Changing Times:

An Evaluation of the Centre for the Advancement of Science and Mathematics Education

Casme

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Dr. David Bateson.

TABLE OF CONTENTS

LIST OF TABLES

A Preliminary Word

The major outcome judgement of this evaluation can be summed up in few words.

> There is no doubt that Casme has had a very profound, positive influence on science and mathematics education in KwaZulu-Natal.

Every piece of available evidence from every source that could be tapped pointed to the successes of Casme, and, despite deliberate probing, no negative evidence of any substance regarding the overall goals of Casme came to light. This report could be filled with glorifying evidence and testimonials heaping praise on both the organization and, most particularly, the highly competent and dedicated individuals within Casme. However, beyond providing positive reinforcement to Casme, such a report would be of little use. Casme is not without problems, and as South Africa changes, so must Casme change. As such, the bulk of this report is dedicated to providing information and suggestions for change that should serve Casme as it strives to meet the challenges of the future. However, readers should bear in mind the overall positive judgement of Casme as they progress through this report.

Before proceeding with the main report, the remainder of this page contains a very few selected quotations from individuals interviewed during the evaluation. They provide a flavour of the vast majority of evidence that was gathered.

Principal: Without Casme? I would not want to imagine how bad it would be.

Principal: They [science teachers] only go to a workshop if it is Casme.

Principal: If Casme didn't have them (courses and workshops) I don't think they [students) would be at the level they are at now. I am proud of my teachers in mathematics now.

Teacher: Before I worked with Casme I was a bad teacher; now it is better.

Teacher: I did not like teaching; I hated to go to school. Now I cannot wait each day to try what Casme shows me, and my students want to do those things too, they ask all the time.

Teacher: At college we were taught that the child knows nothing; now I build on what they know already. It is wonderful how smart they can be.

Teacher: I don't use Casme very much now, but I know that if I ever need anything all I have to do is phone them; they always come back to me very soon quickly.

Student: It is very frustrating to study hard for an examination and then when you write it nothing that you studied is on the test and you fail. Casme's book helps a lot, I will score well now.

Education Official: I don't have to worry about a school if Casme works there.

Exam Marker. You can usually know from students' answers if teachers are with Casme and it has been there. You can see they did practicals in their classes.

Introduction

Like all of South Africa, the Centre for the Advancement of Science and Mathematics Education, better known as Casme, presently stands at a major crossroads. South Africa has just emerged from forty years of apartheid policies under a minority white government, and now is in the first term of a freely elected democracy. Casme was designed to `fight' the previous government and the educational policies of the past, and, with the `enemy' gone, must now seek new directions within a new South Africa. It is hoped that this evaluation can, at least in part, assist Casme in constructive renewal at this critical time.

Without any doubt, this evaluation is one of the most interesting, and probably the most difficult, in which I have ever been involved. Sir Francis Galton is credited with authoring the statement:

> I have a great subject to write about, but feel keenly my literary incapacity to make it easily intelligible without sacrificing accuracy and thoroughness.

This statement most certainly applies to this evaluation and this report. Within Casme and the education system of South Africa there is much that is extremely complex to understand and to describe, and mere numbers and words can accomplish only so much in providing that understanding and description.

While there will always be desires to find `objective' indicators of Casme's efforts, any effort to quantify these indicators will prove to be frustrating, and any such indicators that are found will be totally inadequate to describe what Came really accomplishes. In addition, many of the effects and results of Casme's activities will only be seen decades in the future when students in the classes of teachers working with Casme mature, have children of their own, and contribute to society. Even then, as far as any of these citizens' future contributions are concerned, it will be impossible to attribute them with any confidence to Casme and its programs. Rather than being based on `objective' quantifiable indicators, the evidence of Casme's success should be documented collections of carefully selected anecdotes and testimonials, both positive and negative, couched in the professional judgements of qualified educators. An evaluation of Casme cannot be likened to a 100-metre dash contested among the various non-government organizations and governmental education authorities, where results can be timed and ranked. Casme should be evaluated similar to how one judges an overall gymnastics title

or a team synchronized swimming competition. It should be judged not with the profit and loss statistics of business or the production figures of factories (although some such figures will be presented herein), but akin to the informed opinion about art, music, dance, and theater, or the learned judgements of courts of law.

This evaluation will be based partially on `production' statistics, but primarily on informed judgments derived from anecdotes and testimonials. Throughout this report, where appropriate, direct quotations from students, staff, teachers, principals, and other educators will be presented to provide samples of the evidence on which the judgements were made.

Casme in the Context of Education in South Africa

Casme cannot be described outside of the school contexts and the rapidly changing educational milieu of South Africa. This requires one to attempt to understand and make sense of South Africa's, and particularly, KwaZulu-Natal's educational system(s). I have used a myriad of methods in an attempt to understand and make sense of Casme and what it does and what it accomplishes: questionnaires; time-sheets; structured, semi-structured, and totally unstructured interviews; document analyses; participant observation; studies of background information; and statistical analyses of national, provincial, local, and institutional data bases have all informed and helped to illuminate the prominent features, accomplishments, and problems of; issues within; and potential solutions for this thing called Casme. Many metaphors to describe Casme have been considered: a headless octopus, an exploring amoebae, a structured army, ...; and all have been rejected in that Casme is truly like nothing else. What follows in this report will probably be considered to be relatively unusual, but then South Africa is unusual, the education system of KwaZulu-Natal is unusual, Casme is unusual, and the people of Casme are unusual.

In order to understand Casme, its activities, and its impacts, one must first have at least a basic understanding of the backdrop in which it was born and in which most of it exists: the `Black' schools of KwaZulu-Natal. The most prominent feature of this/these educational system(s) is the tremendous variance among all aspects of all the schools. In order to illustrate this radical variance, two `composite' schools, neither of which exists in reality, but which have been constructed from true, actual situations observed in the field, will be visited: Styx River and Blue Lotus Secondary Schools.

Styx River Secondary School

Styx River Secondary is located central to three small `towns' in rural KwaZulu-Natal approximately 110 km from the nearest major community, and can be reached via 45 km of very rough, potholed, gravel road off the main tarred highway. This KwaZulu school, enrolling approximately 1000 students from Standard 6 to Standard 10 (matriculation), many of whom walk up to eight kilometers each way from home, is comprised of three buildings forming a roughly "U" shape: two parallel units of five classrooms each, separated at one end by a staff room and Principal's office. It has no electricity, no running water, and no sanitary facilities of any type (the two previous times that pit toilets for the school were built, the construction materials were immediately stolen). Only a few panes of cracked and dirty glass remain in the windows, doors are missing or broken, and the grounds are a sea of mud in wet weather and a bowl of dust in dry weather. At one time the walls of the classroom wings were probably white, but they are gradually reverting to the colour of the red-brown soil which permeates and penetrates every inch of the school. Many roof tiles are missing or skewed at weird angles.

Our first place of call is to the Principal. We step over the sill of the entrance to the concrete block staff/administration building at the bottom of the "U" and proceed about four metres down a dark, tight corridor with an uneven dirt floor until coming to an asymmetric hole in the left wall which has been roughly smashed out with a sledge hammer. Cautiously easing through the ragged hole, we enter the principal's office: a room with walls of graffiti-decorated concrete block, one window with no glass remaining, a loose dirt floor, and only three quarters of the corrugated steel roof in place (at least the missing part of the roof admits some light). The Principal has just completed disciplining a seventeen-year-old student for "chronic inattention", and the `stick' is prominently evident on the corner of the collapsing metal-pipe-and-wood table that serves as his desk. No other furniture, school supplies, or books are in evidence. After introductions and a brief discussion we are taken to visit some of the classrooms.

Inside a classroom, the once-smooth concrete floor is pocked with holes and strewn with loose gravel from the disintegrating material. The one blackboard has more cracks and gashes than smooth writing space, and in the centre is hole about 20 cm in diameter. The few desks and chairs that are available are all in need of repair, but then desks are not really needed since there are only four texts for the science class, and students have no writing materials: neither pencils/pens, nor paper. No stacks of handouts are in evidence

since the school has no means of duplicating anything, nor any paper to use even if duplication were possible. We squeeze into the classroom with the more than one hundred students, all of whom are immaculately dressed in crisply starched and ironed blue and white uniforms, totally incongruous to the lack of teaching materials and the dirt on the floors and walls. They are jammed standing or sitting on the dilapidated desks and window ledges, most ignoring the `teaching' which is being conducted. The reason for this inattention on the part of most students soon becomes apparent when that teacher leaves and another enters; there are not enough classrooms to house all the classes at one time. As a result, one teacher will come in and teach her subject to the 20 to 40% of the students who take that subject, and then is replaced by another teacher who teaches his subject to a different 20 to 40% of the students. Only when the English or Zulu subject matter teachers enter do all the students have to be attentive at one time.

We witness a Standard 10 Biology lesson. The teacher reads, directly from the text, a section on mitotic cell division. He then proceeds to read the accompanying questions from the text and select students who must respond verbally to the questions. With each "wrong" answer, the `stick' descends with a loud report on the arm or back of the student who was unfortunate enough to give an answer to the question which, although it was conceptually `correct', was not in the words that are used in the example answer from the teachers' version of the text. When the text questions are exhausted, the science teacher leaves so that the History teacher may begin her lesson. This particular teacher of Biology 10 is not trained to teach science, did not take any science content or methods courses in the three years of Teacher Training College he attended, and, in fact, he has had no science since Standard 8 and that course was taught to him in the manner just described above. However, there is nobody else available who is qualified to teach Biology, so he does his best. The school has none of the equipment, apparatus, or materials required to do any of the practicals (labs) required in the syllabus and for the examination, and since the teacher has never done any of the practicals himself, or even seen any of them done, it becomes too difficult to even contemplate describing or explaining any of the practicals to the students; the practical part of the Standard 10 Biology syllabus will not be addressed this year at Styx River. In addition, although it is nearing the end of the year and examinations are looming, he has not yet completed even the first half of the required theoretical syllabus. However, it is not the teacher's fault, there have just been too many interruptions. Last year, of the 43 students who took Standard 10 Biology, no student passed higher grade and only three of the students passed standard grade, two with Fs and one with an E.

The bell goes and it is break time. All the teachers proceed to the staff room to smoke, drink tea, have a snack, socialize, and generally discuss their unhappiness that the government is not doing anything for them; that promises were made but nothing has happened yet. They know that their students are not doing well, but there is nothing they can do without the government's help for this government school. When the end of the break comes, it takes another 15 to 20 minutes for anything to get going again; tardiness and late starts are as commonplace as extra classes or after-school work are rare.

On our second visit to Styx River Secondary School, we arrived at 9:20 a.m. but the Principal was not there. It appeared odd that classrooms were empty and all the students who were present were milling around the school grounds, the teachers were all in the staff room, and there were several taxis parked outside the school gates. Soon the principal arrived, the teachers' monthly paychecks which he had gone to town to pick up were distributed, the teachers poured into the taxis, and everyone left; we had witnessed payday! The one teacher that remained to do some preparation work for the next week remarked that she thought it was fortunate that this month payday was on a Friday so that less school time was missed than normally. On following up this comment, she said that Styx River Secondary normally closes by noon every Friday anyway to allow everyone to get to town for the weekend. She also told us that the school had missed, in addition to paydays and Fridays, another almost 50 days of school this year for things such as strikes, violence, funerals, elections, etc.

This last teacher to leave the school is young; she only completed her teacher training last year and feels she has been doing her best to implement many of the ideas which were presented to her in methods classes at college. However, she cannot get any of the equipment and materials that she feels she needs, and the Principal does not think her ideas will be productive in any case. She is also receiving criticism from her colleagues that she spends too much time at the school and pays too much attention to her students. They feel she is creating unreasonable expectations with the students and their families, something the teachers do not want to occur. She says she is getting tired of all the problems and is feeling that her efforts are too extensive for what she is paid. She begins the long walk to join her fellow teachers in town.

Blue Lotus Secondary School

Coming over the rocky hill which threatens to remove the undercarriage of our truck, we are immediately struck by the idyllic beauty of Blue Lotus School, a school with which Casme has worked extensively over the last several years. The pastel blue walls and perfect white trim are complemented by the neat patterns of bright red roof tiles; the reflections of the gleaming windows; the polish of the varnished wood doors; and the various shades of green of the lawns, gardens, shade trees, and soccer field. Bright pools of colour splash in the gardens despite the earliness of the season. Only the security person at the gate and the ladies selling fruits and snacks who are sitting and gossiping in the shade of the trees are visible at first glance. Walking past the classrooms as we proceed toward the Principal's Office, we hear a hum of intense activity coming from the classroom units. The Principal greets us enthusiastically and escorts us through a teachers' resource library, past school supplies of paper, pencils, felt pens, glue, etc. and an older, but chugging along photocopier, into his small, bright, and neat office. We ask the Principal about the condition of the school and all the resources which are in evidence and are told that the school receives almost no help and resources from the central education authorities; all that we see are the results of hard work, contributions, and diligent maintenance by the staff, the students, and the community. The view is that if everything had to wait on the government, nothing would ever get done, so the staff and community have recognized that they are actually the government and have provided for themselves. The parents and students know that this is their school, not the government's, an attitude that is constantly reinforced by the staff, and the school is dedicated to improving the lot of the students and the community. The floor of the principal's office is carpeted with a locally woven grass mat, and the walls display photographs and trophies depicting the accomplishments of the school's staff and students in a myriad of activities from chess tournaments and music festivals to athletic contests. Prominently displayed behind the Principal's chair is a large, colourful chart that immediately grabs one's attention. It displays that, in most subjects, 100% of the students passed last year, and the `worst' subject still had an 84% pass rate. We are served tea and fruit juice and the Principal proudly tells us of his school, his staff, and his close to 1000 students from Standard 6 to Standard 10. We are taken on a quick tour of the well-organized library (almost every book has been bought by teachers with their own funds), and then go to visit some classrooms.

What an interesting Biology lesson! Within small groups, random matching and drawing of chromosome pairs to produce the genotypes, assisted by a chart of dominant and recessive characteristics, leads to construction of models of the resultant phenotype `Reebops' made from marshmallows, candies, tooth picks, and pipe cleaners. The class then bring their `animals' together to form a herd of `brothers' and `sisters' all deriving from the same `parents', but most differing in both physical features and genetic makeup. The students discuss their `herd', excitedly comparing, questioning, and drawing conclusions from each other and the teacher. Genetics is alive, and the love of the activity and the learning is profoundly evident. Eating their `Reebops' at the end of the lesson is also enjoyed; no sense in letting the pink `female' and white `male' marshmallows get stale. The bell to end the class and begin the break sounds, but the students do not want to leave. Finally, the teacher clears the room with a promise to continue that afternoon after school hours. As we leave, the teacher explains that this is a review exercise; she has already completed the syllabus and is using the last two months of school to review, revise, and prepare her students for the forthcoming examinations.

During the break we have an opportunity to talk to the senior mathematics teacher. He tells us that every student in Blue Lotus School takes mathematics. We also find out that last year every Standard 10 student at least passed mathematics and among those 114 students there were nine `A's at Higher Grade level! He tells us that he does not expect the results to be as good this year because of all the disruptions that have occurred, but they are trying to compensate for that by holding early morning, late afternoon, and all day Saturday classes; time for which the teachers do not get paid extra. Many teachers in this school conduct similar after-hours classes and the Principal encourages and praises these activities. The teachers also comment on how good it makes them feel to see the results from their students and to receive the grateful comments of parents.

Late in the afternoon the Principal distributes the paychecks to the teachers and they all congratulate one another on a job well done today. Stories of both small and large successes, and examples of methods and procedures which worked well or did not work well with particular students are happily exchanged as the teachers prepare to leave with the setting of the sun.

As previously mentioned, neither of these schools actually exists, but every detail described above has been seen in at least one, and usually in several schools. The schools which I have visited have varied from some of the worst to some of the best that I have seen around the world. In some schools, very little or no `education' can be seen to be taking place, while in others, students benefit immensely. Most of the schools visited receive basically the same support from central educational authorities, the differences lie within the staff and communities of these schools. While much of the blame for under-resourcing of schools in the past has been directed at the central educational authorities, it is pointless to discuss this at length since these authorities will be gone in a very short time, to be replaced by a single new authority, the structure and conditions of which are as yet not known.

In the past, public school education in KwaZulu-Natal has been governed by several government authorities: the House of Assembly: Department of Education and Culture for White students, the House of Delegates: Department of Education and Culture for Indians, the House of Representatives: Department of Education and Culture for Coloureds, and the Black schools by the KwaZulu Department of Education and Culture and the Department of Education and Training. Each of these authorities acted independently of one another, with vast differences in capabilities and resources for the provision of education, with the unifying force being the matriculation examinations system designed for the country as a whole, regardless of educational authority. It is planned that on January 1, 1995 all these authorities will be merged into one department responsible for all public school education. As yet there is no indication of what this one new department will look like. Despite the fact these separate authorities will very soon be officially gone, they will leave a legacy of schools affected by this apartheid structure which will effect the education system for years to come.

Casme was born out of the unbelievably destructive impact of the policies of apartheid on the education of Black students. While the top schools, restricted to only White students, received abundant resources and support from the government, and produced excellent results in terms of students passing the matriculation examinations, the schools open to the rest of the population, particularly those open to Black students, received almost no resources, no support, and the vast majority of students failed to receive an adequate education with only a very few students proceeding past matriculation. Table 1 illustrates the distribution of resources to various types of schools, and Table 2 provides an indication of the number of students in each group benefiting from education.

Table 1 gives a clear indication of the deficiencies of Black schools compared to other schools. Financial resources, which are translated into other resources such as books, as well as school and classroom teaching and learning materials are less; the pupil-teacher ratios are considerably higher, sometimes by a factor greater than four; and the qualifications and credentials of the teachers do not approach those of teachers employed in White schools. A devastating picture of under-resourced Black schools is presented in the table.

TABLE 1
Statistics for Education in KwaZulu/Natal (Jacobs, 1992)

	Black	Coloured	Indian	White
Pupil Teacher Ratios				
Primary	51:1	25:1	20:1	20:1
Secondary	53:1	16:1	23:1	12:1
Per Pupil Expenditures[1]				
Public to Standard 10	730	1360	2227	3082
Technical Colleges	8731	N/A	6349	16037
Universities	13271	N/A	10505	19312
Primary Teachers	N = 26548	N = 771	N = 5449	N = 2854
Unqualified	40.8%	14.5%	2.4%	0%
Qualified	59.2%	85.5%	97.6%	100%
Teaching Certificate	58.6%	81.3%	69.3%	92.4%
Degree	0.6%	4.2%	28.3%	7.6%
Secondary Teachers	N = 10321	N = 588	N = 4483	N = 2639
Unqualified	12.7%	4.0%	0.4%	0%
Qualified	83.3%	96.0%	99.6%	100%
Teaching Certificate	70.0%	68.2%	75.1%	39.5%
Degree	11.3%	27.8%	24.5%	60.5%

[1] Figures are given in Rand per pupil and include capital costs.

TABLE 2
Enrollments and Success Rates in KwaZulu/Natal
(Strauss, Plekker, Strauss, & van der Linde, 1993)

	Black	Coloured	Indian	White
Standard (Public Schools)	N	N	N	N
6	126225	2566	16916	7766
7	99970	2469	16710	8068
8	80982	2184	16215	8638
9	65506	1648	14152	8109
10	46769	1344	12660	7929
Estimated % of age cohort enrolled in Standard 10	±13%	Not Available	±85%	±95%
Enrollment in Standard 10 mathematics	26.6%	42.2%	72.2%	68.3%
Pass Rate (HG)	9%	76%	Not Available	89%
Enrollment in Standard 10 Physical Science	15.8%	22.9%	40.5%	47.4%
Pass Rate (HG)	26%	94%	Not Available	86%
Enrollment in Standard 10 Biology	85.7%	83.7%	73.4%	55.8%
Pass Rate (HG)	11%	Not Available	Not Available	Not Available
General Matriculation Candidates (N)	44707	1283	14542	8857
Failed	57%	12%	5%	5%
Pass without Exemption	33%	60%	50%	47%
Pass with Exemption	10%	28%	45%	48%

While the numbers in Table 2 appear devastating, other numbers which can be derived from them can provide even greater understanding of the vast gulfs that exist between good and bad education. Combining the success ratios with the age cohort statistics provides a realization that while more than 90% of the country's Whites complete matriculation (about half with exemption and half without), only about 5% of the Blacks of the same age complete pre-tertiary education, and only about 1% are successful with

exemption. The figures are even worse when one contemplates specifically mathematics and Science. For mathematics, only three in 1000 of the Black age cohort (0.3%) qualify for tertiary mathematics compared to 570 in 1000 for Whites (57%). The numbers for physical science are Blacks, five in 1000 (0.5%); Whites, 390 in 1000 (39%). Since many students who qualify for mathematics do not qualify for physical science, and vice versa, the number of students who qualify in both mathematics and physical science, a necessary, but not sufficient condition for entry to most science and applied science university faculties, the number of Black students who have the qualifications for post secondary science education is very minute! The above statistics are taken from only two sources (albeit sources which have excellent reputations) and the critical statistics are those dealing with the percentage of the age cohort which each other statistic represents. The age cohort statistics presented in Table 2 may be quite overstated "in a country which has been unable by some millions to establish with any certainty how many citizens it has" (Dunn, 1994). Msomi (1992) provides a less conservative estimate that only one in 10,000 of the Black age cohort qualifies for post-secondary education in both mathematics and science.

The results of the educational process can be dramatically seen in the employment statistics for South Africa. Table 3 displays the numbers of individuals employed in various occupations which require at least a background of mathematics and science.

TABLE 3
Numbers of Individuals Employed in Selected Occupations in South Africa (HSRC, 1990)

Occupation	Black	Coloured	Indian	White
Engineer	244	231	293	22,136
Architect/Surveyor	544	305	187	9,513
Natural Scientist	2,547	1,529	1,372	27,725
Doctor/Dentist/Veterinarian	2,161	879	2,894	32,077
Electrician	4,351	3,176	2,115	44,094
Metal Worker	10,616	8,497	3,671	83,036

In a country where only 10% of the population is White, Whites hold 83% of the positions in the occupations listed in Table 3, and when one considers only those occupations from the table which require a university education in science and

mathematics, the figure increases to 87%. At the same time, Blacks, which represent probably 80% of the total population, only hold 8% of the positions in Table 3 and only 5% of those requiring a university education.

In order for South Africa to progress in today's world, a well-educated populace, particularly in the areas of mathematics, science, and the resulting technologies, is essential. As such, it is essential that this immense problem be addressed, and that is what Casme was born to do. Historically, Casme was aimed at redressing "the educational deficiencies and the lack of opportunities in a system which has entrenched unequal and differential education for decades" (Botha, 1987).

The myriad of conditions and problems that combine to disenable Black students is so vast that only massive government intervention can possibly address the major issues. For a non-governmental organization (NGO) such as Casme, which has very limited financial and personnel resources, the focus must be on particular parts of the overall system which might be effectively addressed. In examining the figures in Table 1, one can see that of even the very small numbers of students who enroll in Standard 10 mathematics and science courses, very few Blacks pass: only 9% in mathematics and 26% in physical science, compared to the corresponding figures of 89% and 86% for Whites.

Within particularly Black schools, something very, discriminatory is occurring, and specifically, something extremely detrimental to education must be happening within the teaching and learning situation of Standard 10 mathematics and science courses to produce the total situation described in the previous pages. Attacking this problem has become the goal of Casme.

As such, the declared mission statement of Casme is

> to contribute to the advancement of science and mathematics education in South Africa.

It is a mission which, considering the plight of Blacks in South African education, and the necessity of addressing the problem for the overall health of the Nation, should be very highly valued. There can be no argument with the social desirability of Casme's mission.

Over the years, Casme has attempted to operationalize this mission in many ways, and many of those attempts continue today. The surviving activities will provide the basic framework for evaluating Casme's present activities within this report, and past endeavors will be mentioned when they serve to enhance an understanding of today's efforts. However, the sections reporting on today's activities should not be considered to be the major results of this evaluation. It is hoped that these sections will prove to be useful in the future as Casme proceeds, but the need for change in Casme as a whole overshadows the evaluation of the present projects and activities of Casme.

While the mission of Casme is as important now in the new South Africa as it was in the legalized apartheid conditions of the past, the way in which the mission is operationalized must change. Since many of the conditions contributing to the educational deficiencies which exist were formerly legalized and institutionalized, the `enemy' for Casme was often seen, in practice, to be the government and governmental educational organizations and authorities. Much of Casme's activities have been designed to counteract and compensate for the legalized discrimination which occurred through governmental policies and procedures. All this has at least theoretically changed, and the result is that Casme must change.

It must now be recognized that the `enemy' is not the government, but rather the deficient and debilitating teaching and learning conditions for mathematics and science. Casme must develop new ways of working with the government, and governmental organizations and authorities, to ensure that future resources and activities are used and designed in a way that can contribute to the best education possible for all people, regardless of race, colour, creed, religion, and gender. The new approaches that will be necessary in the new South Africa will require new structures and activities within Casme. However, the deficiencies which exist in the field will take generations to address, and, as Casme changes, the organization must take care not to `abandon' the many teachers and students who have highly benefited from Casme in the past. Withdrawal from some of Casme's present activities must be gradual and calculated in the best interests of the present and future reality of classroom conditions and practice.

In this report, the structure of Casme will first be described, followed by a series of reports on Casme's present activities. Following these reports, the organization, structure, and leadership will be addressed; specific problems within Casme will discussed; and finally, visions for the future of Casme will be presented.

A Description of Casme

Casme is a Non-Government Organization (NGO) operating basically in the state of KwaZulu-Natal in the Republic of South Africa, with its mission being the improvement of mathematics and science education in South Africa.

It operates on an annual budget of approximately Rand 6,000,000.00 provided from a variety of sources with Shell and the Independent Development Trust (IDT) being the major grantors. USAid and Eskom now also provide some funding; Link Africa, based at Cambridge University supports two field positions; and the Department of Education and Training funds one field position on a secondment basis. Casme presently provides full-time employment to 38 people and part-time employment to a further 11 staff, for a total of 49 employees. Of these staff members, 24 should be considered academic/educational staff, 17 provide necessary support, and eight administer the various resource centres. All the part-time positions are in the areas of support and resource centre administration. Highest degrees of the academic/educational staff include two PhDs, nine Masters with two of them actively working on PhDs, and all the rest have at least a first Bachelors degree. Several of the people with first degrees are working toward a second degree, either a Masters or an advanced Bachelors. Staff members are encouraged and supported by the administration in undertaking advancement of their own qualifications. All of the professional/academic staff have teaching experience, and most are career educators. The qualifications of the professional/academic staff of the Centre are impressive indeed.

Housed mainly on the campus of the University of Natal in Durban, Casme also has seven established satellite resource centres in Newcastle/Madadeni, Ladysmith, Empangeni, Greytown, Pietermaritzburg, Durban, and Port Shepstone, another under development in Umfolozi, and a new centre in Kroonstad in the Orange Free State will open in the new year.

The Centre has a Director who is responsible to the Board of Directors for all aspects of Casme. The Director is assisted by a Centre Manager who is responsible to the Director for most personnel matters, the day-to-day running of Casme, and all non-educational/academic facets of Casme. The funding and budgeting aspects of Casme are attended to by a Finance Manager who reports through the Centre Manager.

While the mission statement of Casme is to improve science and mathematics education in South Africa, in operationalizing its mission statement, Casme basically aims at the professional development and support of teachers of Standard 9 and 10 mathematics, biology, and physical science. In the introduction to this report, a strong rationale for concentrating on these types of activities was presented. Casme does well to focus on limited areas on which it can have considerable impact, rather than to spread its valuable resources so thin that little will be accomplished.

The major activities which Casme supports, all directed at assisting senior science and mathematics, provide the structure for this report: in-service education of teachers (INSET) provided in the forms of workshops, Further Diplomas in Education (FDEs), and the School Science Project(SSP), to include Link Africa; Resource Centres; Subject Interest Groups (SIGs); the Computers In Schools Project (CISP); teacher and school incentive and awards programs; materials development; the Teacher Leadership Course/Project (TLC); the 1000 Schools Project; and research and evaluation activities.

The history of Casme is a story of many successes and some failures, of times of busy progress interrupted by periods of stormy controversy. Casme has successfully struggled to gain what is today a respected place in mathematics and science education; educators at all levels, particularly classroom teachers, now see Casme in an extremely positive light. Much of what is Casme today, and many of the problems it presently faces find their roots in this history. Understanding that history, and progressing in light of, or despite that history is a challenge that Casme must face.

The Present Activities of Casme

Casme is involved in numerous activities, all aimed at improving the teaching and learning of science so that more students will proceed to post-secondary mathematics, science, and the resulting technology education. In order to make this report more understandable, each activity/project, or group of similar activities/projects will be reported in turn. For convenience of reporting, the activities will be clustered under the headings of. In-service education of teachers (INSET) subdivided into workshops, formal courses or Further Diplomas in Education (FDEs), and field work with teachers (SSP); Resource Centres and Subject Interest Groups (SIGs); the Computers In Schools Project (CISP); teacher and school incentive programs; materials development; the more recent developments of the Teacher Leadership Courses/Project (TLC) and the 1000 Schools Project; and evaluation. A discussion of the interactions among these activities will be conducted in the section on administration which follows.

In-service Education of Teachers: INSET

Looking back to the two schools described at the beginning of this report, there are many factors which contribute to the frequently poor quality of education and hinder implementation of active learning methods: large classes in small rooms, with sometimes more than one class taught by more than one teacher all in the same room; a serious lack of facilities (water, gas, flat tables, etc.) which are seen as necessary to conduct practicals; and a lack of equipment, supplies, and materials - orders have not been filled, and there are frequently no budgets for materials and supplies, compounded by the fact that teachers do not know how to budget or how to put in requisitions where budgets do exist. Self-contained kits of materials and supplies, accompanied by teachers' guides, have been developed in an attempt to alleviate some of the problems, but burglary and theft are rampant and some kits only have supplies for one demonstration before they must be resupplied. If a teacher has more than one class, the `single use' kit is only of use for one of the classes. In addition, many teachers do not have the theory or content knowledge which is required to adequately explain what is happening in the practicals and so are very insecure in doing them. It is much easier for a teacher to `chalk and talk' while applying the `stick' (many teachers have a home-made, personal stick made from supple 1-2 cm in diameter fresh wood, usually 70-90 cm long, which is applied liberally, usually to the hands, for offences from being late, to not knowing the answer to a question asked or scoring poorly on a test). Classes are frequently conducted in an atmosphere of fear and subservience, rather than in an atmosphere of mutual respect and encouragement.

Recently, with the expansion of violence and weaponry in schools, this atmosphere of fear has been extended to include teachers also fearing some students. In the new South Africa, both of these atmospheres of fear must change - freedom must be extended to students and teachers, and schools must be returned to the community to be peaceful places where students want to come. Schools must become temples filled with the joy of learning! In order to accomplish this task, teacher in-service must be designed and conducted to empower the teacher to overcome these difficulties and deficiencies, or to teach as effectively as possible despite these problems.

The following section is devoted to examining the direct INSET activities of Casme and will be subdivided into three parts corresponding to the three major projects of INSET within Casme: workshops, formal courses, and field work. While there are other INSET activities sponsored by Casme, these are usually initiated, planned, and conducted by local Subject Interest Groups (SIGs) and will be reported in the section on the SIGs.

Workshops

Workshops are a major component of Casme's activities. Table 4 presents a summary of workshop activities in the subject areas in the various regions. A total of almost 17 000 hours of contact time with people working in schools is very impressive indeed.

Although there is no formal coordination among the three major workshop providers (the biology, mathematics, and physical science people) most of the workshops share very similar characteristics. They are generally conducted for teachers of both Standard 9 and 10 since they concentrate on knowledge and understandings of concepts included in the government matriculation examinations, and the examinations are based on the final two-year syllabus. Workshops usually take place over two- to four-day periods at remote sites convenient to the teachers in those localities, and they are all framed within the sequence of the appropriate syllabus in order to try to time the workshop just before the topic to be addressed is usually taught in classrooms. Importantly, they are activity oriented and are designed to teach instructional methodologies by example - participants are active learners and, to the greatest extent possible, the workshops attempt to exemplify methods desired in classrooms. The choice of the topic for any given workshop is usually determined by the needs expressed by the group of teachers attending the previous workshop.

TABLE 4

Workshops Presented in 1993

Subject	Region	# of Courses	# of Course Days	# of Teachers	# of Teacher Contact Hours
Biology	Durban	4	12	54	972
	Empangeni	2	8	29	783
	Greytown	3	12	35	805
	Ladysmith	2	8	39	1404
	Newcastle	2	4	32	544
	Pietermaritzburg	4	8	43	1118
	Port Shepstone	2	8	18	432
TOTAL		19	59	250	6058
Mathematics	Durban	2	7	52	780
	Empangeni	3	8	60	1140
	Greytown	3	9	26	546
	Ladysmith	3	9	32	608
	Newcastle	2	2	48	288
	Pietermaritzburg	3	9	32	896
	Port Shepstone	3	9	42	1302
TOTAL		19	53	292	5560
Physical Sciences	Durban	3	11	29	725
	Empangeni	2	6	53	1166
	Greytown	1	3	9	180
	Ladysmith	2	7	25	700
	Newcastle	2	2	29	203
	Pietermaritzburg	2	6	15	375
	Port Shepstone	2	6	17	459
TOTAL		14	41	177	3808
GRAND TOTAL		52	153	719	15426
Organizational Development (Principals)	All	12	12	122	1464

A small core of teachers attend almost all workshops while other teachers come and go. However, there are some professional `workshoppers' - Casme has been entitled to eight days per year, the DET or KwaZulu subject advisor may have sponsored another eight days of in-service, the local SIG may use another eight days, and so on - for a `lazy' teacher, with an inattentive principal, it is theoretically possible that he or she could spend close to half of the school year going to workshops and thus avoid much of the work expected of him or her.

Principal. There are lots of workshops; if I wanted to I could go to workshops all year.

Teacher.- I go to a lot of workshops but it takes much time. I have to decide what will be good, My principal only lets me go ten days each year so I want to learn ...Theirs [Casme's] are always very good.

Many administrators will therefore not allow teachers to attend more than a total of eight or ten days of workshops during the year, and, if this happens, or if conscientious teachers restrict themselves to a small number of days that they will be away from their classes, teachers may be very selective about topics and those workshops that they will choose to attend. Another reason for sporadic attendance is a frequent lack of teacher funding; while Casme usually provides accommodation and sustenance for the workshops, travel costs can be a significant factor for individual teachers if the school or department does not reimburse them.

The professional staff at Casme are an extremely dedicated and idealistic group of educators. Because of their dedication and professional approach to education, as opposed to their treating what they do as a `job', they often have a difficult time dealing with teachers who do not approach teaching with the same zeal as they do. They are often frustrated and even annoyed at what they see as `unprofessional' conduct and attitudes such as tardiness; attention to the logistical `comforts' of accommodation and meals rather than concentration on the educational content of the experience; only attending in-service activities during the normal working hours of the normal teaching day (attendance usually drops significantly on the Saturday of a Friday-Saturday workshop); unwillingness to commit any personal resources at all, no matter how large or small, to counteract the neglect of educational authorities in failing to provide necessary and suitable equipment, materials, and supplies; and so on.

Casme Staff.: Many are not what you would call "professional" in their behaviour. They come only if they get time off school, and sometimes not even then.

Such `unprofessional' behaviour on the part of many teachers is recognized by Casme staff, but there is little evidence to show that this problem is being addressed in any systematic way. They report that following a plan of sequential skill and knowledge development in a workshop, where each new section presented is dependent on an understanding of a previous section or sections, becomes extremely problematic when

teachers are significantly late in arriving and when new teachers arrive on the second, third, or fourth day of a workshop. However, the staff of Casme are extremely sensitive to the feelings and `rights' of teachers. As such, inmost cases the individuals who cause the problems of erratic attendance and participation are `catered to', often at the expense of those who have been punctual and consistent in attendance.

Casme Staff. I know it is not right for the others, but I feel I have to get through to everyone, or at least as many as possible. If they make the effort to come, even if they are late, I should help them. It is a problem, it's hard to decide.

Casme Staff: If I didn't help them they might get so mad we might never see them again. We have to accept their ways.

The large degree of tolerance of Casme staff to this type of behaviour is well known in the teacher population, and often teachers take liberties of using time which has been allocated for professional development for their own personal use. They do this knowing that Casme staff will not report- such indiscretions to their administrators and other superiors.

> As the nature of informal INSET changes over the next period of time, standards expected of teachers with regard to professional conduct during in-service education should be clearly delineated, and consequences of failure to comply with such professional standards should be established and consistently applied.

In plain English, if a teacher receives time off, reimbursement of expenses, or any other form of remuneration for attendance of workshops, and does not attend the entire activity without very good reason, it should, at the very least, be immediately reported to the principal of the school. Unprofessional conduct must not be tolerated or condoned in any way. If actions taken by the Casme staff to correct inappropriate behaviour lead to some teachers not taking advantage of the opportunity for professional development, it is highly probable that those teachers would not have benefited from the experience, and their students probably would not have benefited either. Teachers who do not care enough to come on a `day off' will probably not be willing to put out the extra effort and time required to change anything they do in the classroom. It is a very easy job to be authoritarian and didactic in the classroom, whereas methods which deeply involve

individual students in their own learning require dedication and hard work on the part of teachers.

Teachers who have participated in Casme workshops generally provide glowing reports of these activities: they feel they successfully increase their subject area content knowledge and understandings, update their knowledge of the syllabus and the examinations, learn teaching methods and techniques that they can implement in their classrooms, and see how to use the equipment and materials in the kits for practicals. They feel the greatest strength of Casme workshops lies in the practical nature of almost everything that is done. They contrast this feeling with their belief that workshops conducted by the government educational authorities are much too theoretical and really give them nothing that they can use in their classrooms. They also very positively react to the catering provided by Casme: the hotels, meals, and snacks as contrasted to that provided at other workshops. They know that when they attend a Casme workshop they will take back methods, materials, charts, models, etc, which will directly benefit their teaching.

Teacher: I get things I can use when I return to my school.

Teacher, I don't have to plan for many lessons because Casme gives me enough to do. I can do tomorrow.

> Future workshops conducted by or designed by Casme must continue to emphasize practical solutions to the day-to-day problems of classroom teachers.

While it seems that workshops conducted in the three subject areas have no areas where Casme staff drastically contradict one another or interfere with one another, this usually only transpires by chance. There should be much more coordination among the different subject area personnel, and regular, formal occasions where general debriefings on various workshops can be conducted with all staff involved being in attendance. There might also be formalized arrangements where workshop leaders and presenters attend, and possibly assist in at least part of some workshops conducted in the other subject areas in order to thoroughly familiarize each other with all facets of Casme INSET activities. A clearer understanding by everyone of where workshops should fit, if at all, within the

overall efforts of Casme to improve the opportunities of science and mathematics students is necessary.

> One Casme staff member should be appointed to ensure that coordination and mutual sharing of all teacher in-service activities and materials takes place.

The decision of who takes on that responsibility, how that responsibility is carried out, and where within the organizational structure that responsibility is lodged will be dependent on the future structure of Casme. While undertaking such a responsibility is certainly not a full time occupation, it should be made a formal responsibility of one individual who is accountable to the administrative staff for that coordination.

Formal Courses: Further Diplomas in Education (FDEs)

Casme is currently deeply involved with two FDEs: Biology and Physical science. These two-year programs, conducted under the auspices of the University of Natal, provide teachers with an opportunity to acquire a recognized fourth year of formal education training which can be used for advancement on salary scales and to become eligible for promotion. As was reported in Table 1, a significant proportion of Black secondary school teachers lack university degrees, rather, they have certificates from three-year Teachers' Colleges. One of the disadvantages of having a teaching certificate from a Teachers' College is that if a teacher wishes to obtain a degree (traditionally the only way of formally advancing training and qualifications) she or he was required to begin the process at the first-year university level and would have to proceed through the entire degree process from the very beginning; his or her previous college work and teaching experience counts for nothing other than exemption to begin first-year university. The FDEs provide teachers with a unique experience to advance their professional abilities and qualifications.

It is intended that each course will be fully completed by between 20 and 30 teachers (e.g., the first physical science FDE began with 36 teachers; in the second year 29 returned, of whom 28 eventually were certified).

Analyses of the courses' contents, and reports from students who have undertaken the courses, even some students who have failed, leaves one impressed with both of the FDEs under Casme's sponsorship.

Failed participant: I failed, but I still got a lot out of it, I don't do things I used to; I'm a better teacher.

Participant: Even the bad things are better than anything else I have done.

While the academic rigor of the courses is of high quality, the professional aspects of the courses are the most salient and valued feature; almost everything that is done in all the courses is directly practical in classrooms. Methods and techniques of teaching are not just discussed and learned in theory, but are understood through using these methods in teaching the FDE courses. A series of assignments which proceed throughout the school year, and are usually tied directly to the teachers' activities in classrooms, serve to appropriately complement the theory of texts and other print materials. Instructors are readily available to students for questions and consultation, and continual, positive, and constructive feedback to participants is consistently provided. Instructors also have encouraged and assisted localized study groups to form, and they have spent considerable amounts of their own time to ensure that individuals have the resources necessary to be as successful as possible in the courses.

The FDEs are seen by teachers in the field as being so positive that one group of participants refers to the program as amatshe ezulu, which can be translated from Zulu to mean stones of heaven, something which I am told is very rare and valued indeed. While all the participants find the work load to be heavy, almost all say that it is manageable, is spread out well over the years, and its practical applicability to the classroom makes the assignments very beneficial and quite enjoyable to do.

The Further Diplomas should be viewed as a great strength of Casme, and one that can produce the core of well educated teachers that will be so necessary to provide the teacher leadership which will be needed in the new South Africa.

It is strongly recommended that Casme continue to sponsor, and even expand its involvement in Further Diploma in Education (FDE) programs.

Consideration should be given to establishment of a mathematics FDE to complement the Biology and Physical science programs already in place, and present programs should be maintained and expanded. Care must be taken that FDE programs do not expand at a rate which cannot be supported by the resources, both fiscal and personnel-related, that are necessary to maintain the high quality of the present programs.

Consideration should also be given to arranging for some group classes or meetings which include all FDE participants from each of the courses. Such meetings could provide contacts and communication that could be used by participants to establish local support groups for quality teaching, regardless of the subject taught. They would also promote a more holistic approach to science education, and would encourage some integration of mathematics, science, and technology, concepts that are gaining wide acceptance within the world's mathematics and science education community.

A further modification which might improve these already very valuable programs is to invite contributions from personnel who are knowledgeable and experienced in the applications of computer technologies to the teaching and learning process. As computers become available and South African schools become linked to the information superhighway, a core of teachers should be prepared to begin to meet the challenges of these emerging technologies. The FDEs seem like a logical vehicle to at least introduce the possibility of using future developments involving computers and computerized communications.

Field Work: The School Science Project (SSP) and Link Africa

Casme presently provides field support to individual teachers who request such support through their school principal. In general, Casme staff visit such teachers on a regular, usually weekly, basis to help them to gain confidence; to understand concepts and subject matter content; to obtain and use the materials and equipment in kits to conduct practicals in their classes; to plan sequences of instruction and individual lessons; to inform them of educational opportunities for both themselves and their students outside of the local school; and to provide them with, and teach them how to use teaching aids such as charts, models, videotapes, etc. (It should be noted that in many schools the provision of a videotape also requires provision of a Videotape player or `movie box', and additionally, in some situations, an electrical generator.) It is intended that support should be provided at this `intense' level for a period of one year, after which the teacher will be placed on

`back-up'; visits become less frequent and are often confined to when the teacher calls for assistance. Theoretically, in the third year the teacher will proceed without active support from Casme staff, although many teachers will still avail themselves of the equipment, materials, and teaching aids which can be borrowed from one of the Resource Centres. Five Casme staff are involved with this type of concentrated field work, and most of the resources necessary for the ongoing maintenance of these positions and other necessary, resources come from special funding arrangements: Link Africa provides two staff, the DET sponsors one position on a secondment basis, and ESKOM contributes to another position.

While the staff involved with this aspect of INSET achieve excellent results through dedication and hard work with individual teachers, usually in `isolated' situations, the overall impact cannot be judged to have a major impact in accomplishing the overall mission of Casme. In a few cases, teachers involved with this program become even more dependent on Casme staff and resources, despite the best efforts of Casme staff, and little is accomplished in terms of improving the situation in the long-term view. The overall impact is limited to a small number of teachers, often in such isolation that the support necessary for them to continue their efforts is non-existent, and even when the program is successful with the individual teachers, there is little possibility that the successes will impact other teachers in any multiplicative way. With limited resources available, the need for change within Casme, and the change in governmental education authority structure, the responsibility for ensuring that schools receive adequate resources must be shifted to those authorities.

> Consideration should be given to `winding down' and terminating the field-based activities of the School Science Project in its present form.

Because of their dedication, their frequent successes, and their sincere belief in what they are doing, staff involved with this aspect of Casme will find it very difficult to extricate themselves from these activities. In addition, during the withdrawal phase, procedures should be put in place to ensure that teachers who have become dependent on Casme to enhance their teaching of mathematics and science are not abandoned; a gradual withdrawal that leaves the teachers empowered to improve their own situations is necessary.

Resource Centres and Subject Interest Groups (SIGs)

There are eight resource centres currently sponsored by Casme in KwaZulu-Natal, and a further centre is under development in Kroonstad in the Orange Free State. All of these resource centres are located in major population centres and are designed to allow teachers access to materials, equipment, and resources that are not available in their own schools. Each centre is staffed by a part-time administrator recruited from the local area. The centres have a further purpose of acting as places from which local SIGs can operate. Thus the resource centres serve two purposes: to be a `lending library', and to stimulate local input to, and conduct of professional development. These two tasks will be addressed separately.

Resource centres provide a tremendous service to a large number of teachers. Records are kept of the use of materials and equipment, and a casual glance at these records show the benefits provided to science and mathematics education. Table 5 provides a six-month summary of the period January to June of 1994 for the seven resource centres of Newcastle/Madadeni, Ladysmith, Empangeni, Greytown, Pietermaritzburg, Durban, and Port Shepstone. Since the centre at Umfalozi has only recently opended, no statistics are available for that centre.

TABLE 5
Usage of Resource Centres: January to June, 1994

Service	Mathematics	Biology	Phys. Science	Total
# of teacher visits				594
Loan of:				
Videotapes	97	274	264	608
Practical 'kits'	not available	112	150	262
Movie boxes				85
OHPs				51
Generators				20
Resource books				105
Pages photocopied				2576
Materials purchased	67	14	190	271

In addition to what is reported in Table 5, teachers borrow charts, models, and other teaching aids, and receive suggestions about the use of all resources and information about new resources which are available. Teachers have given many testimonials regarding the high value of these services which resource centres provide. Without access to Casme's resource centres by their teachers, thousands of students would never have the experiences with practicals necessary for the final departmental matriculation examinations, and other qualities of their learning experiences would be decreased.

Teacher: I do not have the equipment I need to do the practicals. I get everything from the resource centre.

Teacher: The kits let me do practicals.

Teacher: I have a lot of equipment but I still need some things from the resource centre.

Teacher: I cannot show you my laboratory. DB: Why not? Teacher: I have to get it from the resource centre tomorrow.

Student: Whenever we do practicals we use the wooden boxes our teacher gets.

However, the resource centres are not without problems and the value of each centre varies widely. This variation in the service provided to teachers is dependent, to a large extent, on the individual administrator of the centres. Although all the administrators appear to be diligent and conscientious in their duties (teachers have not reported that they have found centres closed when they should be open, kits are generally complete and properly stocked, and materials are kept in generally good order and in as well maintained as possible), administrators with a background in education are able to provide much better advice and guidance than can those who are not similarly experienced. A strong illustration of this point is the resource centre located in Madadeni whose administrator is a life-long teacher and principal in the system and area which the centre serves. She is able to provide tremendous support to the clients, and the teachers are very liberal in their praise for her.

> Consideration should be given to attempting to staff the resource centres with experienced teachers wherever and whenever possible.

Another problem that a significant number of teachers have reported concerns transport. For many, the resource centre is located up to 100 km from their school and they have no readily available transport. Taxis in many of the areas are few and far between and can become quite expensive when a teacher has to take three or more taxis each way from the school to the centre, and then return. It is also very difficult to carry a typical borrowed package of videos, a kit, a movie box, and a generator in a taxi! When long distances must be traversed, it is also difficult for teachers to arrive at the resource centre during `open' hours. In some situations, both authorized and unauthorized satellite school centres, or cluster schools, where part of the inventory of a centre is kept for the convenience of remote schools, have provided at least a partial solution to these problems.

> The concept of using cluster schools as satellite resource centres should continue to be explored and implemented wherever and whenever there is a need and appropriate, secure locations can be established.

The experiences at the resource centres of Ladysmith (through Bergville), Madadeni, and Empangeni could be considered in setting up such satellite centre situations.

The latest resource centre at Umfalozi provides a good example of how Casme is attempting to shift the responsibilities for resource centres to the local teachers. Here, in response to an expressed need by teachers in the area, a local committee of teachers has undertaken to oversee the development and running of the centre.

The established resource centres also provide an excellent locale for the operations of SIGs, and the centres must provide all available resources necessary to promote and maintain these SIGs. The most valuable aspect of SIGs is that local concerns and local problems can be addressed by the people who know the needs best, the very teachers who are involved. While Casme workshops and in-service can provide excellent service, professional development initiated and coordinated by local teachers should be seen as the long-term goal of Casme; teachers must be empowered in their own development. It is therefore critical that the concept of SIGs, linked to that of teacher leadership should be a central component in new directions for Casme. Casme's experience in attempting to established SIGs must be put to good use.

> The importance of the concept of SIGs in promoting teacher leadership and professional development cannot be overemphasized, and Casme should do everything in its power to promote and support active initiative by local groups in determining their own needs and conducting their own activities.

In some areas and for some subjects, these SIGs are entrenched and working very well; in other areas, not so well. The key to well-functioning SIGs lies in the availability of capable and dedicated local teacher leaders. As the FDEs become better established, as more graduates are scattered throughout KwaZulu-Natal, and as teacher leadership courses/programs proceed, the teachers involved in these activities could form the core of local educators who can be nurtured through additional teacher leadership development activities. Without key, energetic, local leaders, functional SIGs will be difficult to maintain.

> In establishing or rejuvenating SIGs it is critical that strong, local teacher leaders be found and recruited to provide the impetus for success.

In some situations, the key people who do most of the work in the SIGs actually derive little or no direct educational benefit for themselves from their efforts. This occurs because most of the professional development activities which they organize and sponsor through Casme funding are designed to reach the majority of teachers who do not have the knowledge and skills that the organizers possess, and the content of the activities are therefore at too `low' a level to assist these conscientious and hard-working individuals.

Teacher. It is fun to organize the workshops and I know the teachers benefit, but I never learn anything new. It's all right; it helps other students because the teachers will be better to do their work.

Care must be taken that these organizers are recognized and rewarded for their efforts in some other way. At present, they receive most of their satisfaction from knowing they are helping their fellow teachers and therefore students as a whole, but other avenues should be explored to recognize their contributions.

Coordination of the SIGs is presently done by each subject area group in Casme and this system can become inefficient, particularly if communication between the subject area groups is not well maintained. Perhaps a more efficient method of coordinating the SIGs would be to have one staff member to whom all the SIGs can look for general assistance. When particular subject area expertise is required, that coordinator could go to a subject area specialist for guidance and advice.

> Consideration should be given to appointing a single staff member within Casme to be responsible for all Subject Interest Groups in all subject areas.

It is quite possible that responsibilities for all SIGs could occupy all of one staff member's available time. If it is decided to assign SIG responsibility to one staff member, the staff member selected must have a broad background in all three of mathematics, biology, and physical sciences, and must not be seen to be much more strongly committed to one subject area to the detriment of the others. Good communication and inter-personal skills would also be necessary in that she or he would have to work equally and cooperatively with all three of these groups who have a tradition of separateness rather than of cooperation or integration.

The recent development of the resource centre in Kroonstad in the Orange Free State is another good example of how Casme learns and progresses from previous activities. Theoretically, the concept of the Kroonstad resource centre project is elegant, but it remains to be seen whether the project can be successfully implemented. The theory is to employ three coordinators, one each in mathematics, biology, and physical science. The area to be served by the centre is to be broken into a manageable number of geographic areas. Within each of these areas, the coordinators will select central schools which will act as more accessible satellite centres for the area. Highly competent teachers will be selected and further developed to act as teacher leaders and satellite resource centre managers for their area. Cooperation between the satellites and among the subject area teachers will be promoted. If this task can be accomplished, and it substantially hinges on being able to select and train the appropriate people, many of the problems that currently exist within the current resource centre/SIG program can be reduced, and possibly eliminated. This project must be carefully followed and evaluated as it develops, in the hopes that it will provide a better, viable model for the future.

Plans for setting up a network of resource centres in the Eastern Transvaal are presently being solidified. However, work has not progressed to the extent that any comment can be made in this report other than to express satisfaction at Casme's attempts to transfer what has been learned in KwaZulu-Natal to other geographical areas.

At the present time, there is much discussion within Casme of the place, role, and structure of resource centres within Casme. It is hoped that these discussions will prove fruitful and that the preceding section can be of some value in that process.

Resource centres seem to be a project which should naturally be subsumed into the general structure of Casme. Resource centres should not be seen as entities unto themselves, but rather should be viewed as a part of the infrastructure surrounding the overall advancement of science and mathematics teaching and learning. They should be seen as support units for the teachers who work with all projects of Casme instead of being a project in and of themselves.

Computers in Schools Project

Computers have become important and prolific educational tools in many parts of the world. In Canada and the United States of America, it is an unusual school that does not have a computer `lab' of 20 to 30 networked computers, server(s), and printers which are available to students and teachers. Many classrooms have at least one computer in the classroom itself, and few teachers have not been affected by computers. Teachers have usually been forced out of necessity to become at least familiar with the roles of computers, if not extensively computer literate. As computers inevitably become more a part of South Africa's education system, Casme can provide the advice and guidance to central government education authorities on the applications of computer technology in schools. Casme has been involved in a small number of individual projects in schools and should continue those types of activities in order to experiment with and test various applications and models of implementation. It will not be possible for Casme to directly help the large number of schools that will ultimately require assistance, but Casme must be in a position to assist the government education authorities in the difficult task of computer implementation and the necessary accompanying teacher in-service that they will have to undertake.

The implementation of computers in schools, however small and with whatever quality of software, has received enthusiastic response from administrators, teachers, and students alike.

Teacher: They always try to come here, Sometimes they sneak in and I have to ask them where they are to be now. They like coming here to do their work.

The computers are generally highly used for educational purposes (rather than for games and other activities that many people view as frivolous). Students work with and on the computers as long before regular school hours and as long after regular school hours as they are permitted. The teachers jokingly complain that the students make them stay at work too long.

During the times of intense unrest and violence that existed close to the elections of April, 1994, 1 visited one of the schools which had been given computers and software for mathematics CAI. The school had received a threat of immediate violence against it that morning, and the principal had closed the school and dismissed the students and teachers for the day; very few people were visible either outside or inside the classrooms. However, when we entered the room housing the computers, the teacher was there and every one of the 10 available computers was being shared by at least three students. Despite the fact that their lives had been threatened, they voluntarily remained to work on the computers; they saw the threat as a marvellous opportunity to get some `bonus' time at an educational activity they found extremely enjoyable and beneficial!

Many of the comments provided by students during this evaluation provide insights into not only the impact and values of computers and the CISP but also how that interacts with education and society as a whole. They give an impression that many of the social and educational horrors which students have been subjected to can be forgotten for a moment in student-computer interactions.

Student. The computer never gets mad at me, I can make the same mistake ten times in a row and it doesn't tell me I am stupid, or yell at me, or things like that. It just tells me I'm wrong, that I goofed, and asks me if I want to read that part again; it's really patient ... not like my teacher.

Student: The computer doesn't know I'm Black.

Student (female): It treats me like a boy.

While the mass acquisition of hardware and leading teachers into computer literacy have proved to be major difficulties in computer implementation, the CISP has shown that the lack of quality educational software is also a particularly worrisome problem. There are many software packages available, but their quality is of serious concern. Most of them have been developed in the western world, and they are not appropriate to the society and conditions of South Africa. A vast majority are simple drill-and-practice types of programs which, while they may be valuable tools to get students to pass matriculation examinations, do little to enhance the conceptual understandings, logic, and creativity necessary to solve the pressing problems of our evolving world. Casme should immediately begin a project of investigating and implementing models for evaluating educational software packages in a South African context. In conjunction with this it should also attempt to establish and support a network of individuals who are capable and willing to produce educational software which are aimed at all the broad goals of education. When the schools are able to acquire hardware, they must have appropriate software available in order to make the best use of these resources. Another feature of computer software is that it often proves to be more expensive that the hardware requirements. However, agreements for educational prices, group purchases, and site licenses considerably lessen the costs of software to schools. As Casme proceeds with trial projects in schools, it should continue to investigate avenues for reducing software costs for schools and make that information known to the central education authorities when that information is required. Casme should not become an `intermediary' between software companies and the government or the schools, but should be in a position to assist the government and schools in the negotiation and decision making processes.

One of the most valuable uses of computers that has been found in countries which have implement computers in schools extensively, is as communication tools to other sites in the world and as access to the information superhighway. Casme should establish pilot projects which attempt to implement such communications in classrooms of KwaZuIu-Natal. The procedures and resources necessary for such implementation of computers must be trialed and well documented in anticipation of the rapid increase in school computer use that will probably occur in the near, if not immediate future.

> While Casme has provided excellent computer-related service to selected schools in the past, the project should rapidly turn its attention to the services of guidance and advice, based upon trialed

practice, that it can provide to central government education organizations and authorities.

The present focus of the project on providing computers in schools and training teachers to use them should be reconceptualized to focus largely on establishing test sites for policies and procedures of implementation and practice that might be used on a larger scale by the appropriate organizations and/or authorities. Casme's activities surrounding computers in education should be aimed at providing informed advice and guidance to the eventual implementors.

Teacher and School Incentive Programs

Casme has become involved with, and now sponsors a program which provides recognition to schools, students, and teachers who excel in Physical Sciences. Accomplishments in matriculation examinations above and beyond what might be expected are rewarded through public recognition and financial grants to schools, individual teachers, and selected students within the successful schools. Attempts are made to compensate for differences in opportunities, resources, and past records. On attending the 1994 awards presentation at Pietermaritzburg, I was impressed by the extent of the attendance and the reaction of all those involved to the rewards offered. I was also impressed by the fact that some of the monetary awards to individuals are returned to science and mathematics education in some way rather than being used for other, more personal purposes. Such recognition of some type should be continued and even expanded to include the other major areas of Casme involvement: mathematics and biology, if financially possible. Teachers and school administrators must know that their efforts are valued, and `positive strokes' within the KwaZulu-Natal education system, such as those provided by Casme and its funders through this program, are few and far between. The benefits are obvious.

Principal : I want to thank you sincerely, not so much for the prize, but for the idea of recognising, rewarding, and reinforcing good student and teacher performance. I personally find this to be an extremely fulfilling gesture which has been a catalyst in the worst of times in Black education (Casme, 1993, p.52)

Teacher recipient (1993) : Without the 1500 Rand award I would not have been able to take another university course this year ... It has been a Godsend to be able to get little things for my students when I need them.

Teacher recipient (1994) : We worked very much to qualify for this award today. The students know they can now do it so they will work harder next year so they can come here next year.

Student recipient (7994): I could not pay for some course books [at university]; now I can.

Recognition for outstanding achievements also should be extended to Casme staff as a whole. Perhaps Casme should sponsor its own staff awards nights where every member is given an award for significant accomplishments during the period of time selected to separate such celebrations. It might be interesting for each staff member to select and document that for which she or he would receive an award.

Materials Development

The materials development unit is the one place in Casme where communication with all the other projects and groups within Casme necessarily takes place. As new materials need to be developed and/or modified each group contacts the materials development staff for assistance in producing those materials, whether they be publicity flyers, detailed laboratory instructions and diagrams for practical activities, or sample answers to previous matriculation examination questions. The quality of materials that this unit produces is high, and materials are generally produced in a timely fashion, providing reasonable and sufficient advance notice is given. The professional staff can always count on this unit to provide valuable support in their other activities. Not so much as one complaint or negative comment was directed by any of the professional staff toward this activity during the period of this evaluation!

> The materials development activities of Casme should continue to be supported with whatever resources it requires to continue its effective service to Casme in particular, and to mathematics and science education in general.

As new technologies for producing quality media are developed, Casme must ensure that the materials development group are supported in learning about, and using these new technologies. However, in advising central government authorities, the practical realities of school resources must be remembered. If one has at one's disposal the most modern computer equipment, the most sophisticated software, digital scanners, and colour laser printers, it is hard to remember that many schools do not even have electrical power. In my first year of teaching in an isolated, one-room school in the wilderness of Canada where there was no power or running water, my entire media/reproduction inventory consisted of a hectograph. For those of you too young to have seen this museum piece,

one makes an `original' by writing on a sheet of paper with a straight pen using special hectograph ink. One then mixes up and allows to set a tray (usually a cookie sheet) of hectograph gelatine. This gelatine is dampened with a cloth and the `original' is gently placed on the gelatine, rubbed with a soft cloth, and then removed to leave a `master' mirror image on the gelatine. While it is still damp, blank sheets of paper are carefully placed on the pad, rubbed, and removed to produce copies; with practice, the technique was usually good for about six to eight readable copies if the print was sufficiently large. I did not realize at the time that having such facilities could be considered a luxury! When I shared that story with two teachers in a school which I visited they became very interested and wanted to know where they could get hold of such a marvellous tool; it was more than they had now. The only problem that they thought they might have is to get the paper they might need if they could master the technique and accomplish such reproduction! Conditions in schools and their ability to reproduce copies from masters must continue to be carefully considered. Production of affordable materials in sufficient copies for whole classes must continue to be a priority of this activity, and provision of copying facilities must continue to be a service offered by resource centres.

While materials development and production usually proceeds in a timely fashion, it is critical to this unit that they have sufficient time available to produce quality products. All Casme staff must ensure that sufficient advance notice is given to enable the materials development staff to program requirements into their very busy schedule. The materials development unit cannot work well in a `crisis mode', a problem that too often can arise without sufficient advance planning by all Casme staff.

In the areas of senior mathematics, physics, and chemistry, Casme has gained much experience in what is wanted and what is usable in the classrooms of KwaZulu-Natal. Casme must be prepared to share that knowledge and guide educational authorities both provincially and nationally as the new, single governing body attempts to redress the inequities of teaching and learning materials that exist.

The fact that the materials development unit cooperates with all other projects of Casme and that the materials development group does use what they have learned from each project to assist in any given task for any other project is evidence that the necessary inter-project cooperation mentioned so often in this report is both possible and beneficial. Without the knowledge derived from errors made and methods developed when working on all projects, the materials development aspect of Casme could not have gained the

great respect that it has from Casme staff, other educational personnel, and students. Their work shows the evidence of the benefits of cooperation and group work on problems and projects. Their model must be expanded to all activities of Casme.

Teacher Leadership Course

In June of 1994, a one-week course on teacher leadership was conducted at Michaelhouse School. The course was designed to train teachers in conducting field workshops. It is intended that Casme will closely assist these teacher leaders in conducting `practice' workshops during this year, and that they will then come together again next June for another week of follow-up and further instruction. The concept has been widely and enthusiastically received by educators in the field, and the program may well form the core around which Casme will conduct its activities in the future.

> It is strongly recommended that the concept to training teachers to be teacher and workshop leaders be pursued with vigour.

Teacher. Our brothers know what we have to do; not like the government people.

The concept of teacher leadership can be employed to unify many of Casme's present activities, and the potential of using it for this purpose should be explored.

1000 Schools Project

The new federal education authorities are sponsoring a program where 1000 schools will be selected throughout the country to participate in total school development projects which are assisted by a variety of NGOs in each school. The underlying philosophy is that things will only truly get better if the whole school and the community are committed to change, a theoretically worthy idea. In KwaZulu-Natal, Casme is taking both a leadership/coordination role and an active participatory role in implementing the 1000 Schools Project. The province has been broken into three zones, with each zone having three teams (one secondary and two primary) consisting of various NGOs who will work with qualifying schools which are the first to apply. Rather than just work on science and/or mathematics as Casme has done, as many areas of the school as possible will be assisted in their development: subject areas, thinking skills, educational management and administration, community involvement, and so on. This development of the total school and the necessity of the science and mathematics teachers having support within the

school has been a long-time concern of Casme; in the past it has worked with teachers of English and with principals in an effort to improve the climate for science and mathematics teachers. The 1000 Schools Project provides Casme with an opportunity to renew its lapsed attention to many other supporting areas of schools.

> Casme should remain deeply involved in the 1000 Schools Project and continue to provide as much leadership as possible.

As the project develops, Casme should pay close attention to how improvements in other facets of schools support can enhance improvements in the areas of science and mathematics.

Evaluation

Casme has a policy of internal, formative evaluation of all the activities. This policy is designed to provide constructive data and judgements for the staff of Casme as they develop and continually seek to improve projects and their delivery. One staff member has recently been given the responsibility for leading these evaluations. While annual reports of Casme contain brief descriptive accounts of Casme's activities, and much is available on the numbers of teachers who avail themselves of each aspect of Casme's activities and all the financial aspects of Casme, there has been little formal reporting of Casme's activities in an evaluative format.

Many funders of NGOs are increasing their demands for evidence that their money is being well spent; that activities are conducted in a timely and efficient manner, and that these activities have an impact on teacher behaviour and, more specifically, on students in at least one of the cognitive, affective, or psycho-motor domains. It is essential that Casme possess such current information in a form that can satisfy present funders and can be used to seek additional funding as needed. While this report should serve that purpose in the immediate future, its useful life for that purpose will probably be short.

> Casme must maintain a continuous program of internal, formative evaluation of all its activities, and these evaluations must be documented and periodically summarized in an appropriate manner to be available when needed.

Administration

Casme consists of two major structural administrative sub-divisions: the professional/educational component and the support component. While these two components are inextricably intertwined, when considering the attainment of Casme's goals, they may be separated for many analytical and evaluative purposes. As such, each will be treated separately.

The Professional/Educational Component

The greatest strength of the leadership style within Casme is that it is designed to treat all professional staff as professionals; to provide them with the freedom, trust, space, and support to allow them to do their tasks as they are defined.

With the extreme variance that is found within the overall educational system, techniques to deal with the system must be equally varied. What will work with one group of teachers in one situation will not work with another group of teachers in another situation. Extreme sensitivity, flexibility, and creativity are required of all professional staff. In one classroom, a few moments explaining a new and unfamiliar piece of equipment may be all that are required, while nearby a Casme staff member may be helping a teacher acquire a loan to buy a house. While such an activity may not seem to be even remotely connected to improving Mathematics and Science education, discussing the situation with the staff member and the teacher sheds light on the process. The teacher has the dedication and desires to provide quality education to the students under her care, but she has many personal problems and she is living in staff quarters at the school where there is no power or running water. Buying her own small house will give her the self-confidence and pride that will help her to continue her efforts at school with less probability of `burning out'. It will provide her with the space and conditions that make it easier for her to work at home after and before school hours, marking assignments, and preparing teaching materials and lesson plans. In addition, this teacher is a leader in the local SIG and purchasing her own house will allow her to get her own telephone with which she can contact and assist other teachers in the area. In this way, and in this case, helping a teacher go through the unfamiliar procedures necessary to purchase a house yields an outcome of long-term improvement to science education in South Africa! This anecdote provides an excellent example of the need of professional staff to have the freedom and professional trust to be creative in attempting to solve individual problems.

The extremes of conditions require extremes in approaches, and the professional staff need to know they have the freedom to make their own decisions based on their own judgements of what is required in any given situation. The leadership and management style of Casme effectively support the staff with that freedom, respect, and trust that is required under the conditions found in South African education. What is required of the staff is that they honour the trust given to them, and that their activities are, at all times, aimed at Casme's mission of improving Mathematics and Science education.

While all professional staff are strictly accountable to the overall mission of Casme to improve Mathematics and Science education, there is little day-to-day accountability required, such as detailed reports justifying every minor expense or every minute of time. Such a management style strongly promotes the professional activities of Casino.

It appears that this trust is generally well-founded in the activities of Casme staff. Part of this evaluation required all staff members to report to the evaluator, on an individually confidential basis, their activities every fifteen minutes over a three-week period. Table 6 reports the overall results of this `time sheet' activity, and Appendix A includes a more detailed breakdown of staff activities as well as the instrument and directions used to collect the data. While there was considerable variance among staff as to how, when, and on what activities they spent their time, their time was actively and effectively used in working toward the overall mission of Casme. No one individual stood out as using time more effectively or less effectively than any other individual. There were indications that some individuals spend more `extra' time on Casme activities, but no blatant abuse of the trust provided the professional staff was apparent. During the almost two months that I spent within Casme, living and working in the offices; traveling with staff, talking to principals, teachers, students, and most staff; and so on, no indications that the validity of these data should be questioned were detected. The professional staff in general appear to be worthy of the trust given to them by the administration.

However, this greatest strength of the leadership style of Casme is also its greatest weakness; there are undesirable, and sometimes unanticipated outcomes that result from this freedom, trust, and absence of detailed direction that is provided.

TABLE 6
Mean Minutes per Day Spent at Various Activities
(Percentage of Time in Parentheses)

Activity	All Staff (n=24)	Professional Staff (n=16)	Support Staff (n=8)	Senior Staff* (n=7)	Field Staff* (n=9)
Direct Teacher Contact Time	60 (11)	88 (16)	2 (0)	61 (11)	109 (20)
Materials & Equipment Development & Maint.	64 (12)	74 (13)	46 (8)	103 (19)	51 (9)
Planning§	20 (4)	30 (5)	1 (0)	42(8)	20 (4)
Formal Meetings§	44 (8)	51 (9)	32 (6)	54 (10)	48 (9)
Informal Meetings & Coordination	52 (9)	62 (11)	32 (6)	71 (13)	56 (10)
Records, Correspondence, & Administration	118 (22)	72 (13)	210 (40)	79 (14)	66 (12)
Reflection, Evaluation, Profess. Development.	30 (6)	38 (7)	15 (3)	48 (9)	31 (5)
Travel	55 (10)	81 (14)	3 (1)	33 (6)	118 (20)
General Support (maintenance, tea, driving, ...)	45 (9)	0 (0)	135 (28)	0 (0)	0(0)
Non-Productive (breaks, eating, personal, ...)†	61 (11)	61 (11)	62 (12)	56 (10)	65 (11)
Other	3 (0)	4 (1)	0 (0)	0 (0)	7 (1)
Mean hours per day	9.2	9.4	8.7	9.2	9.5
Mean hours per day less non-productive time	8.2	8.4	7.7	8.3	8.6

*"Senior" Staff are those professional staff who are more 'office based': Director, National Coordinators, Materials Development Coordinator, and the Internal Evaluator. "Field" Staff are those professional staff who are more 'field based: Regional Coordinators, Project Coordinators, and School Science personnel.
§Several individuals 'double coded' some time periods to indicate that often Formal Meetings were for the purpose of planning, and whenever this occurred, the time was placed in the Formal Meetings category. Therefore much of the time indicated for Formal Meetings is also time devoted to Planning on a group basis.
† Although I have termed eating to be "non-productive" time, lunches in particular are often times when much discussion surrounding Casme and its activities takes place; its label could be misleading to a certain extent.

The most obvious problem which occurs is that, despite the existing situation that each staff member feels he or she is honouring that trust, there is an underlying belief that others are `taking advantage' of the freedom provided; that not everyone is `working as hard' as others. While over an extended period of time, such perceptions can be shown, in general, to be unfounded, if one looks at that belief on a day-to-day basis, much evidence that mistakenly might be used to confirm that belief is available.

`Work' for the professional staff often occurs in spurts of intense activity broken by intervals of what might seem to be `down' time. If much of the intense activity is conducted on a solo basis in field or home settings remote from the offices, and much of the less intense time is spent in the office environment where it is open for all to view, a mis-perception of the dedication and intensity of an individual's efforts can occur. Also, the activities of Casme require considerable `mental' work: thought, planning, and reflection. It is usually difficult to `see' these things happening. On observation, an individual might be perceived to be `taking a break', where in reality that individual

might be totally absorbed in profound, intense thought which could mean the difference between success and failure of a future activity. As is evidenced in Table 6, Casme staff spend considerable time in the activities of eating, breaks, etc.; activities that would not normally be considered to be `productive' time. In addition, field staff in particular are required to spend significant periods of time traveling to schools, resource centres, meetings, and so on; another activity that some would consider to be less productive time spent. However, if one eats, takes a break, or travels with any of the Casme staff, one quickly realizes that these times are often exclusively occupied with discussions and thoughts about Casme activities.

Mental work is not like physical work. If one is digging a ditch, nothing gets done on the ditch while one is taking a break, eating, or travelling, and one can easily see and even measure the results of `work'; the ditch gets deeper and/or longer. However, if one is planning the design of a new chart to assist in the teaching of exothermic reactions or trigonometric functions, the efforts required to attain the results are much more difficult or even impossible to see, but much is often accomplished during breaks, eating, or travel time. I even had one of the staff comment that the idea for a component of a workshop that I said was so good I was going to `steal' it, came to her while she was sleeping; that she woke up in the middle of the night with it, got up, and wrote for two hours to ensure that she would not forget it. Such is the nature of creative, professional, mental `work'. Thus, the perception that some are not working as `hard' as others might very well be misconceived, but the perception, however justified or unjustified, is still there.

These perceptions can cause, and do cause significant problems. Sometimes, when professionals believe that they are alone in their intense efforts, and they feel that they are not being rewarded for that in any way, they will begin to become somewhat resentful and subsequently reduce their efforts and their commitment to the organization. At other times, a mis-perception of an individual's efforts can cause inter-personal problems that are not conducive to effective team work, cooperation, and communication among the professional staff. Professional staff also, at times, have feared to spend the necessary time on `mental' activities of thought, planning, and, in particular, reflection and evaluation (see Table 6), and have concentrated instead on producing tangibles that others can see as solid evidence of their efforts. Since quality of these overt results depends to a considerable degree on appropriate `mental' work, any situation that causes the appropriate `mental' work to be reduced can only negatively affect the products of

Casme. Left unchecked, all the above behaviours can be very destructive to the overall mission of Casme.

Without detailed direction, or `marching orders', some staff members can feel unsure that their efforts are those which are desired in light of the overall mission of Casme. To compensate of this, the administration must provide more timely feedback so that staff can feel more secure in the directions they are taking.

Some professional staff feel very uncomfortable working in a situation that appears to have very few checks and balances, or accountability procedures placed on their own activities. They often want to be held accountable for their time and what they produce; they want to know where the limits and boundaries are. For some, such desires for closer boundaries can be attributed to not wanting to be professionally responsible for themselves and their activities in a broad sense. For others, it can be caused by a desire to limit their own activities. Many professionals are so dedicated that, without overt guidelines, they will `live and breathe' their occupation and not take the time necessary for relaxation and regeneration, activities essential to quality, prolonged production.

The provision of an open professional environment also can serve indirectly to isolate people and reduce the communication within Casme. The professional staff tend to work alone on individual projects and activities, usually only talking to others at a professional level when they absolutely require something. They act within an atmosphere that has become almost competitive, and definitely protective of their own `turf'. All of this results in a view that each area and project within Casme is not systematically connected with other areas and projects. It seems logical that all projects should be intimately connected; that what is done in biology workshops should be closely tied to the support given to biology teachers in the field, and both should be based on the materials that have been developed and the equipment available in resource centres. Such is not the case; in practice, significant communication among the various groups is usually only done on an ad hoc basis. The problems in communication are compounded because various staff members have joined Casme at different periods of time when different projects were being undertaken and different understandings of what Casme was doing and how it operated then prevailed. While one staff member might have been present when a particular project was initiated and thus understands its history and how it was designed to fit into Casme's overall strategy, a newer staff member might very well operate without benefit of that experience and understanding. When new staff are brought in to work on a

specific project, it is very easy to forget to bring them 'up to speed' on the overall mission of Casme and how everything fits into a common vision.

Various efforts have been made to initiate and conduct regular communication and interchange of ideas. Regular staff meetings where every detail of Casme was discussed have been abandoned as too time-consuming, although shorter and briefer meetings are held on a regular basis. Working groups who were responsible for putting together and presenting discussion papers, including proposals, are presently being used, but the attractive theoretical structure and benefits of the procedure are not being realized. One of the reasons why these groups are not functioning as they were intended is that the authors of the resulting discussion papers and proposals have a keen and overwhelming sense of ownership of them as a result of their efforts in putting them together. When well-meaning criticism is aimed at these papers and proposals, it is seen as a personal attack rather than as an effort to produce the best possible results. When this happens, it results in feelings of anger and frustration on the part of the author(s) and subsequent 'mental' withdrawal from the process and from future efforts. However, much of this condition and much of the problem in general is caused by the feelings and practice that each project within Casme is a separate and distinct activity, that individuals are responsible for each of these activities, and that they exist as separate entities. Each individual has his or her own responsibilities and there is little need seen to interact other than by criticizing other activities and plans. In sort, a `team' feeling does not exist.

Billions of dollars and years of effort go into sending an exploratory spacecraft on a mission to Jupiter. All of this investment can be negated if a single, critical bolt in a crucial piece of equipment fails. The person who made that bolt is as important to the success of the overall mission as is the scientist or engineer who conceived or designed the piece of equipment. In the same way, each and every member of the Casme staff is important to the success of Casme's mission. All staff members must know and feel that, while they personally are not indispensable, their tasks are as critical to the success of Casme as are everyone else's tasks.

Teamwork and a deep sense of `family' or `community', where each individual within the team is supported and encouraged by every other member of the team, are essential to the overall and long-term success of organizations such as Casme. While every individual has their unique characteristics and brings a unique perspective to Casme, all must work

together toward a common goal. Within Casme, a common goal is not the focus of attention, rather individual projects are pre-eminent.

A much greater consolidation of the various activities of Casme must occur. A single unifying force, the improvement of science and mathematics education, must permeate everything that is done in Casme to a much greater extent than is presently the case. In fact, all the activities of Casme are aimed at the overall goal, but often they are not perceived in this way by individual staff members. A major problem is the overlapping structures within Casme. In addition to the separation due to separate projects, there is a superimposed structure of mathematics, physical science, and biology (plus junior secondary mathematics and computers). In the interests of simplifying the structure, Casme might avail itself of the opportunity during this time of change to de-emphasize the subject matter divisions by doing away with them as formal areas. Subject matter specialists are very necessary in almost every aspect of Casme's work, but as long as the specific subject content and methodologies are covered where needed in each project, institutionalized separation should not be necessary.

> A system must be designed to ensure that all projects of Casme are seen as components working with other components toward the overall mission of Casme, rather than as individual projects which operate in isolation from other projects. Consideration might be given to using the unifying concept of teacher leadership as the vehicle to operationalize this system.

The staff of Casme must see themselves as a team working very much together toward accomplishing a common goal. While constructive criticism of proposals is essential to refine and perfect them, these proposals need to have group rather than personal ownership, and attention must also be given to praise and support on a regular basis. People must feel good about their efforts, and positive feedback from colleagues is notorious for pleasing professionals, particularly educators. Unlike in business, rewards in education are rarely financial or otherwise material, and educators must get most of their rewards mentally. Perhaps the words of Thumper to Bambi might be considered; initially if you can't say something nice, don't say nothing at all. One should not be condescending, but initial sincere, positive reactions set an excellent stage for subsequent constructive criticism.

There is also an underlying tension that affects all NGOs; they operate on `soft' money, depending on funding from donors sympathetic to their efforts. Such funding can be withdrawn at any time, possibly leading to the demise of the organization. This lack of security cannot help but effect the morale of Casme staff in some ways. A strong sense of community within any staff is an excellent catalyst for production and achievements. During this time of uncertainty due to change at a national level, unfounded rumors must be kept to a minimum and all staff must be kept informed of all developments which might effect Casme. In order to promote the previously mentioned strong sense of `community', consideration should be given to sponsoring and conducting more `social' types of activities that involve all staff, and even their families when possible.

It is also important that staff feel that their efforts are appreciated by the administrative staff. It is essential that the administration make a consistent effort to provide positive feedback on accomplishments. Usually this can be accomplished through informal means, but regular, formal recognition of superior effort and accomplishments should also be conducted.

It has long been recognized that when people are proud and happy in what they are doing, both the quantity and the quality of what they produce is enhanced. Casme should be a place where everyone involved cannot wait to get to, and staff should always `look forward' to their day of work. Continuing efforts should be made to have all staff members share in a pride and pleasure of being part of Casme.

At the present time, much of the efforts of the Director must be aimed at the broad issues of how Casme will operate in the new South Africa; how Casme can contribute to the process of change, participation in the research and development that will occur over the next several years; and the crucial element of funding. As such, little time is left for managing the details of the social and intellectual climate within Casme, and the details of the educational programs currently being undertaken by Casme. The Director is placed under numerous and intense centre, provincial, and national pressures; he is 'stretched too thin'. As a result, staff are feeling that some areas they consider are important aspects of the Centre are not being attended to sufficiently and in a timely enough manner. This is also contributing to the beginnings of a potentially destructive, general decrease in morale. In order to alleviate the pressure on the Director, an addition to the administrative staff is necessary.

It would be very advisable to add to Casme's staff a senior management position to monitor and coordinate the day-to-day project and educational work of Casme.

The appointment of such a person at a senior administrative level would provide an opportunity to address the fact that women are not well represented in the upper administration levels of Casme, and, as such, preference should probably be given to a very talented woman to fill that role. Such an appointment of a woman would assist in alleviating the problems surrounding various gender issues that will be discussed later.

The Support Component

In the past, the problems associated with the day-to-day running of Casme also fell on the shoulders of the Director. As Casme became larger, became necessarily involved with more funding activities, and increased its areas of commitment in education, the need for a Centre Manager became clear. The Manager position has now been active for nine months and the transition from the Director to the Centre Manager of much of the detailed, day-to-day responsibility of making Casme `tick' appears to be proceeding with very few consistent problems. A vast majority of staff seem quite satisfied with the present arrangements, and the Centre appears to run very smoothly. During the many hours of interaction with staff for this evaluation, no major complaints about lack of support were voiced. Records and planning documents are clear, well organized, and any administrative information that is required can be retrieved and presented in a timely fashion.

The professional staff are provided with all possible resources required to proceed with their tasks, from computers loaded with appropriate software programs on every desk, to paper clips, to vehicles, and staff know that if they need anything reasonable, they only need to ask and it will be there.

Only two `weaknesses' of the physical and fiscal aspects of Casme have been perceived in this evaluation that are worthy of comment: lack of space, and insufficient availability of highly qualified `production' support personnel.

At the present time, the physical premises of Casme are not such that they support a team approach to Casme's activities. While all premises are clean, functional, secure, and well maintained, staff are physically separated: many are housed at the central Casme offices,

but several are located in two huts on the other side of the University of Natal campus, and one coordinator is situated alone in a neighbouring building. It is very desirable that all staff be located in one spot where they can easily and immediately interact on both professional and social levels. All staff members need to feel that they are unique and important contributors to a team working toward a common goal. They need to feel that their contributions are valued and that they are not `second class citizens' in any way. Staff who are not housed in the main Casme office, or who work in less than desirable physical conditions can develop feelings of remoteness and negative differentiation from the centrally located staff, a situation that is detrimental to the achievement of Casme's goals.

> Casme must work to provide physical space for all staff that promotes a team approach to conducting Casme's activities.

While Casme has one excellent meeting area, the Centre also needs additional, smaller professional meeting spaces. Individual offices can provide the venue for meetings of two or three people, but staff offices should not be disrupted by using them for meeting rooms for four to eight or so people. As Casme develops additional physical space, plans must include more space for small group meetings.

The second problem in the support area is very difficult to solve. While Casme has several support personnel who can act in the areas of general typing, photocopying, materials assembly, etc., professional staff do not have readily available, other than in the very busy materials development unit, individuals who can produce and assemble complicated and detailed, subject-specific documents. While some support personnel may be capable of accomplishing these tasks, they are seen to be very busy with other responsibilities and unavailable when needed to assist. In dealing with this problem for many years internationally, particularly with the Third International Mathematics and Science Study (TIMSS), I have come to realize that such talented personnel are as `scarce as hen's teeth'. When one does find the rare individual who can accomplish these types of tasks to the satisfaction of professional staff, s/he is usually very over-qualified for the position at which s/he can be appointed. If one can acquire and maintain such a person as staff, one is very fortunate indeed. As such, there is little that can be done to alleviate the situation; one can only sympathize while continuing to search for those rare, talented employees. Meanwhile, professional staff must resign themselves to occasionally performing activities that they might consider to be less than the most valuable use of

their time; they will have to do for themselves. At the same time, it must be assured that professional staff have assistance for basic clerical and secretarial tasks when such assistance is needed.

At least part of this last problem can be attributed to problems of isolation and time management. Professional staff are very accustomed to working on their own and they are protective of their own projects. As such, they are not used to asking for help, even at a secretarial/typist level. They feel that they know best what is needed and they are often unwilling to take the time necessary to explain their exact needs to others. On a single occasion, it is probably true that it takes just as long, or longer to explain to someone else what you want and how you want it done than it does to do the entire task yourself. However, for tasks that will be repeated, the time spent sharing needs, and the resulting assistance can pay vast dividends. It is also sometimes the case that time is too short to do the necessary explanations, and staff should not be expected to stay late or work outside normal working hours in order to accomplish a task that was left too late in the time line. Too often, crisis management appears to be the mode of operation. This situation is not unique to Casme and appears to be prevalent in educational organizations around the world!

As Casme begins to change its role and method of operation in the educational milieu of the New South Africa it is important that staff be prepared to deal with the intense pressures and responsibilities that will be placed on them. In working with individual classroom teachers, and even in workshops with a couple of score of teachers, if one is occasionally not totally prepared, or has a `bad day', the repercussions are not deeply felt. However, when one is dealing with total education systems, and where decisions and actions effect millions of students, the margin for error and the pressures to perform consistently as professionals can place a great deal of stress on the individuals involved. Quality must be consistent, and in order to ensure this quality and meet the challenges of the future Casme staff must be well prepared. While they are generally well prepared in an educational/academic sense, their preparation, like that of most educators, in the areas critical to management are less well developed.

> Opportunities should be given to all Casme staff, particularly the administrative staff, to participate in courses and programs for life skills development: time management, dealing with stress, avoidance of crises, etc.

Many of these types of courses are offered on a total staff or intact group basis, and Casme should give priority to courses operated in this way. The talents and skills of the Casme staff and administrators cannot be wasted by allowing the pressures stemming from their dedication to interfere with both their professional and personal lives; the tasks of Casme are vitally important, but then so are health, family, and friends!

Gender Issues

In a country where many of the racial inequities of the past are being rapidly redressed, other social inequities are also becoming apparent and they require attention. Within a personnel community who are generally well educated, well informed, and acutely aware of these inequities, issues of gender inequity cannot help but become important, and past, as well as present inequities must be dealt with in order to facilitate the continued effective operation of Casme.

Framed in a multicultural and multiracial context, gender dominance is deeply ingrained within the historical and traditional practice of much of the South African culture. As an example, it is still only a political promise that discriminatory customary laws under which women are considered perpetual minors will be abolished (Buthelezi, 1994). Redressing these inequities will be very difficult, but Casme must provide leadership. However, particular care must also be taken that issues of race and `power' are not brought up with, confused with, and confounded with gender issues. It is frequently easy and convenient to use the `excuses' and 'guilts' of gender to struggle for other desired outcomes, and such confounding must be quickly unravelled and clearly separated in order to address the underlying concerns appropriately.

Particular care must also be taken to ensure that blatant gender discrimination within Casme is not, and never becomes evident. There are also many subtle ways in which gender inequities are expressed, beyond the blatant examples, and Casme must work hard to reduce, and eventually eliminate these occurrences to the greatest extent possible. These more subtle aspects of gender inequity and discrimination, against both females and, less frequently, males, can often be very abrasive for those who are attuned to them, and left unchecked they can cause dissension and unhappiness. However, the deep cultural roots of the gender-related practices must be recognized. The fabric of at least some parts of some South African societies is dependent on long established male and female roles and responsibilities, and care must be taken that the integrity of these societies is not unintentionally compromised and that individuals are not inadvertently placed in undesirably tenuous positions. Like racial issues, it will require generations of consistent effort to pass before gender inequities are no longer commonplace. Until then, care must also be taken that addressing such issues does not become so intense that it interferes with the day-to-day running of Casme and does not detract staff from the attention required to achieve the overall mission of Casme.

Having the advantage and luxury of learning from many years of slow progress in other societies of the world, the progress of change should be accelerated in South Africa. However, change will still not come easy; women must lead by example and be proud of their own abilities and achievements. One of the lessons that can be learned from other places who have been progressing toward gender equality for a longer period of time is that resistance to change will actually increase under intense and confrontational pressure. Much more can be accomplished through less intense, but constant attention to more subtle pressures. The seemingly simple steps of recognition of the problem and commitment to change are the major hurdles to be cleared, and then progress can occur. However, changing long held beliefs and values which are deeply ingrained in the culture requires considerable time. While the "religious-like" conversion of accepting the idea or concept may be rapid, true change in habituated practice will take generations.

In going through the process of change, the greatest catalyst is sincerity, and the ultimate tool is understanding. The views, concerns, and attempts at solutions expressed must be carefully listened to by both genders; men must carefully and sincerely listen to women, women must equally carefully and sincerely listen to men, and stereotyping must be avoided. Nobody's views should be dismissed as part of the solution out of hand simply because of the particular gender of the speaker. Like understandings about race, understandings about gender are difficult for one who has never experienced, and will never experience, a given condition; men can never be women and women can never be men, but both must strive to understand the other's conditions and positions. As people struggle to understand their complementary (not opposite) gender they must be encouraged and nurtured in their attempts, and the process must be undertaken by both genders; discussions, explanations, and debates must be conducted in a facilitating rather than in a debilitating manner. It is the difference between a loud and angry Shut up!, and a calm and sincere Would you mind putting off your discussion until later; I would really appreciate more quiet because I am trying to listen to the music. Confrontation, constant challenges, anger, and impatience only serve to drive people into corners from which there is frequently no escape, and force them to radically, and sometimes irrationally defend polar positions. Understandings which lead to compromise and progressive change are essential, and these understandings are only developed through sincere and rational discourse which does not `endanger' individuals.

In contributing to that change, Casme must lead by example. Casme already does that in at least some ways in that women hold positions of power and respect, both officially and unofficially within the organization. The individuals within Casme are, in general, `worldly'

and purport to hold particularly `liberal' views and values. This group of highly capable individuals must not be drawn into the frequently destructive tactics of confrontation and harassment. They must work hard to continually display their obvious abilities, talents, and accomplishments, and they must be supported within Casme in those steps. The greatest stimulants to change are blatant examples which fly in the face of tradition, and Casme is well situated to provide some of those examples. Staff must continually make it apparent that gender discrimination is not logical or deserved, and they must all strive to work within constructive paradigms of change. In contributing to the progress toward equity, in the long term Casme must continue to attempt to recruit and promote the best people with the highest potential regardless of colour and gender. However, at the present time, there is a perception and reality of a gender imbalance in the upper administration levels of Casme, and this situation is at least partially responsible for some divisiveness among the staff. Solutions might be found in addressing the administrative needs of Casme that are discussed in the section of this report on administration. In any event, to provide leadership, the accomplishments of the women, along with all staff in Casme must become apparent.

> Highly capable women must be actively sought, totally supported, and their accomplishments, along with the accomplishments of all staff, must be celebrated for all to see.

A Future Vision for Casme

The Education Department of the African National Congress (ANC) discussion document on education (1994) makes a point that "we are presented with a unique opportunity to start anew - to do things differently" (p.119), and Casme is also presented with that unique opportunity. With the changes occurring in the educational structure of the country, Casme must not squander that opportunity now presented if it wishes to have a significant and lasting impact on the teaching and learning of science and mathematics, and if it wishes to continue to survive in the new South Africa. It is recognized that NGOs such as Casme have much to contribute in that

> it [educational reconstruction in the post-apartheid South Africa] is a challenge which we can only meet collectively and in a partnership of all sectors of South African society. This will require that we continuously seek and find creative ways of unleashing the creative energies, talents, skills, and resources of all our people: learners, teachers, parents, communities, organizations of civil society, the private sector, organized labour, and the state. Non-governmental organizations are well-placed to make contributions in educational development, innovation, research, and training. (p.119)

In the past Casme has often worked in opposition to governmental educational authorities, and has attempted to counteract the effects of policies and procedures legislated by the government. This situation can no longer occur.

> Casme must enter a new phase of cooperation with governmental educational authorities and must work to assist them in establishing enabling policies and procedures for quality education in general, and superior mathematics and science education in particular.

As changes in the activities emphasized by Casme come about, focus should remain on the traditionally targeted schools of South Africa, the severely disadvantaged and under-resourced.

The changes in Casme approaches and activities which will be necessitated will not come easy for Casme staff, but such changes are essential for the long term achievement of its goals, as well as the long term survival of the organization. Staff become very `attached'

to programs that they have created and nurtured to productive achievement, and the inertia of these established programs and their resulting achievements works against change. It will be difficult for staff to relinquish their hold on projects which must now be more appropriately conducted by their former `enemy' the government educational authorities. Many have become `comfortable' in conducting their projects where they get much personal satisfaction from seeing the immediate results of their efforts. While future major Casme activities may require a more `distant' contact with day-to-day classroom activities, staff might retain intimate contact with teachers and students by undertaking action research projects related to Casme activities, and they should be supported by Casme in any such efforts.

> Casme staff should be encouraged and supported to undertake `action' research activities in South Africa's mathematics and science classrooms and teacher training or in-service programs.

Such research activities should not consume an inordinate amount of staff time, but may become important components of any individual's responsibility to the extent that a particular study might be an integral part of a Casme project. In the past, insufficient time has been spent by Casme staff on evaluation of and reflection about Casme activities. It is important to Casme's future role that such evaluation and reflection take place, and well-conceived research can often provide the vehicle for such activities.

Over its history, Casme has concentrated its efforts in the disadvantaged Black schools of KwaZulu-Natal. Today Casme is beginning to expand its activities with a view to establishing a national presence. To begin to implement this expansion, senior staff members have been appointed as national coordinators, and a cascading model of overall administration, national coordinators, senior coordinators, coordinators, and field workers is being postulated. Kroonstad in the Orange Free State and an imminent project in the Eastern Transvaal are designed to explore models to facilitate expansion while, at the same time, immediately contribute to the improvement of science and mathematics education in these settings.

> Casme should proceed with its efforts to establish a national presence in the improvement of science and mathematics education.

While there is a danger of spreading resources too thin, Casme must gradually become involved in other aspects of the education system which are critical to the attainment of their mission.

Examinations

System-wide, high stakes examinations have a pervasive influence in education. They govern what will and what will not be taught, how it is taught, and when it is taught. They dictate what is important and what is not important, how children should learn and what teaching and learning methods are undesirable, and, most importantly, how many students will pass, fail, and receive the various other marks which determine their future. The higher the stakes for the examinations, the greater the influence the examinations have on the education system, and in South Africa, the stakes for matriculation examinations cannot be higher; they totally decide a student's immediate future. It is an extremely rare case where a teacher has any direct influence on the future fate of a student, other that attempting to prepare her or him for the final examinations. As such, the present system of matriculation examinations must be changed in KwaZulu-Natal.

Many of the former discriminatory policies of apartheid are ensconced, but often hidden, within the matriculation examinations and the policies and procedures that have governed completion of secondary school and admission to institutions of higher learning. The complex and extensive nature of the English used in the examinations for mathematics and science, the technical item construction flaws in the items, the problems of fairly scoring open-ended items, the variability in the availability of calculators to examinees, along with many other factors discriminate against the Black student. The norm-referenced practices of exam construction and score adjustment are at variance with everything that is presently known about science learning and the interpretation and reporting of high-stakes examinations. The examinations system must be uncovered from the veil of secrecy which has typified former practice, and the process must be removed from the hands of politicians and bureaucrats and placed in the hands of the community and professional educators. Examinations must be made fair to all.

Casme is informally involved in many ways in the examinations procedures by some staff members working directly in the process, by making available to teachers and students previous examinations and solutions, and by guiding teachers in the most important areas that are covered by the examinations to name but three. However, Casme as an organization must become officially involved at a much higher level of policy

development and practice. Casme should seek the services of an individual who is highly knowledgeable in testing, measurement, and evaluation theory and practice. This individual must work to expose the often hidden unfairness and discrimination of present practice, from the use of complex English to test students to whom English is a second language, to the norm-referenced procedures of the mark 'adjustment' process.

> Casme must place itself in a position where it can have impact on the changes which must occur to the matriculation examination system in the new South Africa.

To complement these activities Casme might consider becoming a leader in South Africa, or in a group of African countries to establish some sort of a code of fair testing practice similar to formal codes and practices that have been established and accepted or adopted by educational authorities in the United States of America and in Canada. Casme is well placed to take such leadership.

Institutions of Higher Learning

The admissions policies of higher education facilities are also critical to the attainment of Casme's goals. It is a waste of time, effort, and resources if the positive impacts on science and mathematics in secondary schools are not translated into greater access for students in post-secondary programs, be they technical or academic.

> Casme must work with institutions of higher education to ensure that students who can develop further in science and mathematics are given the opportunities to do so.

There are many approaches that might be taken to solve this problem (e.g., the Students and Youth into Science, Technology, Engineering, and Mathematics [SYSTEM] proposal [Centre for Educational Policy Development, 1994]). While it is beyond the scope of this evaluation to expound on all the various options, Casme must work to ensure that solutions are found. Science and mathematics education at post-secondary levels must become more open to students; access is critical!

Casme presently works very much in the area of in-service teacher education and little attention is presently given to one of the biggest problems leading to the need for intensive in-service: the deficiencies in pre-service teacher training. In the past, Casme

has run in-service training for college lecturers; today these workshops are run by WITS RADMAST in January and July for lecturers from all over South Africa. However, the opportunity is now available to totally remake and reform the whole education system, and actively working with the teacher training programs could allow great strides to be made in increasing teacher competencies and attitudes.

> Casme should consider the possibilities of reintroducing teacher pre-service education into their overall strategy for improving science and mathematics education.

While it might be appropriate that Casme remain relatively remote from pre-service teacher training, the possibilities available at the present time should be explored.

Research

Casme is uniquely placed to contribute to the research base of science and mathematics education in South Africa. The staff are well qualified and experienced to provide leadership in research, a task which they already undertake, albeit in usually an unofficial capacity. Members of the Casme staff have been integral in establishing and maintaining professional and research-based organizations such as the Southern African Association for Research in Mathematics and Science Education (SAARMSE), promoting conferences associated with these organizations, and producing scholarly publications, all activities which are essential to the advancement of theoretical, pedagogical, and administrative educational knowledge in a South African context. In the period of change facing South African education it is essential that scarce resources are not wasted on large scale, unresearched `experiments', and Casme is in a position to assist and advise educational authorities on future directions. Although much research in mathematics and science education is available around the world, comparatively little has been done in South Africa, and South Africa's educational milieu is so unique it is doubtful that much of the present research available is directly applicable here. Casme has a history of immersion experience in the realities of senior mathematics and science classes of KwaZulu-Natal, and the lessons Casme has learned must be used to ensure the best possible delivery of education in the new South Africa.

> Casme must continue to stimulate and expand its efforts to encourage and promote mathematics and science education research in international, and particularly South African contexts.

Casme should also consider becoming involved, presumably through government sponsorship, with research activities which transcend provincial and national boundaries. As an example, Casme is superbly positioned to provide substantial assistance to Phase 1, and possibly act as the National Project Coordinator for the second phase (beginning in two years) of the Third International Mathematics and Science Study (TIMSS) that is presently being conducted in over 50 countries in the world. Through Casme's efforts an `African' sub-study might be undertaken similar to the that being undertaken by the Caribbean nations. Participation in such international studies would be very illuminating for a country just now re-entering the world community and economy. Casme can provide a leadership role in such undertakings.

Participation in an activity such as TIMSS might also provide Casme, and possibly other NGOs with the opportunity to design appropriate instruments and collect the type of impact data that funders are increasingly demanding. TIMSS could be used as the base for developing more valid instruments, to include performance testing, in a South African context and curriculum, where costs of such development might be prohibitive without such a base from which to springboard.

Links with other NGOs

The tremendous benefits of the work that Casme does with the development of science and mathematics teachers will only be fully realized if the changes in teacher behaviour which are necessary actually occur. If teachers are not fully supported in their efforts by the principal, the rest of the school staff (particularly any other science and mathematics teachers), and the community, the potential effects of Casme's work will be diminished. Teachers need a supportive infrastructure, both physical and mental to institute positive changes. In supporting this notion, the 1000 Schools Project shows great potential. However, any activity that can provide wider support for educators and students should be seen as positive and much of such activity relates to the work of other NGOs. Casme must continue to maintain constructive relationships with other NGOs, particularly those who work in mathematics and science at any level.

The closest and most influential of the other NGOs to Casme is the Science Education Project (SEP) headquartered in Johannesburg. SEP works throughout South Africa providing curriculum materials and INSET to science teachers at Standard 6, 7, and 8 in much the same way as does Casme. In addition, the Primary Science Project (PSP)

which is also headquartered in Johannesburg, and which works throughout the country (but at the Standard 3 to 5 levels) uses many of the same approaches and has many of the same philosophies which are common to both SEP and Casme. Thus, PSP, SEP, and Casme theoretically can provide an uninterrupted flow of support for science education from Standard 3 right to matriculation. As such, there should be a much greater intensity and formality in cooperation among the three NGOs to realize this potential. At the present time, Casme, SEP, and PSP have a forum which meets twice a year to discuss common areas of concern. However, under the present circumstances and climate, these meetings are probably insufficient to deal with all that is desirable or required. With Casme, SEP, and PSP all involved with the 1000 Schools Project, this innovation will be an excellent testing ground to explore the methods of, and benefits accruing from, a vertical continuum of mutual SEP and Casme involvement with a school and group of teachers. This cooperation should be closely monitored. For Casme, it is most critical that formal links be established with SEP and that affected staff meet frequently. Casme has plans to extend out of KwaZulu-Natal, and SEP has plans to broaden its work to Standards 9 and 10. As developments progress, particularly on the national scene, it is essential that Casme and SEP do not compete in the same areas and thus waste resources through unnecessary duplication of services. NGOs are going to have a difficult time in the future and these difficulties should not be amplified by destructive competition. If available resources rapidly decline, the sharing of support infrastructure, building space, professional literature, and libraries, to name but a few, would appear quite attractive.

> Formal, cooperative links with other NGOs, particularly with SEP, but also with the PSP, should be immediately established.

The Future of NGOs

The future of all NGOs, including Casme, is uncertain at this point in time. NGOs are unique as they operate in South Africa and were born to fight the results of the discriminatory policies and practices of apartheid. With apartheid gone, what is to happen to. NGOs? Will they disappear with official apartheid policies despite that fact that there is still a legacy of systematic deficiencies? The one, single potential development that would have the greatest impact on NGOs is if much of the funding previously provided to NGOs is redirected to the new, central, unified department of education. If this occurs, as it very well might, NGOs who are poised to provide important services through the government, on possibly a contract basis, should still be able to work toward their goals. Casme must be one of those NGOs.

> Casme must focus its efforts and be prepared to provide the new South African education authorities with advice, guidance, and services which will benefit science and mathematics education.

Casme's future and the future of positive change in science and mathematics education is dependent on Casme's vision remaining alive and well; Casme must structure itself and position itself to survive.

Summary

In summary, this evaluation has found that Casme has had a very profound, positive influence on science and mathematics education in KwaZulu-Natal.

It has also found that there is a pressing need for change within Casme in order that it can continue to do positive work and even improve on its position of influence. Throughout this document, recommendations have been made which, it is hoped, will assist Casme in designing a framework for action during this time of change. These recommendations are collated below for the convenience of the reader.

1. As the nature of informal INSET changes over the next period of time, standards expected of teachers with regard to professional conduct during in-service education should be clearly delineated, and consequences of failure to comply with such professional standards should be established and consistently applied. (p.21)

2. Further workshops conducted by or designed by Casme must continue to emphasize practical solutions to the day-to-day problems of classroom teachers. (p.22)

3. One Casme staff member should be appointed to ensure that coordination and mutual sharing of all teacher in-service activities and materials takes place. (p.23)

4. It is strongly recommended that Casme continue to sponsor, and even expand its involvement in Further Diploma in Education (FDE) programs. (p.24)

5. Consideration should be given to `winding down' and terminating the field-based activities of the School Science Project in its present form. (p.25)

6. Consideration should be given to attempting to staff the resource centres with experienced teachers wherever and whenever possible. (p.28)

7. The concept of using cluster schools as satellite resource centres should continue to be explored and implemented wherever and whenever there is a need and appropriate, secure locations can be established. (p.29)

8. The importance of the concept of SIGs in promoting teacher leadership and professional development cannot be overemphasized, and Casme should do everything in its power to promote and support active initiative by local groups in determining their needs and conducting their own activities. (p.30)

9. In establishing and rejuvenating SIGs, it is critical that strong. local teacher leaders be found and recruited to provide the impetus for success. (p.30)

10. Consideration should be given to appointing a single staff member within Casme to be responsible for all Subject Interest Groups in all subject areas. (p.31)

11. While Casme has provided excellent computer-related service to selected schools in the past, the project should rapidly turn its attention to the services of guidance and advice, based upon trialed practice, that it can provide to central government education organizations and authorities. (p.35)

12. The materials development activities of Casme should continue to be supported with whatever resources it requires to continue its effective service to Casme in particular, and to mathematics and science education in general. (p.36)

13. It is strongly recommended that the concept to training teachers to be teacher and workshop leaders be pursued with vigour. (p.38)

14. Casme should remain deeply involved in the 1000 Schools Project and continue to provide as much leadership as possible. (p.39)

15. Casme must maintain a continuous program of internal, formative evaluation of all its activities, and these evaluations must be documented and periodically summarized in an appropriate manner to be available when needed. (p.39)

16. A system must be designed to ensure that all projects of Casme are seen as components working with other components toward the overall mission of Casme, rather than as individual projects which operate in isolation from other projects. Consideration might be given to using the unifying concept of teacher leadership as the vehicle to operationalize this system. (p.46)

17. It would be very advisable to add to Casme's staff a senior management position to monitor and coordinate the day-to-day project and educational work of Casme. (p.47) 18. Casme must work to provide physical space for all staff which promotes a team approach to conducting Casme's activities. (p.49)

19. Opportunities should be given to all Casme staff, particularly the administrative staff, to participate in courses and programs for life skills development: time management, dealing with stress, avoidance of crises, etc. (p.50)

20. Highly capable women must be actively sought, totally supported, and their accomplishments, along with the accomplishments of all staff, must be celebrated for all to see. (p.54)

21. Casme must enter a new phase of cooperation with governmental educational authorities and must work to assist them in establishing enabling policies and procedures for quality education in general, and superior mathematics and science education in particular. (p.55)

22. Casme staff should be encouraged and supported to undertake `action' research activities in South Africa's mathematics and science classrooms and teacher training or in-service programs. (p.56)

23. Casme should proceed with its efforts to establish a national presence in the improvement of science and mathematics education. (p,56)

24. Casme must place itself in a position where it can have impact on the changes which must occur to the matriculation examination system in the new South Africa. (p.57)

25. Casme must work with institutions of higher education to ensure that students who can develop further in science and mathematics are given the opportunities to do so. (p.58)

26. Casme should consider the possibilities of including teacher pre-service education into their overall strategy for improving science and mathematics education. (p.59)

27 Casme must continue to stimulate and expand its efforts to encourage and promote mathematics and science education research in international, and particularly South African contexts. (p.60)

28. Formal, cooperative links with other NGOs, particularly with SEP, but also with the PSP, should be immediately established. (p.61)

29. Casme must focus its efforts and be prepared to provide the new South African education authorities with advice, guidance, and services which will benefit science and mathematics education. (p.62)

This evaluation of Casme has been extremely challenging, but very interesting and enjoyable. I have seen the best and the worst of education, have made wonderful new friends from all stations of life, and have had my own knowledge and understandings advanced significantly in everything from sociology, politics, and education to ornithology, zoology, and nutrition. I would like to thank the funders and the administration of Casme for allowing me the opportunity to work with Casme, and sincerely hope that the contents of this report will prove useful to the organization as it charts its future course.

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APPENDIX A

Casme Staff Time Records

The following pages contain forms that you will use to provide information which, when totaled and summarized will provide a picture of the day-to-day conduct of *Casme*'s activities. Please remember that these individual records are recorded **in confidence** among you, myself, and Lynne. They will be used only for the purposes stated above, and no other person will be able to link any of the data to any individual! Note that your name is at the bottom of this page to be used only to ensure that I have records for everyone; it will be removed as soon as I "tick" you.

Please try as hard as possible to honestly record your activities as soon as possible after they occur and as close to the recorded time as possible!

Filling in the one-page time grid

The following page containing the "time grid" for three weeks of your own activities is a cross tabulation of:

- vertical—time during the day, from 7:00 am (0700) to 6:45 pm (1845), and
- horizontal—the day of each week (Monday, Tuesday, Wednesday, THursday, and Friday) for Week 1 (1-5), Week 2 (6-10), and Week 3 (11-15).

For each 15 minute time period during the day, write the letter (or letters) that correspond to the activity (or activities), from the list below, which took **most** of your time during the 15 minute segment of time preceding the written time on the recording sheet. As a rule, only one letter will be placed in each box, the exception being when approximately equal time during the 15 minute segment is spent on two different activities. As an example:

if you spent most of the time between 0830 and 0845 in driving to a school, you would record an "a" in the 0845 time box for the day in question.

KEY TO ACTIVITIES

a. Travel
b. Planning
c. "Waiting" (e.g., for teaches to arrive, while a phone call is dealt with, etc.)
d. Content discussions with teacher(s)
e. Pedagogical discussions with teacher(s)
f. Materials/equipment use/maintenance discussions with teacher(s)
g. Administrative discussions with teacher(s)
h. Other discussions with teacher(s)
i. Public Relations - principal, other teachers, students, parents, general public etc.
j. Administration/record keeping/logistics
k. Care and maintenance of equipment and materials/resupplying kits
l. Correspondence in (reading)/out (writing)
m. Developing/producing materials
n. Own professional development (read articles, new texts/materials, research, etc.)
o. Formal "meetings"
p. Coordination/linking between/among projects within *Casme*
q. Coordination/linking between/among projects outside of *Casme*
r. Other informal discussions with other *CASME* staff
s. Reflection/evaluation on what has been done
t. Personal tasks
u. Eating/break/resting
v. Other (please specify on a separate sheet with date and time)
w Making and serving tea
x Care and maintenance of premises
y Photocopying
z Switchboard
Blank. either not yet started 'work' or finished 'work'

DAY	1M	2T	3W	4H	5F	6M	7T	8W	9H	10F	11M	12T	13W	14H	15F
07:00															
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Mean Minutes per Day Spent at Various Activities
(Percentage of Time in Parentheses)

	All Staff (n=24)	Professional Staff (n=16)	Support Staff (n=8)	Senior Staff[1] (n=7)	Field Staff[2] (n=9)
Direct Teacher Contact Time - Content	13 (2)	19 (4)	0 (0)	9 (2)	28 (5)
Direct Teacher Contact Time - Pedagogy	15 (3)	23 (4)	0 (0)	32 (6)	16 (3)
Direct Teacher Contact Time - Materials	12 (2)	19 (3)	0 (0)	10 (2)	26 (4)
Direct Teacher Contact Time - Administration	5 (1)	6 (1)	0 (0)	4 (1)	8 (1)
Direct Teacher Contact Time - Other	11 (2)	16 (3)	0 (0)	2 (0)	27 (5)
Public Relations	4 (1)	4 (1)	2 (0)	4 (1)	5 (1)
Direct Teacher Contact Time - **TOTAL**[3]	60 (11)	88 (16)	2 (0)	61 (11)	109 (20)
Equipment Maintenance and Resupply	13 (2)	15 (3)	10 (2)	14 (2)	16 (3)
Materials Development	51 (9)	58 (11)	36 (7)	89 (17)	34 (6)
Planning	20 (4)	30 (5)	1 (0)	42(8)	20 (4)
Formal Meetings[4]	44 (8)	51 (9)	32 (6)	54 (10)	48 (9)
Informal Meetings and Discussions	14 (3)	18 (3)	7 (1)	17 (3)	19 (3)
Coordination Within Casme	23 (4)	26 (5)	16 (3)	31 (6)	22 (4)
Coordination Outside of Casme	15 (3)	19 (3)	8 (2)	23 (4)	15 (3)
Public Relations	4 (1)	4 (1)	2 (0)	4 (1)	5 (1)
Correspondence	16 (3)	11 (2)	27 (5)	17 (3)	7 (1)
Records & Administration	101 (19)	60 (11)	183 (34)	62 (11)	59 (10)
Reflection & Evaluation	12 (2)	13 (2)[5]	11 (2)	19 (4)[6]	7 (1)
Own Professional Development	18 (3)	26 (5)	4 (1)	28 (5)	24 (4)
Travel	55 (10)	81 (14)	3 (1)	33 (6)	118 (20)
Facilities Maintenance	7 (1)	0 (0)	22 (4)	0 (0)	0 (0)
Catering (tea, coffee, snacks, etc.)	5 (1)	0 (0)	14 (3)	0 (0)	0 (0)
General Support	22 (4)	0 (0)	66 (13)	0 (0)	0 (0)
Driving Others	11 (2)	0 (0)	33 (7)	0 (0)	0 (0)
Breaks & Eating,	45 (8)	39 (7)	57 (11)	38 (7)	39 (7)
Waiting	5 (1)	6 (1)	2 (0)	2 (0)	9 (2)
Personal Time	12 (2)	17 (3)	3 (1)	17 (3)	17 (3)
Other	3 (0)	4 (1)	0 (0)	0 (0)	7 (1)
Number of Days Worked (14 maximum possible)	13.0	12.8	13.8	13.6	12.1
Mean hours per day	9.2	9.4	8.7	9.2	9.5
Mean hours per day less *non-productive* time[7]	8.2	8.4	7.7	8.3	8.6

[1]"Senior" Staff are those professional staff who are more 'office based': Director, National Coordinators, *Materials Development* Coordinator, and the Internal Evaluator.

[2]"Field" Staff are those professional staff who are more 'field based: Regional Coordinators, Project Coordinators, and School Science personnel.

[3]TOTAL may not be the exact sum of the preceding six rows due to 'rounding errors'.

[4]§Several individuals 'double coded' some time periods to indicate that often Formal Meetings were for the purpose of planning, and whenever this occurred, the time was placed in the Formal Meetings category. Therefor much of the time indicated for Formal Meetings is also time devoted to Planning on a group basis.

[5]These are the only statistics where the distributions have an outlyer which radically skews the distribution, namely the internal evaluator who includes evaluation as a major component of her responsibilities. Without her data included, the mean statistics for the rest of the total professional staff are 9 (2) and for senior staff are 11 (2).

[6]These are the only statistics where the distributions have an outlyer which radically skews the distribution, namely the internal evaluator who includes evaluation as a major component of her responsibilities. Without her data included, the mean statistics for the rest of the total professional staff are 9 (2) and for senior staff are 11 (2).

[7]Although I have termed eating to be "non-productive" time, lunches in particular are often times when much discussion surrounding Casme and its activities takes place; its name could be misleading to a certain extent.

APPENDIX B

The following are the questions which framed the interviews with principals, teachers, students, and Casme staff. Interviews with governmental education officials, staff of other NGOs, university personnel, parents, and members of the general population were tailored to the particular information desired from each individual.

Principals

1. Name
2. School
3. Years of experience teaching (total)
4. Years of experience as principal
5. Career information (transiency)
6. Training and certification:
7. Teacher(s) with Casme
8. How has Casme helped your teachers?
9. What would it be like for them and the school without Casme?
10. What is the best thing that you see about Casme?
11. Are there any problems that you see with Casme?
12. What is the worst thing that you see about Casme?
13. What more would you like from Casme?
14. If you had the power, how would you change Casme?
15. Is there anything else you would like to tell me?

Note information about the school/class/teaching situation/catchment community/etc.

Teachers

1. Name
2. School
3. Subjects and grades taught
4. Years of experience teaching (total)
5. Years of experience teaching science/mathematics
6. Career information (transiency)
7. Training and certification:
8. How are you associated with Casme? How long have you been involved?
9. How has Casme helped you?
10. What would it be like without Casme?
11. What is the best thing for you about Casme?
12. Are there any problems with Casme?
13. What is the worst thing about Casme?
14. What more would you like from Casme?
15. If you had the power, how would you change Casme?
16. Is there anything else you would like to tell me?

Note information about the school/class/teaching situation/catchment community/etc.

Students

1. Name:
2. School:
3. Teacher:
4. Course:
5. Do you enjoy school? Why or why not?
6. What is the best thing about school?
7. What is the worst thing about school?
8. Do you enjoy science/mathematics? Why or why not?
9. What is the best thing about science/math?

10. What is the worst thing about science/math?
11. What sort of marks have you always had in science/math?
12. What sort of marks are you now getting in this science/math?
13. Do you think you will go to university? Why or why not?
14. If you do go, do you think you will take science/mathematics? Why or why not?

SCIENCE ONLY

15. How often does your teacher do demonstrations of practicals?
16. How often do you do practicals yourself of with other students?
17. Do the practicals/demonstrations help you? How?
18. Do you know that your teacher works with a group called Casme?
19. IF "NO", "ask what would you like to see changed about your science/math course?" and skip the next two(**) questions

**20. How do you know about your teacher and Casme?
**21. What sort of things do you think your teacher does because of his/her work with Casme?

Try to encourage the student to talk about him/herself and education, particularly science/mathematics.

Casme Staff

1. Name:
2. Position:
3. Education/training:
4. Experience:
5. **Why** are you working for Casme? and not for something/somewhere else
6. What do you see as the goal(s)/role(s) of Casme?
7. How does what you do fit into that/those goal(s)?
8. Do you think that Casme reaches this/these goal(s)/roll(s)? why or why not?
9. Do you think that you accomplish what you want to accomplish in terms of the overall picture?
10. What is the best thing you can tell me about Casme?
11. What is the worst thing you can tell me about Casme?
12. If you had the power, what would you change about Casme, how would you change it, and how would that change improve matters?
13. What do you see as the future of Casme?
14. What do you see as the future of NGOs in general?
15. What else would you like to tell me about Casme, or about education or science/math in general?