be regarded as a theoretical concept rather than a construct. A good reference for reading more about this is in the Handbook of Communication and Social Interaction Skills (Greene & Burleson, 2003) but the very theoretical nature of the book renders it less useful for the scope of this exercise.

What has developed though through the technology surge are the increased means of communicating and accessing information such as gaming software (Gee, 2003), video technologies (O' Brien, 2001), technologies that establish communities on the Internet (Chandler-Olcott & Mahar, 2003), search engines (Jansen, Spink & Saracevic, 2000), webpages and many still emerging (Leu, Kinzer, Coiro & Cammack, 2004). This variation brings in the component now commonly referred to in literature as Information and Communication Technology (ICT) literacy. Katz (2007) defines ICT literacy as:

> *…the ability to appropriately use digital technology, communication tools, and/or networks to solve information problems in order to function in an information society. This includes having the ability to use technology as a tool to research, organize and communicate information and having a fundamental understanding of the ethical/legal issues surrounding accessing and using information. (Katz et al, 2004, p.7)*

Some small scale studies have shown that students appear not to use technology effectively when they communicate (Rockman, 2004 as cited in Katz, 2007). There is also a preconception amongst teachers and educators that students and learners of today display less information “savvy” than previous generations. Increased communication tools and technologies have therefore not necessarily resulted in more effective communication (Breivik, 2005 as cited in Katz, 2007). Learners need to be taught to be ICT literate as well as posses the necessary level of communication skills in order to benefit from these new powerful information tools (Rockman, 2004 as cited in Katz, 2007). For the purpose of this report, we therefore added another level of analysis into the assessment of the Foundation Phase curriculum to look at the intended and possible teaching of ICT in this curriculum. This analysis is not included in the actual frameworks but rather as an overview, and discussed in Section 2 later on under the Discussion. The components of ICT literacy from Katz (2007) were used to guide this analysis (see Appendix B).

3.3 BLOOM’S TAXONOMY

Bloom's taxonomy is hierarchically ordered with *Knowledge* being the lowest level and *Evaluation* being the highest level of thinking skills (cognitive domains). In coding the assessment framework in terms of Bloom's taxonomy, the hierarchical order was considered and the highest cognitive skill identified for a particular assessment standard was listed. These were not colour coded. However, where no cognitive skill from the taxonomy was thought to be relevant to a particular assessment standard, the block was filled in with red. The assessment standards were coded according to guidelines from Bloom's *Taxonomy of Educational Objectives* (Bloom & Krathwohl, 1984). A summary thereof is presented in Table 3 below.

Table 3: **The characteristics of the cognitive domain.**

Level of cognition	Definition	Typical action verbs	Skills demonstrated
1. Knowledge	Remembering previously learned information	Arrange, define, describe, identify, label, list, match, name, outline, show, label, collect, examine, tabulate, quote	• observe and recall information • knowledge of dates, events, places • knowledge of major ideas • mastery of subject matter
2. Comprehension	Understanding the meaning of information	Classify, discuss, estimate, explain, give example(s), identify, predict, report, review, select, summarise, interpret, 'in your own words', contrast, predict, associate, distinguish, estimate, differentiate	• understand information • grasp meaning • translate knowledge into new context • interpret facts, compare, contrast • order, group, infer causes • predict consequences
3. Application	Using the information appropriately in different situations	Apply, calculate, demonstrate, illustrate, interpret, modify, predict, prepare, produce, solve, use, manipulate, put into practice, calculate, examine, relate, change, classify	• use information • use methods, concepts and theories in new situations • solve problems using required skills or knowledge
4. Analysis	Breaking down the information into the component parts and seeing the relationships	Analyse, appraise, calculate, compare, criticise, derive, differentiate, choose, distinguish, examine, subdivide, organise, deduce separate, order, connect, infer, divide	• seeing patterns • organisation of parts • recognition of hidden meanings • identification of components
5. Synthesis	Putting the component parts together to form new products and ideas	Assemble, compose, construct, create, design, determine, develop, devise, formulate, propose, synthesise, plan, discuss, support combine, integrate, modify, rearrange, substitute, design, invent, what if?, prepare, generalise, rewrite	• use old ideas to create new ones • generalise from given facts • relate knowledge from several areas • predict, draw conclusions
6. Evaluation	Making judgements of an idea, theory, opinion, etc, based on criteria	Appraise, assess, compare, conclude, defend, determine, evaluate, judge, justify, optimise, predict, criticise, assess, decide, rank, grade, test, measure, recommend, convince, select, judge, explain, discriminate, support, summarise	• compare and discriminate between ideas • assess value of theories, presentations • make choices based on reasoned argument • verify value of evidence • recognise subjectivity

3.4 TIMSS

In the Science and Mathematics Frameworks developed for the TIMSS evaluations, both content and cognitive domains were included. The cognitive domains have been foregrounded in this report. These were adapted from the Bloom's taxonomy and divided into three main categories of *Knowing*, *Applying* and *Reasoning*. For more information on each of these categories, see Appendix A. A summary of the breakdown of the categories into more detailed components is presented in Tables 4 and 5 below. In the Science Framework, 40% of the items in the Fourth Grade test were devoted to *Knowing* type questions, 35% to *Applying* and 25% to *Reasoning*. In the Mathematics Framework the breakdown was as follows: *Knowing* - 40%, *Applying* - 40% and *Reasoning* - 20%.

Table 4: **Cognitive domains used in Science Framework for TIMSS**

Domain	Behaviours
Knowing	Recall/Recognize Define Describe Illustrate with examples Use Tools and Procedures
Applying	Compare/Contrast/Classify Use Models Relate Interpret Information Find Solutions Explain
Reasoning	Analyze/Solve Problems Integrate/Synthesize Hypothesize/Predict

Table 5: **Cognitive domains used in Mathematics Framework for TIMSS**

Domain	Behaviours
Knowing	Recall Recognize Compute Retrieve Measure Classify/Order
Applying	Select Represent Model Implement Solve routine problems
Reasoning	Analyze Generalize Synthesize/Integrate Justify Solve non-routine problems

The Learning Areas of Mathematics, Natural Science, Economic and Management Sciences and Technology were thought to be the most suitable in applying the analysis from the TIMSS frameworks.

3.5 PIRLS

From the *PIRLS 2006 Assessment Framework and Specifications*, (Mullis, Kennedy, Martin & Sainsbury, 2006), the two components that formed the basis of the written test of reading and comprehension were used in this analysis, i.e. *processes of comprehension* and *purposes for reading*. These were applied in the Home and First Additional Language Frameworks where applicable (where reading was identified as the communication skill). Tables 6 and 7 below provide a summary of the guidelines followed in the analysis.

Table 6: **Processes of Comprehension**

Types of Processes	**For example:**
Focus on and retrieve explicitly stated information	• Identifying information that is relevant to the specific goal of reading • Looking for specific ideas • Searching for definitions of words or phrases • Identifying the setting of a story (e.g., time, place) • Finding the topic sentence or main idea (when explicitly stated)
Make straightforward inferences	• Inferring that one event caused another event • Concluding what is the main point made by a series of arguments • Determining the referent of a pronoun • Identifying the generalisations made in the text • Describing the relationship between two characters
Interpret and integrate ideas and information	• Discerning the overall message or theme of a text • Considering an alternative to actions of characters • Comparing and contrasting text information • Inferring a story's mood or tone • Interpreting a real-world application of text information
Examine and evaluate content, language, and textual elements	• Evaluating the likelihood that the events described could really happen • Describing how the author devised a surprise ending • Judging the completeness or clarity of information in the text • Determining an author's perspective on the central topic

Table 7: **Purposes for Reading**

Purpose	**Description**
Reading for literary experience	Reader engages with text to become involved in imagined events, setting, actions, consequences, characters, atmosphere, feelings, and ideas, and to enjoy language itself. To understand and appreciate literature, the reader must bring to the text his or her own experiences, feelings, appreciation of language and knowledge of literary forms.
Reading to acquire and use information	Reader engages not with imagined worlds, but with aspects of the real universe. Through informational texts, one can understand how the world is and has been, and why things work as they do. Readers can go beyond the acquisition of information

	and use it in reasoning and in action. Informational texts need not be read from beginning to end; readers may select the parts they need.

4.The assessment frameworks

These were compiled in excel. Each Learning Area opens in a separate file, with each Grade (R - 3) of the Foundation Phase being represented on a separate sheet within that file. Colour shading was used to further enhance the value of the analysis for the communication and analytical skills. Where an analytical or communication skill could not be identified, the block next to that assessment standard in the framework was filled in with red, under the relevant column. Where we felt the analytical/communication skill was being strongly advocated in the intended curriculum, we shaded the block in green. And where we held the opinion that the analytical/communication skill was being touched on or only being partially realised, we shaded the block yellow.

Discussion

A discussion on each of the analyses as presented in the frameworks is outlined.

1.Analytical skills

A quantitative tally of the frequency of the various analytical skills was carried out as an indication of possible gaps that need to be addressed in our curriculum. This exercise should be viewed as a surface indicator rather than an "absolutist" source of information. This is due to the subjective nature of coding the assessment standards as well as the non-standardised format of the different Learning areas. For example, the Natural Sciences Learning Area presents far less detail of content in its assessment standards than the other Learning Areas. However, the Home Language and First Additional Language curriculum statements provide a lot of detail regarding specific content. The frequency of analytical skills as presented by our frameworks could therefore be skewed by these limitations. On the other hand, as has already been mentioned, a chasm is likely to exist between the intended and implemented curriculum and we cannot be sure that analytical skills will be taught and learnt as intended

by the curriculum. So we viewed the main aim of this exercise to identify the strengths and weaknesses of our written curriculum and make recommendations based on these, as well as available literature and our experience within education. A brief paragraph on each Learning Area is first presented followed by concluding paragraphs on analytical skills in the Foundation Phase curriculum.

At the FP level, the ***Economic and Management Sciences*** (EMS) curriculum is still very brief. This resulted in only a few analytical skills being covered in this Learning Area, with most of the emphasis on *making decisions, applying knowledge* and *reflection*. In our opinion, this is unfortunate as this particular LA has wonderful scope to draw on real-life contexts of the learners and engage them in challenging *problem-solving* even at this young age. On the whole the curriculum appears to underestimate the reasoning and problem-solving abilities of young learners and the necessity to practise and develop these abilities. A lack of entrepreneurial skills (which cover a range of analytical skills) are being engendered in the FP.

In the ***Natural Science*** curriculum the largest focus of the assessment standards appears to be on *solutions* and *reflection. Solutions* involves formulating plans and implementing them to solve problems. In our coding, this keyword was used when the problems were not explicitly complex problems, but rather ones that were already broken down into steps for the learners. As the nature of science involves scientific investigation and mastering a range of process skills (DoE, 2003), an obvious gap for us in this curriculum in the FP is the lack of assessment standards that require *data collection, interpretation and synthesis*. While these do make a brief appearance in some of the other LA's, in general it appears that the development of these three core science skills is being left for the Intermediate, Senior and FET phases. *Solving complex problems* (that are presented as a problem and the learners are not guided step-by-step in solving them) was also not evident at all in the Natural Sciences curriculum or any of the other LA's. This too, is a deficit that needs to be embraced if we are to improve the analytical skills of the learners in our country.

While also still quite brief and limited in the FP, the ***Technology*** curriculum evenly deal withs a range of analytical skills, including: *parts, solutions, applying knowledge, reflection* and *visualisation*, without any specific skill coming to the fore as dominant. In our opinion the two skills of *solving complex problems* and *explanation* are obvious gaps that could have been more developed within this particular LA.

The ***Social Sciences*** curriculum currently has a heavy emphasis on the analytical skills of *decision*, followed by *identifying relationships, reflection* and *applying knowledge*. Although not presently the case, this LA, especially in relation to history provides adequate context and scope to also address skills such as *parts*, where learners are required to identify/define essential components or ideas of a whole/problem. Reflecting on the past as well as on geographical aspects should also create opportunities for learners to learn and practise the analytical skill of *explanation*, which requires learners to evaluate situations and solutions in terms of their appropriateness.

The ***Arts and Culture*** curriculum is extremely dominated by the analytical skill of *reflection*, focused on how the learner feels and encouraging the learner to explore and express this aspect. *Applying knowledge, decisions, identifying patterns* and *visualisation* are covered to a lesser extent. A gap that is evident in the particular LA is *logical thinking* which could have been more explicitly included within the Arts and Culture assessment standards.

As expected (by the very nature of the subject) the ***Mathematics*** curriculum encourages a lot of analytical thinking, with the skill of *decision* appearing the most, followed by *applying knowledge, visualisation* and *identifying patterns*. The range of skills that this LA covers though is disappointing from our analysis. For example, we could only find a few assessment standards that explicitly required *logical thinking, explanation, data collection, data analysis* and *data synthesis*. No complex problem-solving was observed either. Perhaps it is assumed that these skills will be taught and practised in the mathematics class, but in our opinion these need to be provided for both in the curriculum and in the Teacher's Guide to developing Learning Programmes (DoE, 2003) if we want to optimise the development and benefit thereof for our learners. This particular LA enjoys 35% of the teaching and learning time according the time allocation by the DoE (2003), and therefore an attempt should be made to enhance the potential analytical skills that this LA is in a position to engender in young learners.

Similar to some of the other LA's already discussed, the ***Life Orientation*** curriculum foregrounds *decision, applying knowledge* and *reflection*. Gaps existing in this curriculum include *visualisation, identifying relationships, parts, adaptability, credibility and explanation*. The practical approach and relevance of this LA make it an important vehicle for the teaching and learning of the above-mentioned, currently under-addressed analytical skills.

The ***Languages (Home and First additional)*** curriculum encompass a range of analytical skills dominated by *applying knowledge* and *decision*. Although to a lesser extent *identifying patterns and relationships, parts, reflection, logical thinking, data synthesis* and *visualisation* are also well embraced within this LA. In fact, this LA appears to be the richest one in terms of the explicit teaching and learning of analytical skills. This is encouraging as the curriculum guidelines (DoE, 2003) require schools to spend 40% of their allocated time on Literacy.

In conclusion, *decision, applying knowledge* and *reflection* emerged as the analytical skills that are mostly addressed throughout the FP curriculum. Evidence of *credibility, adaptability* and *data analysis* appeared the least number of times and *solving complex problems* is not encouraged at all in FP curriculum in our opinion. While adaptability is a difficult analytical skill to explicitly teach, it can be practically implemented through group work and activities that require the learner to move out of their comfort zone or that which they are familiar with. This all depends though on how the teacher implements the intended curriculum, and could be more obviously observed in the classroom rather than in the curriculum document. We did not find sufficient evidence though in either the curriculum documents or the teacher's guide to suggest that teachers are being encouraged to embrace this analytical skill of *adaptability and flexibility*. In our opinion, while this is a skill that matures along with the individual, starting to encompass it more in the FP curriculum could be beneficial for learners as they progress through the schooling system. For example, learners could benefit from understanding that in mathematics there is often more than one way to approach and solve a problem. Perhaps learners would also become more accepting of others and their cultures if adaptability and flexibility are actively promoted by the curriculum.

Our learners in South Africa, even at this young age, need to be given an opportunity to *solve complex* and challenging *problems* in order to master this invaluable analytical skill. A problem-solving approach to teaching and learning (also known as Problem-based learning or PBL) has been being highly advocated in the literature during the past three decades (see

for example Fosnot, 1983; Vernon & Blake, 1993; Hill & Smith, 2005) and is used in the training of, for example, medical professionals (see for example Barrows, 1993; Colliver, 2000). This approach also promotes many of the other analytical skills currently appearing as gaps within our curriculum, and various ways of doing this are being propagated in Early Childhood Education (for example Srivastava, Muntz & Potkonjak, 2001; Wheatley, 2006). The intention here is not to suggest formal ways of doing this though, but to rather work on increasing the informal, less-structured activities given to learners in this phase. Interventions that support such training and design of PBL programmes within our schools, particularly for our teachers (including pre-service teachers) should therefore be developed and supported as far as possible in an attempt to improve the analytical skills of our learners.

2.Communication skills

On the whole, these skills of *visual recognition, listen, speak, sing, read, write, interaction* and *non-verbal skills* are well-covered by our intended curriculum. The new intended curriculum certainly requires far more participation from and interaction between the learners, giving them more opportunities to speak, rather than a focus on listening and writing which was the case in the previous dispensation. Once again, this will need to be realised at the implementation level in order to optimise the current ideals of the new curriculum.

With regard to ICT literacy, the curriculum of the different Learning Areas were analysed in terms of a) explicit reference to ICT literacy and opportunities in the intended curriculum and b) possible scope for implementing ICT literacy through the intended curriculum. In general the curriculum documents carry very little explicit reference to ICT literacy and opportunities and outcomes that directly address these skills. The ***Technology*** curriculum document (DoE, 2002) has a section on Page 7 that directly address Information and communication technology. It makes the point that:

Learners need to be equipped with knowledge and skills to be competent and confident in accessing and working with various forms of information data. These skills are included in Learning Outcome 1 as Assessment Standards related to investigating (e.g. information gathering, storing, processing, management) and communication skills (e.g. presenting information, identifying sources). The approach to information and communication technology focuses on the use of learning support materials and equipment to access, process and use information in the most appropriate ways. Where resources are available, schools should interpret the use of information and communication technology as including the following skills:

- *Word processing (skill needed in all learning areas);*
- *Spread sheets (skill needed mostly by Mathematics, Economic and Management Sciences);*
- *Database management (skill needed mostly by Social Sciences, Economic and Management Sciences);*
- *Graphics (skill needed mostly by Arts and Culture, Technology, Languages, Social Sciences); and*
- *CD-ROM referencing (needed by all learning areas)*

The focus above is mainly on computer software and it is unfortunate that the intended scope was not broadened to include other technology such as video and digital cameras, Internet tools and gaming. The assessment standards within the intended curriculum certainly offer content that could be used to teach ICT literacy more effectively than the curriculum currently emphasises in our opinion. This is also the case in other learning areas.

The learning area of ***Languages*** is another domain where wonderful scope abounds for integrating ICT literacy. The only explicit mention in this curriculum document (DoE, 2002) is where teachers are given some examples of multimedia texts that learners in the Foundation Phase could be exposed to. These include: Television programmes, Videos, CD – ROM and Internet, simple Television advertisements and films. The use of photographs and games are also mentioned briefly but not in relation to ICT or multimedia.

The ***Natural Sciences*** curriculum (DoE, 2002) refers to “technological contexts” in all three of its Learning Outcomes, but this is not explicitly carried through in the assessment standards. The other mention of ICT literacy appears as a “Process Skill” in the form of “Communicating science information” (p. 14):

This skill…is important both in helping the learner reflect on own learning and in building confidence as a person. Competence in communicating involves knowing when it is important to make extra effort to communicate one's ideas or results, and choosing an appropriate means to communicate with the specified audience. In the science classroom, this skill may involve learners in forms of communicating such as giving oral reports, writing prose text, using an art form such as poetry or drama or comic strip, and using graphic forms such as posters, diagrams, pie-charts. Communicating also involves more conventional science forms such as tables, concept maps, word-webs, graphs, making physical, constructed models, or enacted models such as using people to show the motion of the planets around the Sun.

The ***Arts and Culture*** learning area is the only other document in the curriculum (DoE, 2002) with explicit reference to ICT literacy. Learning Outcome 4 encompasses "Expressing and Communicating" and the following definition is giving (p. 13):

The learner will be able to analyse and use multiple forms of communication and expression in Arts and Culture.

This Learning Outcome requires that the learner develops the ability to read and use nuances of cultural expression to convey meaning through the Arts. It also deals with forms of communication media (television, radio, film, advertising) and their influence on people and societies.

No further guidelines or information are provided within the assessment standards relating to ICT literacy or use, but again, this is a learning area that lends itself so well to developing these skills. In our opinion of the implementation of the new curriculum, these opportunities are currently being under-utilised in this particular domain. This is probably mainly due to a shortage of properly trained and competent teachers specialising in Arts and Culture as well as the lack of resources in most of our schools.

The learning areas of ***Life Orientation, Social Sciences, Mathematics*** and ***Economic and Management Sciences*** contain no explicit mention or reference to ICT literacy in their curriculum documents (DoE, 2002). However, these learning areas all also lend themselves to providing wonderful scope and content in their intended curriculum that could teach, use and practice the ICT literacy skills, even in the Foundation Phase. For example, one of the assessment standards in the History component of the ***Social Sciences*** learning area deals with "retelling stories about the past". Learners could be encouraged to use photographs, videos, slides, music, etc. as a means to achieving this assessment standard, and also be shown or retrieve visual data through the Internet, movies and television relating to this. This

would certainly make the subject more relevant and accessible to more learners and foreground the need for it in learners' lives. In ***Life Orientation***, the Personal Development and Health Promotion Learning Outcomes could be enriched by the use of ICT. For the ***Mathematics*** curriculum, some of the better resourced schools in South Africa already make use of computer software such as excel and geometry sketchpad, but only in the higher grades. Calculators are also often reserved for the higher grades, but while they should not be abused (or replace the need to be able to do mental mathematics), learners should learn to use them as a technological tool even in the Foundation Phase. There are also good software packages that teach critical thinking skills such as logical thinking on the market currently that can be used in the Foundation Phase (for example the game CIRCUS).

Overall we are of the opinion that neither our intended nor implemented curriculum are adequately explicitly addressing the learning and use of ICT literacy in the Foundation Phase. As already mentioned, this may have to do with resources, but it also probably has something to do with the enormous amount of other basic skills learners are acquiring at this early stage of their schooling. However, this should not prevent us as a country encouraging the use of ICT even in this Phase. The literature suggests that learning through play (see for example Rieber, 1996) and games (see for example Gee, 2003; Arnseth, 2008) can be more effective in children than formal activities. ICT provides another rich platform for "play learning".

Perhaps an "idea bank" for teachers (specifically in the South African context) could be developed in the form of a web-site and materials that assist teachers in making more use of ICT literacy throughout the learning areas of the curriculum in the Foundation Phase. This could be developed with specific reference to assessment standards that offer suitable content, and also with the aim of integrating the learning areas through the use of ICT literacy (for example projects that run across several learning areas).

Where there is a shortage of resources in schools, a project could perhaps be launched to provide “ICT literacy kits” to schools. These could include, for example, a digital camera, a computer with various software, a television and DVD player, or alternatively scaled down kits that contain materials such as mobile phones and the cheaper small laptops that are available now on the market. In the past certain NGO’s have had success distributing and training teachers to use, for example, mathematics kits and natural science kits (see Barnes, 2004).

A lot of in-service training over the last few years has focussed on the shifting philosophy within our education system to OBE and the introduction of the new curriculum. This has been at the expense of equipping our teachers to enable learners to become more ICT literate and thereby also enhance their communication skills. Purposeful workshops for teachers in this regard, could help to address this deficit.

In conclusion, it is our opinion that the introduction of more ICT usage in schools also holds great potential for assisting teachers with the growing challenge of discipline. Learners are no longer satisfied with passively listening to the teacher when they are exposed to so many more forms of communication in their everyday lives. ICT literacy as an important part of communication skills has the potential to bring the real world more actively into the classroom thereby also addressing a growing global need within education.

3.Bloom’s taxonomy

The two lowest levels of cognitive domains (*knowledge and comprehension*) dominated the assessment standards overall in the FP. *Application* followed in frequency with *analysis, synthesis* and *evaluation* being indicated in only a few of the Learning Areas. This is not all that surprising however, owing to the nature of Early Childhood Education where the belief is that a good foundation has to be laid. While this is certainly true, we are of the opinion that the ability of young learners to carry out the higher-order thinking skills is often underestimated. *Analysis, synthesis* and e*valuation* are important cognitive domains that need to be developed early in our learners to equip them to become critical and independent life-long learners.

While we made our judgement of the classification of an assessment standard according to Bloom's taxonomy on the intended curriculum, this may also turn out to be quite different to

the level that is attained in the actual teaching and learning in the classroom. This once again depends on the central agent of implementation - the teacher. In workshops and interventions that are designed and/or funded, it is recommended that teachers be exposed to various taxonomies in their approaches to teaching, learning and assessment. Other relevant taxonomies include ones such as the Solo taxonomy (Biggs & Collis, 1982; Biggs, 1999) and/or the Quellmalz taxonomy (as cited in Stiggins, Griswold & Wikelund, 1989) and documents such as Ennis' (1985) Critical Thinking/Reasoning Curriculum (Ennis, 1985).

4.TIMSS and PIRLS

According to the analysis, the categories and components as outlined in the available documents relating to these studies are mostly sufficiently covered in our intended curriculum in the Foundation Phase. The only deficit we could detect is that learners are perhaps not given sufficient opportunities to *read for information* purposes within the various Learning Areas, other than the Languages. In working with pre-service and in-service teachers, we have also often observed teachers giving assignments or texts to learners to read independently and then reading through the text aloud with the learners. This does not encourage this independent type of *reading for information* skill that is being evaluated in the PIRLS study.

The lack of content detail does not always make it clear to what depth or extent our learners are required to read, but according to the face-value analysis of our intended curriculum, our learners should be adequately equipped by Grade 4 to be able to perform better in the TIMSS and PIRLS studies than current results indicate. This is an important conclusion in that it once again points us to the implementation phase of the curriculum in determining why our learners are not attaining the required or even expected standard with regard to basic Numeracy and Literacy skills. As the Foundation Phase is focused on laying a good basis for Numeracy and Literacy, it is imperative that research and training of teachers become a priority with regard to funding and support in improving the teaching and learning of these two core domains.

Conclusion

The main conclusion we can draw is that while there are gaps in our intended curriculum relating to the development of analytical skills, these are not as severe as the chasm that may be occurring between our intended and implemented curriculum. This chasm is largely influenced by the teachers in the Foundation Phase who are the prominent role-players in implementing the intended curriculum. Where possible it is recommended that teachers and pre-service teachers be trained and supported in the teaching, learning and assessment of analytical skills and in the design and development of materials that can assist them in this regard. Particular analytical skills that the Foundation Phase intended curriculum does not adequately address are complex problem solving, adaptability and flexibility and the evaluation of the credibility of sources. Linked to this was the emergence of very few assessment standards requiring the high-order thinking skills of analysis, synthesis and especially evaluation from the learners according to Bloom's taxonomy. Learners need to be given more opportunities to implement and develop these skills. Training teachers to be better equipped for and informed about effective teaching strategies such as Problem-Based Learning could help to alleviate this deficit in our intended curriculum and lessen the gap between the intended and implemented curriculum.

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Appendices

Appendix A – TIMSS Mathematics and Science Frameworks

Appendix B - Components of ICT Literacy (Katz, 2007)