

# **JISTE**

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*JISTE* is an official, refereed publication of ISTE. The goal of ISTE is to publish six to eight articles in each issue. Using the Seminar theme, articles in the first issue of each volume are based on papers presented at the previous seminar. Articles in the second issue are non-thematic. Points of view and opinions are those of the individual authors and are not necessarily those of ISTE. Published manuscripts are the property of JISTE. Permission to reproduce must be requested from the editor.

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Non-Thematic

JISTE

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# **Secretary General's Message**

Janet Powney

## Editor's Message

Welcome to the second issue of JISTE Volume 7 and another wonderful array of articles from across the world. Welcome also to our new Secretary General, Dr Janet Powney and look forward to her visions for the future for ISTE. The high standard of papers submitted from the ISTE Conference in Denmark means that a number of the articles published in this issue also saw their genesis at that conference. Firstly, there is an article by Susan Tilley and Joyce Castle who provide an overview of teacher testing in Ontario, Canada- a practice that raises debate amongst educators in that country and elsewhere in the world. Karlheinz Rebel then discusses the poor results received by German students in literacy, numeracy, and science, and the implications of these results for schools and teacher education. Dumma Mapolelo takes an in-depth look at the effects of teacher' views of mathematics on their teaching practices in Botswana. Richard Berlach and Anthony Improsciano compare measures of 'Emotional Intelligence' (EI) with the more traditional IQ test results to determine if EI can provide valuable information on a student's true performance. Engaging students in academic learning – an issue of ongoing attention in many countries- sees Ghazi Al-Rasheedi take a look at how teachers spend their time in Kuwaiti primary schools comparing the time spent 'teaching' students with that of maintaining control and other activities. Finally, Anna Mazzaro and Jacalyn Willis provide a model for enhancing language learning in English and other languages for students, based upon their work in the USA, through the use of "engaging and relevant subject content such as science" and by means of teaching practices that address student learning styles. Thus again, JISTE brings to its readers a variety of issues and approaches to teaching and teacher education. I hope you will enjoy reading all the articles as much as the reviewers and I have.

I would now like to encourage you to submit papers for possible publication in next year's JISTE (Volume 8). While ISTE 2003 had to be cancelled because of the SARS virus, I would still encourage all of you who had intended to present papers in Hong

Kong this year to still consider reworking your papers and submitting them by 1<sup>st</sup> September, 2003 in accordance with the guidelines described in this issue of JISTE. You might like to show 'potential papers' to colleagues or other members of the ISTE family to obtain their suggestions for improvement in the absence of the Seminar. Of course, you can submit other papers of your research, your work, or your ideas. I would also like to strongly encourage you to ensure that your paper is within the word limit as this can create the greatest difficulty for authors in the revision stage. Also, I would like to continue to publish as wide array of articles as possible, and this is just not possible with long articles. Please also encourage your institutions to subscribe to the journal and offer to be a reviewer. I look forward to receiving many interesting papers.

Catherine Sinclair

# **Teacher Testing: Dimensions and Debates in one Canadian Context**

Susan Tilley  
Joyce Castle

*In this paper we explore the concept of teacher testing in the North American context, and specifically, in relation to the ways in which it has been characterized in Ontario, Canada. We provide an overview of the Ontario program and highlight the debate surrounding its conceptualisation and implementation. We close with thoughts related to the future of teacher testing in Canada and around the world.*

## **Introduction**

One of the most controversial aspects of the Ontario provincial government's ongoing education reform plan has been its “Teacher Testing Program.” The Ministry of Education has pointed to what it asserts is a province wide concern about the performance levels of school teachers, and has set out to provide a structured way of dealing with this problem and improving educational quality. Toward this end, the government has introduced a number of testing initiatives.

This paper explores the concept of teacher testing in relation to the ways in which it is characterized in Ontario and from an English Canada perspective. Given that Ontario is the first province in Canada to introduce a teacher testing program, a review of the program as well as the issues concerning teacher testing is timely. We begin with an overview of the Ontario context and the Ontario testing program, and we then explore the central aspects of the debate surrounding the conceptualisation and implementation of the testing program. We close with thoughts related to the future of the teacher testing movement in Canada and around the world.

## **The Ontario Context**

In the Canadian context, educational policies and reform are the mandate of provincial government bodies and not the federal government, except for a small number of specialized areas, for example, national multicultural education policy. In Ontario, the provincial requirements for teaching call for both an undergraduate degree from a recognized university, and teacher certification to practice in the province. Teacher certification is granted through the Ontario College of Teachers, a body authorized by the Provincial Ministry of Education (Ontario Legislative Assembly, 1996). With its inception in 1996, the College of Teachers became the regulatory body for the teaching profession. In this capacity it sets standards of practice for teachers, establishes teaching qualifications, grants accreditation to teacher education programs, and issues certification to teach in the province. In addition to the College of Teachers, other professional bodies exist in the province in the form of teacher unions, each representing and lobbying for different segments of the teaching profession. One important body is the Ontario Teachers Federation and its affiliates—the Secondary School Teachers’ Federation, the Elementary Teachers’ Federation of Ontario, the Ontario English Catholic Teachers’ Association, and the Association of Francophone Teachers of Ontario. A second professional body is the Ontario Principals’ Council, a group that represents school administrators and works to address issues of teaching quality in its schools. A third group is the Ontario Association of Deans of Education, a group representing the Faculties of Education throughout the province. Taken together, these various components of the Ontario educational system result in a complex network.

### **The Ontario Teacher Testing Program**

Teacher testing came into the spotlight in the province in 1999 when the Premier announced that his government intended to improve education in Ontario and that part of the plan would include a teacher-testing program (Ibbitson, 1999). The following year the Ministry of Education specified the elements of the new program (a) a language proficiency test, (b) a qualifying entrance test for teachers, (c) an induction program for new teachers, (d) a teacher re-certification program, and (e) a performance appraisal

process for teacher evaluation (Government of Ontario, 2000, July 13; Government of Ontario, 2000, September 26).

## **Language Proficiency Test**

The Language Proficiency Test was introduced to ensure language competency among teachers. As part of the basic requirements for certification outlined in Regulation 184/97 of the Ontario College of Teachers Act, language proficiency was deemed essential. In 2000, the government approved this requirement, making a language test mandatory, and by January 2001, the language test was in place, making this component of the program the first to be implemented.

The test itself calls for the successful completion of written and oral language tasks before certification to teach in the province is granted. The test is required only for those applicants who have not completed their teacher training in either English or French (Canada's two official languages). There has been no serious opposition to this requirement, but there has been debate around the scope of the test. The College of Teachers had called for all teacher applicants whose postsecondary work and teacher training were not in English or French to pass the tests, but the Ministry determined that only applicants whose teacher training was not in these languages would be required to pass the test (Woon, 2001).

## **Teacher Qualifying Test**

The Teacher Qualifying Test was introduced to regulate entry to the profession. The government addressed this concern in 2001 with Bill 110, the Quality in the Classroom Act, which specified the need for evidence of quality and competence from teachers (Ontario Legislative Assembly, 2001a). The Ministry put out a call for proposals to design, develop, and implement the qualifying test; and, Educational Testing Services (ETS), a private company from the United States, was awarded the contract, along with the Ontario Principals Council (OPC). This partnership of the ETS and the OPC was viewed as an opportunity to combine the technical expertise of the American testing service with the contextual

understanding of the Ontario education system (Ontario Principals' Council, 2002).

The development and implementation of this qualifying test have continued to generate debate in relation to who should prepare and administer such a test and who should control its content and scoring. Faculties of Education argue that an accreditation process is already in place in Ontario, and that the faculties themselves should have full responsibility for preparing teachers and determining whether or not teacher candidates are fit for the profession. Representatives of the Ontario College of Teachers (OCT), as the provincial regulatory body for teachers, want to control entry into the profession. And finally, the Ministry of Education argues that it alone has the responsibility to ensure that new entrants actually have the knowledge and skills that the Ministry says they should have before entering teaching.

When the Ministry announced in the spring of 2002 that the test was ready and that education students must write and pass the test in April if they wished to be certified to teach, the response by stakeholders was less than supportive (Schmidt, 2002). A key complaint related to unresolved concerns about test validity and reliability. Six days before the test date, the Ministry recanted and announced that the qualifying test “would not count” for 2002. All graduates were still required to write the test, but the results were collected for pilot test purposes. To date, no information has been released regarding outcomes or findings from the pilot results. Future announcements are expected in relation to the requirements for writing the qualification test in 2003.

## **Induction Program**

The third component of Ontario's testing plan, the Induction Program, applies to new teachers and is aimed at providing these novices with coaching and support from experienced teachers to ensure a strong start in the profession. Mentoring during the first two years of teaching is the intention, and this corresponds with the normal probationary period for new teachers in Ontario. Such

programs have tended to generate ongoing support in the province, but to date the government has released scarce information in relation to the specifics of this aspect of the program. Additional announcements are expected in the near future.

## **Teacher Re-certification**

This aspect of the testing program differs considerably from those above in that this component directly affects already practicing classroom teachers. With the passing of Bill 80, the Stability and Excellence in Education Act, in 2001, the government outlined the requirements (Ontario Legislative Assembly, 2001b). The program was described as a 5-year professional learning cycle that called for all teachers to successfully complete 14 courses every cycle to maintain their license to teach.

In 2001, all new teachers, as well as a third of practicing teachers in the province, were targeted by the government to begin this five-year cycle. These teachers were directed to successfully complete 7 “core” courses and 7 “elective” courses from approved lists of courses and providers. Failure to meet these conditions would lead to a one-year suspension, followed by cancellation of the certificate if course work is not initiated.

Opposition to this mandatory re-certification has remained intense. Teachers’ unions, in particular, have been highly vocal (Elliot, 2001; Ontario Secondary School Teachers' Federation, n.d.; Schuster, 2001). In the spring of 2002, for example, the English Catholic Teachers’ Association advised its members not to accept into their classrooms any student teachers from Faculties of Education who were providers for re-certification courses. Implementation of this initiative by the government will remain a challenge, and time will reveal to what extent the political support of teachers’ unions becomes important to the current government as their mandate draws closer to an end.

## **Performance Appraisal**

This final aspect of the testing program provides a standards-based, province-wide performance appraisal program for all practicing teachers. The standards provide the basis for ongoing assessment and continuous improvement of every teacher's classroom performance. The need for such a program was addressed in the Quality in the Classroom Act in 2001 and the Ministry put the appraisal format into place in the spring of 2002. School boards remain responsible for managing and overseeing the evaluation of their teachers, but this program provides them with a high level of consistency in expectations, process and procedure.

Initially there was little resistance to the notion of province wide appraisal standards, but its recent implementation is becoming controversial. A key complaint from teachers' unions relates to the required input from parents and students in each teacher's evaluation. A second key complaint from school administrators relates to the time required for appraisal. In short, the legislation requires all new teachers to be evaluated in each of the first two years of their employment and all experienced teachers to be evaluated on three-year cycles. Debate around the specifics of this performance appraisal process will no doubt continue and time will remain a challenge for school administrators (Woon, 2001).

### **Issues Driving the Teacher Testing Debate**

While a testing program for teachers is a new concept in Canada, attention to teacher testing has been addressed in other countries, most notably the United States (U.S), in the last several decades (Anrig, 1990; Flipppo & Foster, 1984; Haney, Madaus, and Kreitzer, 1987; Ludlow, 2001; Stedman, 1984). Given the information accumulated in the literature and the lessons to be learned from practice and research to date, it is useful to consider the conceptualisation and implementation of Ontario's program in relation to the popular rhetoric on teacher testing and the issues driving the debate on its effectiveness.

### **Rhetoric on Teacher Testing**

The teacher testing movement reached a high point in the U. S. in the 1980s and 1990s, and the assumptions fuelling the movement have changed little since that time. The key assumption surviving that period is that testing provides a means of ensuring that only competent teachers will teach and that these in turn will provide quality education. Haney et al. noted in 1987, and Pullin reiterated in 2001, that the heavy reliance on tests as the primary tool of education reform grows out of a great faith in the use of tests to assess, promote and ensure educational quality. This faith in testing as a means of ensuring educational quality has been critiqued in the past, and continues to be challenged. For example, in the 1980s, Pugach and Raths reported that “there is scant evidence to support the contention that performance on a teacher competency test is correlated with effective teaching” (1982, p.13), and more recently, Dybdahl, Shaw and Edwards (1997) concluded that basic skills tests were of little use in predicting later achievement in the teaching profession. Despite such challenges, a strong belief persists that teacher testing is a cure for education’s problems.

The educational discourse developed within this movement includes the language of competency, standards, accountability, and quality. Yet while these concepts have been written about extensively in rationales for testing initiatives, they have not always been clearly defined (see, for example, Short, 1985, for a discussion of the use and misuse of the term “competence”). Diverse interpretations of these terms have resulted in diverse purposes and approaches to ensuring improvement in education.

In Ontario, a similar discourse and lack of definition of terms have also surfaced. When the provincial government called for accountability on the part of schools and teachers, their call for the use of a testing program scored well in public opinion polls (Daley, 1999). To date, however, the appropriateness of the tests as well as the implementation of aspects of the program has been called into question. While the controversy can be connected to a number of aspects of testing programs, we emphasize 3 areas of concern as most relevant to the Ontario setting. These areas relate to issues

around quality, diversity, and the high stakes that are part of teacher testing initiatives.

### **Tests for Quality Education**

Test validity is an area we suggest needs to be interrogated before decisions are made in relation to teacher testing programs. Do such tests measure what they claim to measure? Empirical research in this direction is scant so little evidence exists to suggest that such tests deliver on what they claim (Haney, Fowler, Wheelock, Bebell, & Malec, 1999). In particular, the claim that tests predict “potential” of teacher candidates has been called into question, specifically the predictive validity of testing initiatives, particularly those emphasizing basic competencies and their adequacy in measuring the skills and knowledge competent teachers require. Dybdahl et al. (1997) summarize the research succinctly: “The fact is that after more than a decade of teacher testing, research has failed to demonstrate any significant relationship between basic competency tests and other measures of program success, including success in teaching” (p. 252). An ongoing problem has been the difficulty in achieving consensus on a definition of competence: “Developing valid competency tests is an elusive enterprise. Competence seems so simple when viewed from afar, and so complex when analysed in detail” (Piper & Houston, 1980, p. 39). Furthermore, the focus has largely been on using testing programs to keep incompetent teachers out of the profession. This strategy provides no guarantee that those who pass such tests have the skills and knowledge to practice effectively in the classroom.

Associated with the question of test validity is the responsibility of test constructors to take validity issues seriously. To be productive, testing initiatives must meet the goals of the programs for which they were constructed and be judged to be effective by independent bodies given that responsibility. This is especially important in light of the fact that decisions made will often hold influence over lengthy time periods. Stedman, as early as 1984, suggested: “No practice should be permitted without a rigorous validation plan. This is especially true for legislated

decisions which are not likely to change for long periods of time” (p. 5). But even though the validity of the tests administered to teachers for various purposes has been questioned, parties constructing these tests have not been held accountable for their validity.

In Ontario, issues related to quality have also surfaced. It appears that the government, for the most part, has followed the general movement of the U.S. rather than use research findings to inform current decisions. For example, the Ontario government has included a qualifying entry level test in its program regardless of research conclusions calling into question the validity of just such tests (Educational Testing Services, 2003). As well, the Ontario government has forged ahead with the implementation of a professional learning program for practicing teachers despite the lack of a shared understanding of what constitutes competency and what experiences promote quality education. And finally, the haste with which the components of the Ontario testing program was developed and implemented continues to be of concern. Many groups noted this as especially problematic in relation to hasty development of the Qualifying Test for Entry to the Profession, which many felt should have allowed more time to ensure validity. In 2002, following the announcement that the test was ready and that all teacher candidates would be required to write the test, the Ontario Association of Deans of Education wrote in a letter to the Minister of Education that “in our view, and in the view of other stakeholders, the 2002 test scores should be used only to validate the test for next year and to provide data that is particular to the educational context of Ontario (Ontario Association of Deans of Education, 2002).

### **Issues of Diversity**

A second area of concern we emphasize is the connection between testing programs and the marginalisation of particular groups within educational contexts. In many U.S. states a concern exists that teacher shortages will occur, or in some cases worsen, as a result of testing programs and that when shortages do occur,

particular groups will be affected. When describing the Massachusetts Education Certification Test, Melnick and Pullin (2000) wrote:

The January 2000 administration of the tests resulted in the highest pass rates: 56% of the test takers passed all three parts. For persons of color [diverse ethnic backgrounds], test results were especially discouraging; for example, among the 29 African Americans taking the tests, none passed all sections on the first administration. (p. 262)

The authors go on to explain that the state no longer publicly reports demographic rates. By excluding demographic analyses, states can de-emphasize the effects of testing on particular groups of people (Dybdahl et al., 1997, p. 249). If particular marginalized/minority groups are not certified as a result of testing policies, then the gap between minority group representation in teaching and their white counterparts becomes even greater. When this occurs, standardized teacher-testing functions as a gate-keeping mechanism. Flippo & Canniff (2000) write:

Consistent evidence suggests that high-stakes tests like the MECT adversely affect underrepresented minorities and second-language learners. The National Education Association in 1987 found that entry-level teacher licensure testing excluded tens of thousands of African-Americans and Hispanics from the teaching force. (p. 1/5)

According to Darling-Hammond (2000), what happens in states battling teacher shortages is that ways are created to circumvent the certification process. For example, emergency licenses are awarded, or training centres outside the domain of colleges and universities are given authority to grant licenses. Darling-Hammond warns that these practices lead to variations amongst teachers assigned to particular schools, and that as a consequence, the numbers of teachers representing diverse cultures and backgrounds in schooling contexts may decrease rather than increase. In the case of Massachusetts, “the K-12 student

population [primary-elementary-secondary students] will become nearly one half students of color [of diverse ethnic backgrounds]—native, migrant, and immigrant—with an increasing number of limited English-proficient children . . . yet, the proportion of minority teachers is decreasing (Melnick & Pullin, 2000, p. 266).

Although the degree of ethnic and racial diversity differs across Ontario, the new testing program needs to address the diversity concerns noted in the literature. The city of Toronto, in particular, is quickly becoming more multi-cultural and facing challenges similar to those described in the U.S. Rather than addressing the effects of testing in relation to vulnerable groups as an after thought, such issues need to be examined in the design and implementation of Ontario's testing programs. Canada has a multi-cultural policy that recognizes and values various forms of diversity as well as a ministry policy that addresses equity issues, and as such, issues of diversity should be seriously considered in any teacher testing initiatives put in place in the name of quality education. Unfortunately, there has been little to date to suggest that issues of diversity have been incorporated into the design and development of the testing program.

## **High Stakes Testing**

The final issue we address has particular relevance for Ontario and revolves around what is referred to as “high stakes.” High-stakes include such things as loss of teacher credibility, loss of jobs for teachers, and closure of teacher education facilities due to testing outcomes, all of which are possible consequences attached to the results of teacher testing. According to Ludlow (2001), “high stakes tests are becoming increasingly powerful determinants of students’ and teachers’ lives and life chances” (p. 1).

The drive for teacher testing in the U.S. followed from a public view that large numbers of teachers were incompetent (Miles, 2000). However, the introduction of testing initiatives caused some erosion of teacher credibility as well. As reports of testing results

were made public in various states, some portrayals of teachers in the media were highly derogatory (e.g. use of terms such as “idiot” or “incompetent”) and recovery from this bad press can be difficult (Pressley, 1998). In Ontario, support still exists for teachers, but it is unclear how the results from the new testing programs will be reported and understood over the next while. Our concern is with what Melnick & Pullin (2000) describe as “face validity,” the validity that untrained people perceive tests as having (p. 269). While the validity of the tests will be questioned by many with the expertise to ask particular kinds of questions, others may make assumptions about the meaning of these results based on face validity. It could prove difficult for the teaching profession to regain any credibility lost as a result of the implementation of ineffective testing initiatives. Furthermore, this loss could have devastating effects on the educational system as a whole, including the recruitment of people into the profession.

One of the major differences between the Ontario and U.S. context is that in the U.S. many teacher preparation programs have not been accredited, and testing becomes the way to ensure that all teachers have mastered the knowledge and skills required for teaching. The Higher Education Act in the U.S., passed in 2001, requires the publication of the results of the teacher tests from every institution across the country receiving federal financial support (Hansen, 2002). Such requirements do not exist in Ontario at present, but may become part of the landscape. As happens in various U. S. states, Canadian provincial government bodies may also choose to connect funding decisions to results reported from testing programs, and this can put teacher education programs at considerable risk (Melnick & Pullin, 2000). Individuals who pass the tests but later do not prove to be competent teachers are also cause for concern, for in such cases the high stakes are directly connected to students in the classroom and their access to quality education.

Few people would disagree that teachers should be held to high standards. However, the use of expedient high stakes tests to determine what makes a “competent” teacher is called in to

question (Ludlow, 2001; Melnick & Pullin, 2000). Given that the price paid for the implementation of various testing initiatives has often been very high in the U.S., the Ontario government needs to attend closely to what can be learned from past experiences of our counterparts situated in the U.S. context.

## **Conclusion**

It is difficult for educators not to support, at some level, the call for better, quality education, which includes ensuring teachers have the necessary skills and knowledge to educate pupils in their classroom. However, what constitutes the most effective methods for ensuring quality education continues to be open to debate. What we have explored here is the current focus on the use of teacher testing to improve education. This movement has survived several decades and is not about to go away; in short, the rhetoric of the testing movement lends itself too well to the public's cry for accountability (Pullin, 2001).

We remain concerned, however, about what will happen with the testing initiatives that have begun in Ontario. We hope the story will unfold differently in Canada than it has in the U.S. Hopefully other Canadian provinces will not plunge into initiatives of their own without being proactive in learning more about the possibilities and limitations of testing. Others need to be well informed and articulate in their arguments against implementing externally mandated testing programs that can lead to more harm than good in their local educational contexts.

As well, we hope that other countries may learn from the experiences of Ontario. In the same ways as those of us who border the United States are physically affected by their policies and practices, countries at a distance also feel ripple effects. With the push for globalisation of education and the continued development of research initiatives often "sold" to other countries by North America, teacher testing may be packaged and sold abroad with little consideration for the fact that these initiatives were developed from a western, Euro centric perspective. Ontario is currently feeling the effects of its government's uncritical assumption that

American designed teacher-testing initiatives could be easily translated and effectively used in Canadian contexts. If we add in the degrees of difference between North American contexts and other educational contexts around the world, the differences multiply exponentially.

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# **PISA Gives Shocking Marks to the 16 German Educational Systems: Implications for Their Schools and Teacher Education**

Karlheinz Rebel

*The 16 German States take part in the 'Programme for International Student Assessment' (PISA). The publication of the results of the first of the three assessments (2001) have caused a deep shock and intensive discussions, particularly as they reflect former international studies like TIMSS<sup>1</sup>, indicating not just a temporary deficit but pedagogical and psychological problems. These problems have shown our educational systems not sufficiently adapted to newer societal, individual, technical, economic etc. changes. Among these changes, the consequences of the transition of modern societies from an industrial to a 'Knowledge Society' seem to be the deepest going influences. There is a basic consensus that neither organizational reforms nor better top-down administrative controls as isolated measures will decisively help. Instead, the right answer to the modern challenges is better teaching-learning on all levels: What kind of knowledge is taught in which way and learned by the students in which learning mode is the key 'bundle of questions'. Further, how should teacher education be improved is one of our most difficult problems to solve. The present systems still produces highly qualified teachers with regard to their subject field knowledge but too often poorly qualified professionals with regard to the new roles required and their professional knowledge and skills.*

*This paper:*

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<sup>1</sup> TIMMS = Third International Study

1. *Summarises the conceptual framework and main results of PISA on the basis of the*
2. *connections between 'knowledge society' and teaching - learning in schools,*
3. *Analyses some of the proposals to improve student achievements, and*
4. *Formulates some changes in teacher education.*

## **A Short Introduction to PISA**

In response to a growing demand for international comparisons of educational outcomes, the OECD has launched the Programme for International Student Assessment (PISA). PISA represents a new commitment by the governments of OECD<sup>2</sup> countries to regularly monitor the outcomes of education systems in terms of student achievement and within a common framework that is internationally accepted. Thus PISA aims to provide a new basis for policy dialogue and for collaboration in defining and operationalising educational goals in innovative ways that reflect *judgements about the skills that are relevant to adult life*. PISA results provide inputs for *standard-setting and evaluation*; insights into the factors which contribute to the *development of competencies*, and into similarities and differences between countries relating to the way in which these factors operate. By supporting a shift in focus from the inputs into education systems and their institutions to the *outcomes of learning*, PISA seeks to assist policy-makers to bring about improvements in schooling and in the preparation of young people for adult life at a time of rapid change and increasing global interdependence.

## **Aims, the Conceptual Framework and Some Results of PISA**

PISA provides the OECD countries with data on 15-year-old students' knowledge, skills, and competencies in *reading*, *mathematics*, and *science* on a regular basis and in a reliable and nationally representative way. In addition, *cross-curricular competencies* and central *motivational features* necessary for

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<sup>2</sup> OECD = Organization for Economic Co-operation and Development

*methodical, self-regulated, and co-operative learning* are assessed. While the tests sample content and skills from the curricula of the national states, the main interest of the monitoring efforts of PISA lies in the question: How well have the students mastered primarily *processes*, less so, *content*? In other words, how well does their understanding of concepts within a specific content domain enable them to handle various life situations?

The results are interpreted in light of socio-demographic characteristics of both *schools and students*, as well as the culture and opportunity structures of schools. The project involves *three overlapping four-year cycles*, each with a thematic focus. In the *first cycle*, finished in 2000, *reading* was the major domain, with mathematics and science representing the minor components. Cross-curricular competencies will span all three of these domains, connecting them in the form of a general component. Thirty-two OECD countries participated in the first phase. In 2003 and 2006 the *next cycles* will follow, each with a different focus (in 2003 *mathematics*, in 2006 *science*). In the middle of 2002 an additional report followed describing the results of a comparison of school achievements among the 16 German States (PISA E), with a random sample of 50.000 students from all types of schools.

PISA uses as its key concept such basic competencies, which are in our modern societies necessary for a satisfactory way of living both in personal and economic respects. The philosophy underlying PISA is directed towards the functionality of the competencies acquired within the obligatory school age and which are needed for our youngsters to master their lives as young adults and their ability for continuous learning in their life span (Baumert et al, 2001, p. 16).

The basic competencies tested by PISA cover not only the mastery of the content according to the curricula prescribed in the national states but also form an essential stock of knowledge and skills. The main interest of the monitoring efforts of PISA lies in the question how far the students have learned to *primarily* master the *processes* and *not - as their main aim - the learning content*: i.e.

their understanding of concepts, and their ability within a specific content domain to handle various situations.

PISA's approach has a *functional* view of the basic competencies to be tested within the three domains mentioned before (Weinert, 1999). These competencies are considered as *basic cultural instruments* expressed by the term '*literacy*'. PISA conceives of the term in a very wide sense, almost as 'general education' for our modern knowledge society. The justification of PISA's approach is the assumption that the mastery of the mother tongue in the spoken and the written, a sufficiently confident handling of mathematical symbols and models, and the ability to interpret and understand science phenomena are necessary in all Information and Communication Societies, as the core of their cultural literacy. The concept of "basic competences" changes, too. It now refers to principally learnable, more or less domain-specific knowledge, skills, and strategies. These are not just facts but different forms of knowledge and may be communicated and mediated. Their necessary *universality* is a consequence of the change from an industrial into a knowledge society.

## **Some Results of PISA for Germany**

Generally spoken the achievements of the German students are highly disappointing and unexpected.

### **Reading Literacy**

- a) PISA distinguishes five levels of competences with regard to the three aspects of reading literacy:
- b) *To gain information from a text:* Depending on the complexity of the task this aspect requires a direct understanding of this part of the text and maybe a comparison of the various pieces of information occurring in the text.
- c) *To interpret a text closely sticking to it and develop a general understanding of it, i.e. to construct meaning and*

draw conclusions from one or several parts of the text (e.g. to determine the author’s intentions).

- d) *To reflect and assess content and form of the text*, (e.g. to connect the text with your own knowledge or to demonstrate evidence for the validity of statements in the text on the basis of general world knowledge etc.).

On each of these subscales PISA distinguished five levels of competency according to difficulty, and complexity. Level I stands for a basic requirement, level V for highly complex and difficult tasks. An example of Level II reading literacy follows: A “Level Two” teen is able to make a comparison or several connections between the text and outside knowledge, draw on personal experience and attitudes to explain the text, recognize the main idea when the information is not prominent, understand relationships or construe meaning within a selected part of the text, and locate one or more pieces of information which may require inferences to meet several conditions.

Table 1: Performance of Selected OECD countries on PISA - Reading Literacy- Results from first cycle PISA 2000

Country/ Rank	Mean	Standard Deviation SD	Competence Level I Below I	Competence Level V
Finland 1	546	89	2.5 %	18.0%
Canada 2	534	95	3.5%	18.5%
New Zealand 3	529	108	4.9%	19.0%
Australia 4	528	102	4.0 %	17.0%
UK 7	523	100	4.5%	16.0%
<b>OECD-Average 16</b>	500	100	6.0%	9.5%
Denmark 17	497	98	6.0%	8.0%
<b>Germany 22</b>	<b>484</b>	<b>111</b>	<b>9.9%</b>	<b>8.8%.</b>
Mexico 31	422	86	16.0%	0.5%
Brazil 32	396	86	23.0%	0.3%

These results place German students below the reading achievement of several OECD countries including Spain, Canada and the U.S.A. The difference between Finland with the highest mean score (546) and Germany (484) is dramatic. A mean score of 484 means that, generally speaking, our students just manage to read a text with difficulty. In countries with a mean score of 540 their 15-year old students understand complicated texts, and are able to draw conclusions and link them systematically with their pre-knowledge.

The most dramatic result is that the percentage of German students whose reading achievement is *below* Level I is relatively high (9.9%) compared to the OECD average (6%). Brazil, Mexico, Latvia, and Luxembourg have higher percentages of students reading at or below Level 1, whereas Australia, Finland, UK, Japan, Canada and Sweden have lower rates (below 5%). Another 12.7% of German students reach only Level I (OECD average 11.9%). Add this to the below Level 1 reading group and we realise that almost 23% of our students are normally unable to fulfil the requirements of Level II as described above. This is well above the OECD average of 18%. Neighbouring states like Sweden, Austria and France have 18% and less of their students at the lowest level of the five-level test.

Just what are the difficulties that our German students have in reading, especially with assessing and reflecting on the text? What are the factors in the society and or the educational system that create or contribute to such difficulties? The chart above shows that 8.8% of the German sample achieved at Level V of the Reading Literacy test. This is the level with the most complex and difficult tasks. At this level the German achievement is close to the OECD mean value of 9.5% and is similar to the achievement in Denmark, France, Austria, Iceland and Switzerland. But twice as many students in Finland, Canada and New Zealand achieve at this level.

## **The Case of Mathematical Literacy**

Mathematical literacy means the ability to understand the role of mathematics in the world, to be able to judge mathematical statements and to handle mathematics in such a way that is adequate to the demands on a sensible, reflective, constructive person. The pure knowledge of mathematical sentences and rules is not enough. Accordingly PISA mathematics has again five competence levels. Level I means that the test person disposes only of a primary school level of knowledge. Level III expresses the standard of mathematical literacy, namely the ability to model and link mathematical concepts in order to solve problems. Competence Levels IV and V go beyond this by their increased complexities of demands. The German students reach only rank 21 having a mean of 490 (OECD average 500). The highest rank countries are Japan with 557, New Zealand 537, Finland 536, Australia 533, Canada 533 etc.). The tests from this domain show that too many German students are more or less unable to mathematize real situations by applying models, and to draw conclusions from such models and evaluate them in real situations. The number of students reaching competence Level V is extremely small (below 1%), less than 50% of the German students reach the standard competence (Level III and higher), and about 25% belong to the 'risk group' on Level I or below whose mathematical literacy might prove to be insufficient for their vocational training.

## **The Case of Science Literacy**

In the *science literacy* the German students are again below average (OECD mean). Especially they do not possess the ability to understand science compared with students from many other countries. In the top-level groups the Germans are also just average. Other countries are better equipped to support and foster poor *and* high achievers whereas for German schools a high selectivity is characteristic. There are other causes and factors to be mentioned to explain the differences in achievement comparisons: e.g. in how much esteem do the public, the parents, the politicians hold the sciences in schools and also express their esteem publicly? What is the status of science teaching-learning inside and outside

schools? How is the science subject field organized (separation or integration of the single science subject)?

### **We Summarize the PISA Results for the German Student Sample**

- a) German students are in the lower third of the ranking lists in the international achievement comparison in all three domains thus having a lower achievement level than their international counterparts.
- b) Within the upper third Germans are average. The group of the best readers in the German sample is smaller than that in the UK or Belgium sample.
- c) The German school systems are extremely unfair towards poorer students. In no other comparable country does social origin determine a successful school career so strongly as in Germany.
- d) Germany belongs to the leaders with regard to the variance of school achievement. In all three domains the difference between the groups of good and of bad achievers is larger than in almost any other country. Our school systems fail to secure minimum standards of achievement.
- e) The German students show in the international comparison an especially low interest in reading.
- f) Problematic is the achievement profile of our students: the more ambitious, complex and therefore difficult is a task in the reading and math tests the more distinctly the achievement scores of the Germans decline. What they usually are able to do in reading is the simple finding and integrating of information from texts and in mathematics procedural, technical skills and knowledge.

It is my contention in this paper that there is a *gap* between current schooling and the new educational tasks of schooling

demanded by the “Knowledge Society” and this gap is primarily responsible for the disappointing PISA results in Germany. Isolated reform steps like establishing more all day schooling (which is the exception in the German school system) may as such be meaningful but cannot cure the main weakness in our 16 educational systems. The results from PISA have to be interpreted by applying systemic explanatory models rather than isolated approaches concentrating on a single phenomenon in a single state or even in the whole country.

### **Implications of PISA for the Further Development of Germany’s Educational Systems**

The complicated relationship between a "Knowledge Society" and the learning behaviour of those living in it, especially with regard to our youngsters, indicates that our educational systems have to be changed systematically on the institutional level as well as with the learning individual in his/ her interactions between teacher and student. The adaptation processes have to comprise systemic aspects as well as educational interferences on the side of the involved persons, and they should be based on integrated concepts as the problems to be solved and the knowledge we are applying are of an integrated nature. For teachers on all levels of our educational systems traditional habits and pedagogic routines will have to be questioned. What we need are newly conceived educational tasks standing for basic needs of human beings that originate out of our living conditions today.

Some of the concrete implications of the social and individual changes for the work of teachers in their classes are:

- a) Working in education today requires teachers and students opening their minds to societal changes caused by the transformation of our societies into "*Knowledge Societies*". This means to deal with today's understanding of "*knowledge*": its highly differentiated semantic field, the differences between detailed knowledge and its basic structures and the conditions

of knowledge acquisition under the present societal and individual tasks.

- b) Pedagogic reflection follows the model of the *self-determined, self-responsible, reflective subject* and its individual and social developmental tasks. This explains the strong interest of today's approaches in biographical learning and a much wider understanding of learning (e. g. informal, situational, everyday knowledge, learning en passant, just in time, and non-institutional learning) .
- c) Learner-oriented didactic approaches have to accept a strong individualization even of younger students in all areas of their lives. The implications of individualization for the daily work in classes are immense for the identification of aims, learning needs, the selection of learning content, methods, learning speed etc.
- d) The gap between the various modes of knowledge is getting deeper, especially between scientific and application and general knowledge. However, a pure *transfer* of knowledge from one mode to the other is in most cases probably insufficient, especially if curricular knowledge is needed. On the other hand, it belongs to today's most difficult educational and didactic challenges to *transform* the societal and individual knowledge from its academic and scientific mode into relevant, learnable content in the classes.
- e) Didactic designs have to consider the special interest of students in unplanned, informative situations and tightly packed descriptions from everyday life. Mere knowing of facts is not enough. Application of the content learned should be interpreted as the ability to understand situations, know how to analyse them in order to find keys to solve the problem in question, use certain models which fit to similar situations and allow their transfer etc.
- f) Teaching learning models seem to develop nowadays towards *task oriented teaching learning configurations*. The

development and adequate structuring of relative complex teaching learning tasks (e. g. projects, scenarios, simulations, key issues and key problems etc.) is gaining importance and rather often decides success or failure in learning. Tasks should be meaningful, authentic, challenging, everyday-oriented and sufficiently complex. On the other hand they have to be anchored in the subject fields in question, and they should show clearly what the aim of the learning is, and should aim at clearly defined learning results.

- g) Decisive for a successful learning not only of our students and the conceptual basis for the PISA test batteries are the following aims:
- h) The development of the ability to transform learned knowledge into other contexts,
- i) The ability to bring out clearly a mathematical, science or language problem which requires a clear structuring of the task, the ability to illustrate complex facts of the matter in question by using sketches, diagrams, scenarios etc. And a highly developed flexibility in choosing the best suited way to solve the problem in question,
- j) The development of certain abilities and skills to enable the learners to fulfil the requirements mentioned above (e.g. the development of their imagination, acquisition of a reliable methods- and strategy knowledge),
- k) The ability to combine the level of subject field knowledge and the meta-knowledge needed to handle it.
- l) The complex present educational tasks can only be carried out by professionally educated and trained teachers working on their professionalisation during their whole active life span. But they also need the support of many other groups and of the society as a whole.

## **Some Necessary Changes in the German Teacher Education**

The central point of the problems we have to deal with in our schools as PISA shows very clearly is that not the teachers or the students or somebody else are "guilty" in the sense that they did their jobs badly. Most of the German teachers did their job as they had learned it and according to this measure well. However, they cannot perform their job properly because the teaching learning in their school classes does not support at least a large number of them sufficiently. And they don't get this support because the majority of our teachers have not acquired the necessary amount of professional knowledge, skills and strategies for teaching today's students.

The following does not have the rank of a new model of teacher education but concentrates on points which have become visible in the previous paragraphs.

Teachers need additional competencies and qualifications today. They have to develop themselves in the direction of genuine professionals by means of continuously learning throughout their professional life span. The aim is to enable them to reflect their practical work also in the light of the existing theories in their subject fields and their professional areas (education, psychology, sociology), to bridge their own experiences with expert knowledge and to develop a communicative/ social competence to get support and receive support their colleagues.

The following competencies and qualification tasks for the teaching force might be helpful:

- Being able to conceive and design learning environments which are supportive to active, self-responsible learners, allow the application of modern information and communication technologies but remain under the control of the teaching staff,
- Being able to anticipate learning processes, to articulate them, using adequate methods to keep them going and helping to make them effective, interesting and relevant,

- Being able to diagnose individual and societal learning conditions and achievements,
- Being able and willing to clarify their self-conceptions and their role perceptions and role expectations - especially important today applying autobiographical reflection and the development of distance from their own world understanding.

One important instrument which we have failed to develop and regularly apply in the German educational systems is the *evaluation* of not only the achievements of our students but also of our schools, tertiary institutions, and our teachers - and all this not in order to criticise them for the sake of criticism but to help them to develop themselves further in the right direction. We need internal and external evaluation models, and also in the future international achievement tests, and many forms of self-assessment.

The role set for teachers should also change, but as yet this has not happened. Teachers have primarily to become or to be experts for the arrangement of teaching learning processes. They also need a lot of knowledge and the skills to diagnose problems our students might have in learning.

The relationship between practice and theory is by far narrower than many of us thought. We have to realize that problems in educational practice may be better solved with the help of theoretical and reflective knowledge. The relationship between both is also influenced considerably by the everyday learning needs. Many of our practitioners heartily dislike theory and reflection. This can be explained but it is no longer tolerable. The model of the adequate practitioner can be described as a person willing and able to reflect on his/ her professional and personal doing and thus being able to develop it further. Such a modelling process has to start from the first semesters of initial teacher training, and it ends only at the end of the professional career.

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# Case Studies of Primary School Teachers' Mathematics Instruction: Dealing With Reform In Mathematics Teaching

Dumma C. Mapolelo

*Case studies were conducted to describe and compare how four primary school teachers' perceptions of mathematics affected their attempts in transforming their teaching. Qualitative methods were used to explore the relation between these teachers' perceptions of mathematics (using Ernest's model, 1996) and their teaching actions.*

## **Introduction**

One of the goals of education in Botswana states that problem-solving ability, critical thinking, individual initiatives, and understanding mathematical concepts are important components of mathematics education (Government of Botswana, 1993). This goal suggests mathematics' teaching methods should encourage co-operative learning, problem solving and an investigative approach, all of which are departures from the procedural-oriented and teacher-centred teaching of mathematics in Botswana schools (Prophet, 1995; Prophet & Rowell, 1990; Snyder & Fuller, 1991; Taole & Chakalisa, 1995).

Following research findings about the poor state of mathematics teaching in Botswana (Pendaelli, Ogunnyi & Mosothwane 1993; Prophet & Rowell, 1990; Snyder & Fuller, 1991), the National Commission on Education and the Revised National Policy on Education Reports (Government of Botswana, 1993; 1994) recommended reform in the teaching of mathematics. In particular, an emphasis was placed on the need for activity-based and co-operative teaching approaches. However, primary school teachers have been slow to change their methods. One reason advanced to explain this phenomenon is the model of pedagogical change employed in Botswana (Tabulawa, 1997). The Ministry of Education's Curriculum Unit utilises a top-down approach with little input from practising teachers (Maruatona,

1994). Also inhibiting change is the prevailing view of educators ‘... that mathematics consists of a set of procedures and that teaching means telling students how to perform those procedures’ (Battista, 1994, p. 463). In order to bring about effective teaching and learning, fundamental changes may be required in the content and processes of teacher education. Positive and lasting change requires empowerment of teachers to examine and reshape their professional identity and an opportunity to develop their professional competency.

### **Perceptions about mathematics and mathematics teaching**

A teacher’s conception of mathematics and its teaching is his or her belief system concerning the nature of mathematics as a whole (Ernest, 1988). Such views form the basis of one’s philosophy of mathematics. Lerman (1983) discusses philosophy as a belief system that underlies action; as such, one’s philosophy is a belief about what mathematics is and how it should be approached. Beliefs are personal principles constructed from experiences and used, often unconsciously, to interpret new experiences and guide action (Pajares, 1992). Beliefs do not develop through rational thought, but are mental summaries of significant episodes. Knowledge, however, is built up through intellectual activity, debate and reasoning, and is stored in the form of propositions subject to further evaluation and change.

Teachers, however, have been found to treat their beliefs as knowledge (Thompson, 1992), and characteristics of teachers’ belief systems have been linked to some components of their subject matter knowledge (Cooney & Wilson, 1993). Shulman (1986) has emphasised the importance of teachers’ content knowledge and pedagogical content knowledge in the teaching of mathematics. Also, in cases where articulated philosophies are made, mathematics teaching approaches have been found to incorporate assumptions about the nature of mathematics, and any philosophy of mathematics has classroom consequences (Cooney, 1988; Steiner, 1987; Thompson, 1984).

Ernest (1991a) identifies three philosophical positions of mathematics that can be grouped into two philosophies of mathematics, absolutist and fallibilist (Lerman, 1983; Roulet, 1992). Ernest's (1996) model suggests that:

... a value-position of a teacher plays a vital role in mediating between personal philosophies of mathematics and the image of mathematics communicated in the classroom. For example, an absolutist philosophy of mathematics combined with authoritarian values can give rise to an authoritarian view of school mathematics. Similarly, a fallibilist philosophy of mathematics combined with personal-centred and humanistic values can give rise to a humanistic connected view of school mathematics. (pp. 3–4)

The impact on practice of a teacher's beliefs about mathematics is 'mediated by the constraints and opportunities provided by the social context of teaching' (Ernest, 1991a, p. 290). Teachers may be supported or hindered in the classroom expression of their images of mathematics by the expectations of students, parents, curriculum designers, policy makers, future employers and the general public. Studies show that examining the link between teachers' views about mathematics and their instructional practices reveal the constraints provided by the teaching context (Cooney, 1985; Ferrell, 1995; Thompson, 1984).

### **Purpose of the study**

This study investigated how teachers with different views about mathematics attempted to implement the reforms in teaching mathematics suggested by the National Commission on Education and the Revised National Policy on Education reports (Government of Botswana, 1993; 1994). More specifically, this study documented the effects of four teachers' views about mathematics on their instructional practices. The following questions were addressed: To what extent are teachers' instructional practices expressions of their images of mathematics? What are the struggles

involved in teachers' efforts to implement suggested mathematics reforms?

## **Methodology**

The subjects were four standard seven<sup>3</sup> primary school teachers in Botswana, one female and three male teachers, referred to by the pseudonyms Joey, Pete, Rola, and Sindi. Participants were selected on the basis of their self-acknowledged, written disposition towards mathematics and its teaching, the strength of their mathematics background, and the recommendations of their respective head teachers. All have a bachelor degree (BEd) in primary education with a specialisation in mathematics, and all were mathematics resource persons in their own school-based workshops. Joey and Pete held views of mathematics that are more absolute, while Rola and Sindi held fallibilist views of mathematics.

## **Data collection and analysis**

Document analysis, observation, and semi-structured interviews were used to document the teachers' experiences in line with insights from Bogdan and Biklen (1982) and Glaser and Strauss (1967) in order to understand how the participants' views of mathematics influenced their attempts to implement reform. The interview structure was derived from participants' prior written statements.

During the first stage of data collection, each participant wrote a brief statement about the nature of mathematics and his/her views of mathematics teaching, and mathematics reforms. Participants were then interviewed to collaboratively explore the meaning of their words so that my interpretations were accurate. This also allowed participants to expand on any ideas expressed in their written statements. Each participant was later observed teaching mathematics on consecutive days for four weeks. Each lesson

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<sup>3</sup> The term 'standard' in Botswana context refers to primary school level class (Age range: 7-14).

period was approximately 50 minutes. Prior to each observation, there were interviews about their instructional planning, and after each lesson reflections on their teaching. The consecutive planning, observation, and reflection cycles helped me to trace the influence of the teachers' views of mathematics on their teaching and their attempts to implement reforms.

Data were analysed using interpretative research methods and grounded theory (Glaser & Strauss, 1967). Constant comparative methods were used to search for 'misunderstandings, incomplete understandings, deeper understandings, alternative explanations, and changes with time and context' (Addison, 1989, p. 113). In this case, I explored how the participants' views of mathematics affected their teaching and how they dealt with social constraints that affected their attempts at reform.

All data collected were examined for the frequency of occurring themes. Theme headings were developed and attached to the various perceptions of mathematics in the data. Once themes were apparent in the groups' perceptions of mathematics, data related to practice were examined to determine the incidence of the same idea. Also, constraints that affected teachers' teaching were grouped and compared across the two groups of participants.

## **Findings**

**Patterns across absolutist views, lesson planning, and presentation.** Pete and Joey, the two teachers holding absolutist views of mathematics, described mathematics as: 'a clear and straightforward subject. Students either know the concepts or not. There are no short-cuts to that.' Both described understanding mathematics as procedural competency: 'You show an understanding of mathematics by being able to do a mathematical problem correctly. Following correct procedures and getting correct answers is essential in doing and understanding mathematics.' Pete and Joey both viewed their teaching as 'completely traditional'. They saw themselves as having the 'responsibility' in developing students' self-esteem and wanting to

‘give them the basic mathematical concepts’. They saw teaching to develop ‘concept knowledge’ as making a ‘clear and coherent presentation of mathematics content’. Yet, there were some differences in the context in which they taught and the ways in which they approached their teaching.

Pete taught in a small remote village<sup>4</sup>, built for remote area dwellers. He taught the only standard seven class in the school. He described his class as very good in mathematics. During the week of my first visit to Pete’s class, he was completing the topic of graphs. His class was working in groups and making reports of their observations to the class. Pete asked the class to write about their observations as a group project. This, I observed, was a complete departure from his reported views about how mathematics should be taught and learned. When asking him about this, he said:

I am aware of other alternative ways of teaching mathematics. I have learned and used some of them during my teacher training period. But I found them to be ineffective. ... I have decided to stick to what works for the students and me. You know, some topics lend themselves to this approach. You can see I have not prepared to teach this lesson this way. But I just felt it might be better done this way, and it worked very well. I think the students are very pleased. But I can’t teach all topics this way... by letting students do as they did with this lesson. For example, students can’t learn much in the topic algebra. They need me to tell them how to solve algebra problems. I haven’t taught the topic on algebra. But I do not see what they can do by themselves.

On subsequent visits to Pete’s class I observed him teaching algebra (equations from number stories). The goal for his lessons was to teach students how to translate word story problems into algebraic equations. He demonstrated accurately and precisely how the equation could be derived. Then he referred students to the

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<sup>4</sup> Remote village in the Botswana context refers to a settlement without a modern social infrastructure such as tarred roads, electricity supply etc.

textbook to do seven of the nine problems with the remaining two assigned as homework because they were difficult. Very little discussion took place during his demonstration and only a few bright students participated. Questions were asked of the students to ensure that they were paying attention. Although Pete made detailed explanations, the final outcomes of most of his lessons were well-understood rules, facts, and procedures.

After a week of such practices, students were shown how to translate the equation problems into story problems. This exercise was very difficult for most students due to a lack of English reading skills. Pete had his own difficulties too, since he was not fluent in the students' local language (Sesarwa). He had to abandon his approach and concentrate on having students formulate their own problems and translate them into equations instead. This was again surprising because the practice contradicted his views about mathematics teaching.

Joey's school was in a small town about 80 km from Pete's school. This was a new school with a beautiful administrative block and impressive facilities. Joey described his class as the top in a three-class stream. Algebra (solving equations) was one topic of the ten lessons I observed. Joey's instructional approach was based upon his view that mathematics involves a lot of practice and following the right procedures. Joey's lesson typically started with a review of the previous lesson, followed by a 10 to 15 minute demonstration on the board. The students then worked individually and Joey walked around helping the weak students. The homework was always of the textbook problems and was thoroughly marked. The grades, however, were not recorded. The purpose of marking assignments was to encourage students to do the homework. Parents were reported to be pleased with their children's performance. In one of the Parents Teachers Association meetings parents commended the school for keeping students busy with homework.

Although Pete and Joey had different teaching styles, their lessons were similar with respect to their planning and lesson aims.

Both had brief but detailed lesson plans, with clearly defined content and precise and measurable objectives. My interviews and lesson observations revealed that both teachers also had adequate mental plans. Joey's demonstration on how to solve problems was of the listening–watching manner, followed by questions such as 'Do you understand?' The conclusions of the lessons were specifically for practice purposes. Students were given an average of 10 similar problems each day to solve. Problems assigned were from the textbook and the answers were at the back of the textbook. Students were advised to check their answers against the ones at the back of the book.

Although most of their students had no major problems with computation, both teachers still emphasised accuracy in computational skills and procedural knowledge. Most student–teacher interactions involved univocal aspects, usually in the 'Initiation-Reply-Evaluation (IRE)'. This was evident during the demonstration segments of their lessons. In general, the teaching of both teachers involved few questioning strategies. The purpose of any question seemed to be to ensure that the step-by-step completion required of a problem was mastered. Students were rarely asked to explain their reasoning and were not given opportunities to work through a problem publicly in ways that could reveal their understanding of the concept. Where discussion did occur, the purpose seemed to be to confirm that students followed the required procedure to solve a problem.

**Patterns across fallibilist views, lesson plans, and presentations.** The two teachers (Rola and Sindi) holding fallibilist views of mathematics presented a different view about mathematics and its teaching. Rola and Sindi described mathematics as 'a vehicle for acquiring an understanding of one's daily life experiences'. For them, doing and understanding mathematics meant reasoning, making conjectures about events, and being able to solve problems without relying on prescribed procedures. Knowledge of procedures was seen as an advantage, not a prime requirement.

For these teachers, ‘mathematical knowledge’ is derived from discovering relations in the mathematical exploration. They consider the belief that mathematics is difficult a myth that influences students’ attitudes and teachers’ instructional practices. Rola commented, ‘I do not want to put emphasis on high grades. This often encourages students to lose focus on understanding mathematics rather than concentrate on failsafe routes to correct answers.’ Most students, because of their previously acquired skills and ideas, follow this trend, but Rola was not in a position to abandon her ambition of developing mathematics confidence among her students. She reiterated that:

My responsibility is to provide these students with new experiences of what math is and how to learn math. Of course there is no best method of teaching maths. Sometimes showing procedures is very suitable to students. But when students determine their own procedures, they are likely to be good problem solvers and feel good about themselves.

The description of a ‘good’ lesson presentation was ‘one that leaves the students with the motivation to learn mathematics, the skills and ideas of how to solve similar and difficult problems, ... the pride of being in control of the mathematics learned, and the power to discuss the mathematics they learn.’ Sindi commented:

I do not get convinced with a student who scores 80% in tests but cannot explain some of the basic concepts in mathematics. There are students who are so good at remembering procedures, but not so well in explaining the relation between concepts. I do not think they have conceptual knowledge. This is the type of knowledge I want my students to have. Sometimes it is not easy to teach students to appreciate this. They simply want rules and formulas. In their previous years they may have got used to that way of teaching and learning mathematics. It is sometimes difficult for me to change their experiences in a short period of time.

Both Rola and Sindi taught in urban schools about 10 km apart. The schools were in the catchment area for several Community Junior Schools. Most students in their schools were from affluent families and were interested in going to Senior Secondary Schools.

Rola planned to introduce the topic on division of fractions, while Sindi introduced the topic on reading and interpreting graphs. Rola's class had learned how to solve simple linear equations such as  $3k = 12$ . Her lesson plan showed that she was teaching solving of fractions like  $\frac{2}{3} \div \frac{3}{4}$  by using an algebra approach. In the lower classes (standards 4–6) students were taught the principle of 'invert'. For example,  $\frac{2}{3} \div \frac{3}{4} \Rightarrow \frac{2}{3} \times \frac{4}{3} = \frac{8}{9}$ . This procedure sometimes brings confusion in children. The procedure is never explained to students as to why  $\frac{3}{4}$  becomes  $\frac{4}{3}$ . It is the procedure for solving problems involving division of fractions. The algorithmically based errors in computing fraction division expressions include inverting either both the dividend and the divisor, or the dividend instead of the divisor. When students view an algorithm as a memorised procedure, they may forget some of the steps or interchange the steps.

Students did not at first favour Rola's approach. They thought it was too long. One student said, 'We can do this problem in a shorter way.'

Teacher: What is a shorter way?

Child: Invert the  $\frac{3}{4}$  and then multiply. It always gives the correct answer.

Teacher: Yes it works, but let us learn a different approach and see if we get the same answer.

Rola referred the class to their experiences with the meaning of division and multiplication of whole numbers. She discussed with them the meaning of  $16 \div 2$ . She asked the children to write the problem as a multiplication problem. They wrote that with minimum difficulty. She then asked them to do the same with the

problem  $2/3 \div 3/4$ . When she asked them to solve the problem using algebra techniques, the class came to life. Most students whispered, 'It works!'

Sindi's presentation on reading and interpreting graphs involved activities and teaching aids that interested students. Students brought in their 'under-five cards'. These cards show how a child's weight increased or decreased since date of birth. The profile of each child is recorded every month the child visits the clinic for check-ups. Sindi and his class discussed some of the students' profiles. The class was very interested and participated fully. The exercise that followed the discussions was that each student describes his/her growth profile and also discusses reasons that could have affected his/her weight during the five-year period.

When Sindi introduced a pie-chart, he did not use the same approach. Instead, he showed students how to read and interpret the graph.

Interviewer: Why are you telling them this time?

Sindi: I could not find anything that could interest them.

Interviewer: When you can't find anything that interests them do you always do that? Resort to a lecture approach?

Sindi: Ya, there is nothing wrong really -- as long as that is effective. For me teaching is making students learn and understand. If they understand when I lecture or not, I am pleased. But I always want them to investigate and make observations so that they believe in themselves.

There were similarities in Rola and Sindi's lesson planning and presentations. Their presentations focused on students' participation. Students were required to give an explanation for their answer. Out of a total of 20 lessons I observed, there was evidence of these activities attempted. Students were allowed to work in groups, were questioned by their peers about some of their reports, and were sometimes convinced to change their positions.

One common feature of their mathematics teaching was discussion. The main goal of the discussion was to collect multiple ways that students have discovered to solve a problem. Students were helped to construct their own methods and shared their strategies with the whole class. Every method or solution was considered important and informative. The incorrect procedures or strategies were discussed to help the students to understand the origin of their errors and why the strategies are incorrect.

## **Discussion**

Both groups of teachers in this study were clearly concerned about students' understanding of mathematics. Yet both groups viewed the teaching and learning of mathematics differently. The absolutists refer to understanding of mathematics in terms of students' mastery of concepts, which was to be demonstrated through being able to follow the taught procedures efficiently. Threlfall (1996) argues that such a view of how concept knowledge can be acquired leads teachers with absolutist views to suppose that there can be no misunderstanding, only failure to understand, and as a result, their teaching cannot respond to a student perspective. The fallibilist understanding of mathematics, on the other hand, refers to a broader sense of mastery of concepts. Learning mathematics involves not only mastery of procedures, but developing new ones that are mathematically correct. Understanding of mathematics includes a conception that leads students to correct conclusions.

The actual lesson presentations of the two groups of teachers in this study differed in several aspects. Lesson planning by the absolutists clearly showed the distinctions between the roles of the teacher (knowledge provider) and the student (passivity and note-taking). Students are to practise the procedures and master the content as presented by the teacher. The textbook is the source of knowledge. Lesson planning and presentation by the fallibilists, on the other hand, emphasised discussions and students' participation. Students discovering the connection and disconnection between mathematical concepts and finding other ways of solving problems

were encouraged. The textbook is considered as a reference book, not a source of knowledge.

Superficially, three of the four teachers in this study showed remarkable consistency between their mathematics philosophies and actual mathematics teaching. For example, while all four teachers considered enhancing students' self-esteem as an important goal, they used different strategies to achieve it. Pete's and Joey's lessons demonstrated their mathematical perception at work in their planning and instructions. Students worked competitively with little opportunity to discuss with each other, (considered as copying someone's ideas). Rola and Sindi on the other hand, are unique individuals with different professional experiences. Their perceptions of mathematics and teaching styles, while having some common themes, are different from each other. Rola's views of mathematics can be described as fallibilist, while Sindi presents a mixture of absolutist and fallibilist views. This mixed perception was also evident in his teaching style. In their mathematics teaching, Rola, however, attempted more consistently than Sindi to teach in a manner consistent with the reform suggestions. Although Sindi's instruction did not completely stray from constructivist teaching approaches, in some cases traditional teaching approaches were evident.

In all teaching contexts there was evidence of some constraints in trying to accommodate their perceptions of mathematics in the recommended teaching approaches. The main source of constraints derived from the school culture. Schools in general want to maintain good reputations with the communities they serve. A head teacher in Rola's school commented during one of my visits that, 'Your children are quiet and working hard.' When such descriptions of 'good' teaching and learning are held by the school officials or any senior education official, it is not surprising that teachers like Rola may feel frustrated by their attempt to implement the suggested reforms. Parents also bring to school concerns about their children's performance. They usually meet individuals with equally traditional views about mathematics and its teaching.

## Conclusion

This study attempted to expand our knowledge of the interplay between teachers' subject conceptions and their instructional approaches, in particular their attempts to translate specific subject conceptions into action, and the constraints and opportunities provided by the social context of teaching on their practice (Ernest, 1991b, p. 290). It is possible that teachers may be supported or hindered in the classroom expression of their perception of mathematics by the expectations of students, parents, school administrators, and sometimes by colleagues. Many students, often those who are most successful in the current system, resist changing from the process in which they know how to succeed to the one that fosters intellectual development in a context of some uncertainty. Resistance may also come from parents who understand the existing system but find the new expectation confusing. It is also not easy for teachers to learn the new roles required of those who want to foster constructivist learning among students.

The findings suggest that mathematics teaching reforms cannot take place unless teachers' deeply held views about mathematics and its teaching and learning change. Trying to change the existing system by decree from the top as observed by Maruatona (1994), disenfranchises teachers who may have worked so hard to reach more students. Desiring reforms in mathematics teaching, and making them happen are different issues. The case for the desired reforms has strong support in the research literature. The means, however, by which these reforms can be attained is not so certain. There are many barriers to change, such as the operational and cultural beliefs and differing priorities of teachers, administrators, parents, students, and reformers. The strategies for overcoming them are not fully understood and appreciated. For example, the extensive time spent with participants, studying the relationship between their beliefs and practices and observing their professional lives, has raised a number of questions not directly discussed in this study. What types of professional networks and activities are supportive of change in subject perceptions? What is the

appropriate balance between freedom for individual teachers and Ministry of Education control of the curriculum? These are questions for further research.

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## Does the Notion of EI Make IQ Obsolete?

Anthony Imbrosciano  
Richard G. Berlach

*In 1995, Daniel Goleman questioned the value of placing too much emphasis on IQ as a predictor of success in life. He presented compelling evidence for the need to further investigate the efficacy of a more affectively mediated intelligence, which he characterised as emotional intelligence (EI) – an epithet that has become synonymous with his name. In this study, ten EI-type tasks were created and administered to 87 Year three students. The same students were then asked to complete a standardised IQ test. Variables were then cross-correlated to determine whether significant relationships surfaced. Prima facie, it appears that certain EI tasks relate to IQ results as well as to each other. Results appear to support the conclusion that certain EI tests may provide valuable information on children’s broader performance. Such information, however, ought to be treated as an adjunct to the IQ score rather than as a substitute for it.*

### **Introduction**

Daniel Goleman's *Emotional Intelligence* describes how the place of feeling in the mental life had previously been surprisingly slighted by scientific research, but that this is now being corrected; and he is optimistic that we are now “gaining tremendous insights into the workings of the human heart” (1995, p. xi). Such a view has been strongly endorsed by subsequent work which also realised the importance of emotional, or affective, intelligence (see, for example, Bar-On & Parker, 2000a; Epstein, 1998; Nassbaum, 2001; Stein & Book, 2000).

Certainly, within Educational Psychology there is a growing appreciation of the complex nature of the relationship between intelligence and the emotions. It is now commonly accepted that previous dichotomies drawn between cognitive/affective domains of learning; intellectual/emotional reasoning; and notions of what constitutes intelligence itself, may have been overly simplistic (Gardner, 1993; Woolfolk, 2001).

Together with a re-evaluation of IQ as the preferred measure of intelligence, its predictive capacity for success in life has been questioned. Indeed, there are such widespread exceptions to the rule that IQ predicts success, that there are more exceptions than cases that fit the rule. At best, Goleman concluded, “IQ contributes about 20% to the factors that determine life success, which leaves 80% to other forces” (1995, p. 34). Accordingly, Goleman has challenged writers such as Herrnstein and Murray (1994), who place a primary importance on IQ, arguing that even they conceded that other characteristics are ultimately important in deciding success in life.

The theme of *Humanity and Efficiency nicely* encapsulates the ongoing IQ/EI dialogue in two ways: First, by presenting both sides of the debate as they are popularly interpreted, namely, associating the warmth of humanity with EI and aligning the potential coldness of efficiency with IQ, and second, by using the inclusive conjunction ‘and’ rather than its more polarizing counterpart ‘or’, thus suggesting conceptual complementarity rather than disjunction.

The purpose of this research was to investigate whether IQ (dependent variable) correlated with potential EI indicators (independent variables) across the factors gender, socio-economic status, and school type. If a link can be established, then teacher educators and teachers alike could utilise these EI tasks as a corollary to IQ tests, thus potentially obtaining broader performance-related information.

## Methodology

**Subjects:** The subjects for this study were some 87 Year 3 primary students (approximately 8 years old) with the following profile (Table 1). Sampling was deliberative by school type within socio-economic area (SES). Statistical correction was made in regard to gender balance.

Table 1. Profile of Participating Students

<u>School</u>	<u>n</u>	<u>SES</u>	<u>School Type</u>	<u>Gender</u>	
				<u>M</u>	<u>F</u>
1	21	L	NG	12	9
2	19	L	G	12	7
3	23	H	NG	10	13
4	24	H	G	11	13
Total	87	40-L, 47-H	43-G, 44-NG	45	42

*Note.* L=lower; H=higher; G=government; NG=non-government; M=male; F=female

The variable socio-economic status SES was determined by reference to AUS-STATS, a census-derived database maintained by the Australian Bureau of Statistics. Schools were then selected via convenience sampling and it was determined that the vast majority of students who attended these schools resided in the area. Two government and two non-government schools were selected with those in the latter category being Catholic schools. For the purpose of enhancing reliability, it was thought sensible to select two non-government schools where the same general ethos was professed.

**Instruments and Procedure:** The project used 2 testing instruments:

[1] Standardised: 1 commercially available IQ-type test.

Participating students were asked to complete *the NFER-Nelson Non-Verbal Reasoning 8&9 Test* (Smith & Hagues, 1993). This is a standardised cognitive ability (“IQ”) test for circa eight years of age. This test was selected, as it required no linguistic proficiency, this removing this skill as a possible confounding variable related to SES status. The test was entirely visual-spatial in nature and comprised 40 items, with students being allowed, as per the Manual, 20 minutes to complete it.

[2] Experimental: 10 researcher-produced EI-type tasks.

The instruments below came from two sources: first, adaptations from other reported EI-type studies and test instruments (e.g. Daniel Goleman's Emotional Competence Inventory (ECI 360), 1998; Reuvon Bar-On's EQ Inventory [EQi], 2000a,b; and Mayer, Caruso and Salovey's MSCEIT, 2000 [see also Mayer, DiPaolo and Salovey, 1990; Mayer, Salovey and Caruso, 2000]), and second, from the researchers' own experience and intuitive sense that the selected tasks might correlate with IQ-type items. As such this test comprises a unique bank of items being tested for the first time.

### **EI-type tasks<sup>5</sup>**

- a) welcoming of challenge (unjumbling letters to form a word – opts for 1, 2, or 3)
- b) optimism & pessimism (response to 5 questions, inc. 1 picture)
- c) estimation of time (start watch, stop me when 2 minutes is up)
- d) ease of distraction (Stroop Test)

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<sup>5</sup> Further details of test instruments are available upon request.

- e) perseverance (aimlessly filling in small boxes for up to 15 mins.)
- f) consideration for others (tidying up paddle-pop sticks after use)
- g) ease of surrender (when give up attempting an impossible task)
- h) response to setback (attribution for failure on previous task - performance)
- i) response to criticism (attribution for failure on previous task – personal)
- j) preference for precision (method selected for colouring-in a grid)

## Results

All correlations were analysed using a Pearson product-moment two-tailed test, using SPSS (version 10) software (Pallant, 2001). A pairwise analysis was undertaken for all correlations. The relationships between all variables (n=16) were examined with scatterplots being generated to assist with the interpretation of the correlation coefficients. The strength of the relationship was determined using Cohen’s (1988) correlation criteria for the behavioural sciences ( $r=.10$  to  $.29$ , + or - = small;  $.30$  to  $.49$ , + or - = medium;  $.50$  to  $1.0$ , + or - = large). The significance level was set at  $>.01$  and only significant correlations with medium or large degree of relationship were identified for comment (Table 2).

Table 2. Medium-to-large correlation coefficients

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<i>Variable 1</i>	<i>Variable 2</i>	<i>Pearson r</i>	<i>alpha level</i>
IQ	SES	.601	.000

IQ	Stroop Test <sup>a</sup>	-.327	.003
Estimation of time	Stroop Test <sup>a</sup>	-.316	.005
Estimation of time	Perseverance	.348	.002
Response to setback	Stroop Test:Ratio	.317	.005
Type of school	Ease of Surrender	.301	.007

<sup>a</sup> Refers to the incongruent mode of this test as explained in the following section.

The correlations identified in the above Table will form the basis of the discussion, which follows, and will be treated in the order in which they appear in Table 2.

## Discussion

**IQ & SES.** That the relationship between IQ and SES ( $r = .601$ ) is strong and in a positive direction is hardly surprising, as has been attested to by numerous other studies (for recent work see Blakey and Heath, 1992; McLoyd, 1998; Peck , 2001). In fact, one significant study reported that the longer the child is in poverty, the stronger will be the negative impact on achievement (Bronfenbrenner, 1996). Citing research undertaken by Garcia (1991) and McLoyd (1998), Woolfolk (2001) asked the question “what are the effects of low socio-economic status that might explain lower school achievement...” and made the following observation,

Many factors maintain a cycle of poverty. Poor health care for mother and child, limited resources, family stress, interruptions in schooling, exposure to violence, overcrowding, homelessness, discrimination, and other factors lead to school failures, low-paying jobs – and another generation born in poverty. (p. 162)

Whatever the reasons for the results, which surfaced in the present study, one thing appears certain yet again: that the academic *haves* and *have-nots* can be differentiated by socio-economic status.

IQ and Stroop Test. It was disappointing that the EI experimental instruments generally, did not correlate highly with the IQ instrument. The only experimental variable where the strength of the correlation on Cohen's criteria was categorised as medium ( $r = -.327$ ) was the Stroop Test (named after John Ridley Stroop, 1935). This task consisted of presenting colour words in the congruent mode (e.g. the word 'red' written in a red colour) and the incongruent mode (e.g. the word 'red' written in a different colour). The correlation reported in Table 2 refers to the incongruent mode of the test (for an example of the test see Hoover et al, n.d.). The Stroop Test has been variously interpreted, for example, as an indicator of specific neuro-behavioural performance such as speed of cognitive processing (MacLeod, 1986; Nova, 2000); as a correlate of ADHD (New Zealand, 2000); and as a factor in cognitive flexibility (Gelaes & Thibaut, 2001). That IQ correlates with the Stroop Test may not be surprising in that both variables seem to be cognitively mediated. What is of interest is the nature of the metacognitive processes activated for both IQ and Stroop and how these may be inter-related, that is, what specific factors are common to both tasks. Such information may further inform the nature of the relationship between IQ and EI. Only further research may reveal what these common factors may be. It has already been suggested in the literature that the area of the brain known as the anterior cingulate cortex may provide a neurobiological explanation (Casey et al., 1997; van Veen et al., 2001).

Researchers such as Lohr (1995), Hoover, et al. (n.d.), have investigated the Stroop Test in relation to affective disorders and attentional dysfunction, and found positive connections. This may indicate that while the Stroop Test possibly shares common factors with IQ, this does not in and of itself exclude it from also sharing common factors related to EI.

While a very strong correlation emerged between IQ and SES ( $r = 6.01$ ), this was not to be found in the case of the Stroop Test ( $r = -.131$ ). It may be the case that for those characteristics that are sensitive to both IQ and Stroop, the latter may be more appropriate where the variable SES requires isolation.

**Estimation of Time and Stroop Test.** The estimation of time test (in which the subject was told “I’m going to start my stop watch. I would like you to tell me when you think two minutes is up”), correlated with the Stroop Test ( $r = -.316$ ). As this is a negative correlation, it appears that those who estimated time most accurately tended to do better on Stroop. A plausible explanation may be that the neural pathways activated for estimation of time (a largely abstract task) are simply similar to those required for success on the incongruent version of the Stroop task (a visual task). This may be a genetic propensity, in which case, the knowledge may be of little pragmatic value. A more exciting explanation may be that the challenge to estimate time, like the Stroop Test, are both tasks that require intense engagement and forced attention. As such those who have more highly developed attentiveness will perform well on both Stroop and the estimation of time task. If this can be shown to be the case, then teachers may be able to use such information to help children develop more robust attentiveness capabilities. The correlation between Stroop and the estimation of time test can then be used to gauge the success of any attentiveness-enhancing program.

**Estimation of Time and Perseverance.** Similar reasoning may account for the correlation between estimation of time and the perseverance task, where comprehensive instructions were given.<sup>6</sup> As the correlation was positive, indicating that the more accurate the estimate of time the more boxes were completed, it may be that

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<sup>6</sup> On your desk there is a sheet, containing 1000 little boxes. These are arranged in 50 rows or 20 boxes. Your task is to write out numbers from 1 to 20 on each row of the sheet. The purpose of the task is NOT to see how many boxes you can fill in. You may fill in these boxes for a maximum of 15 minutes, but may stop at any time you wish. You may not ask what time is remaining.

both tasks required a considerable amount of attentive behaviour. It may also be that these two, of all the experimental tasks, generated the least amount of interest and challenge, thus both engendering mindless compliance.

**Response to Setback and Stroop Test: Ratio:** Returning to the Stroop Test, a correlation was found between the response to setback task<sup>7</sup> and the ratio between the congruent and incongruent (C:I) versions of the test. What is interesting is that the vast majority of respondents (77%, see Table 3) indicated that failure was due to the difficulty of the task. Attributional Theory researchers (Dweck & Elliott, 1983; Weiner, 1980,1994) would likely expect to see more of an even spread. The disparity may be explained by the possibility that the children correctly perceived the task as being beyond their capabilities, or in the case of (d), because of the authority teachers hold for third graders, they didn't want to denigrate their teachers. The low selection of (b) coupled with the high selection of (a) would indicate that, overall, the children have fairly positive self-concepts.

Table 3. Descriptive statistics for C:I correlated with response to setback task

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V26	Ratio	N	N%	Min	Max	Mean	Std. Dev.
a	C:I	66	77	1	4	2.04	.61
b	C:I	7	8	1	3	2.29	.70

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<sup>3</sup> [Instruction given upon completion of the previous task – impossible puzzle]. Your answer is incorrect. So you have failed this task. Why did you fail it? Which of the following reasons comes closest to explaining why? [A sheet is then shown with the following choices: a) because it was too difficult; b) because I am not smart enough; c) because I don't have good teachers; d) because I didn't try hard enough.

c	C:I	1	1	3	3	3.00	.0
d	C:I	12	14	1	4	2.45	1.00

**School Type and Ease of Surrender.** A positive correlation was found between School Type and the Ease of Surrender task <sup>4</sup> ( $r = .301$ ). Students from government schools (1.0) gave up on the impossible task earlier (mean=234 seconds) than their non-government school counterparts (2.0) mean=299 seconds). Several reasons for such a finding can be posited. First, it may be that non-government schools emphasize the qualities necessary for ‘stickability’ to a greater extent than do government schools. Conversely, it may be the case that children in government schools are in fact more proficient than their non-government school counterparts at recognising when a task is futile and thus ought to be abandoned. Thirdly, it may be that the Catholic schools selected are not representative of other schools within the Catholic system. Finally, it may be that Catholic schools are not representative of other non-government school systems and so have yielded non-generalizable results. The reason for such a finding is not at all clear and only further investigation may shed light on the relationship between school type and the ease of surrender task.

## Conclusion

Results need to be viewed with caution because of the limited number of schools and relatively small sample size used in this study. Nevertheless, the present study has shown that firstly, SES and IQ are strongly related. Second, that apart from the Stroop Test, the other experimental tasks do not seem to covary sufficiently with IQ to warrant further investigation. Finally, that

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<sup>4</sup> You have ten minutes in which to try to solve the puzzle that you will be given. The puzzle is extremely difficult. You may use the entire ten minutes to try and work it out, or you may give up on it at any time you wish. You may not ask any questions about the puzzle. Are you ready to begin? Your time starts now.

several of the experimental factors do appear to correlate with each other and as such may benefit from further investigation.

Emotional Intelligence is a slippery concept, with factors which one might intuitively expect to correlate with IQ proving, at least in this study, to be experimentally unsustainable. What is clear is that while the concept of EI may well be pointing to something of great importance, and may be a very much needed corrective to an over emphasis on IQ, clearly articulating it, with a view to developing reliable “EI tests” is going to prove a considerably difficult task. In view of the criticisms that IQ has attracted, we would caution against haste in the development of EI testing.

It may in fact be the case, as suggested by Stein and Book (2000), that the two constructs are not mutually exclusive but rather complementary, in predicting success in life. As such, it may be more fruitful to concentrate on further developing an understanding of EI rather than searching for how it correlates with IQ. Such an approach appears to have found favour with researchers such as Reuven Bar-On (1997) who has developed an EI test in both adult (EQ-i) and, with Parker (2000b), youth (EQ-i:YV) versions.

For now, the final word regarding both the nature of the EI construct, as well as the relationship of EI to IQ, is far from spoken. The best that can be offered, given the present results, is that both constructs are useful in helping to build a student profile.

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## Time-on-Task in Kuwait primary schools

Ghazi AL-Rasheedi

*This paper aims to present information on the proportion of time that a primary school teacher in Kuwait spends on teaching (time-on-task), and how much time is wasted inside the classroom. The paper also aspires to find out the proportion of time that the teacher spends applying different teaching methods like class teaching, group teaching and one-to-one (individual) teaching.*

*A study of third and fourth grade primary (elementary) teachers found that the teachers spend 77.6% of class time on teaching (verbal and non-verbal interaction) whereas the remaining time is spent either on class control or wasted without teaching. The study also showed that primary school teachers in Kuwait spent about two thirds of class time talking in one direction (teacher to student), while pupils are given the remaining third to ask or answer questions, etc.*

### **Introduction**

Time-on-task is one of the subjects that have been frequently and carefully studied in western literature. The concept of quality in teaching has been taken seriously in the west for over 30 years, but only a few studies in Arab literature, and Gulf studies in particular, have tackled the issue of time-on-task (Al-Rashed, 1995; Hammad, 1995; Nashwan, 1989).

The researcher believes that this phenomenon is due to the fact that educational systems in the Gulf countries, including Kuwait, still concentrate on quantity in teaching, and they still measure the effectiveness of their educational systems by digital rather than analytic measurements. In other words, educational systems in the Gulf countries focus on graduating the largest number of teachers

to achieve self-sufficiency as national teachers without paying much attention, at least for the time being, to the competence of these teachers or to their performance in class. This study tries to focus on what happens inside the classroom because that is what really matters (Barr, 1970).

The aim of this study is to observe and report on time-on-task, not to focus on the quality of this time, despite the importance of the latter point which could form the subject of further studies in the future. The objectives of the study are:

1. To identify the proportion of time that teachers in Kuwait spend on-task in the classroom.
2. To observe the proportion of time that teachers spend in different kinds of interactions with pupils.

## **Literature Review**

This section sheds some light on results from various studies regarding the notion of time-on-task. Evidence of the positive effect of time-on-task on the learning process will first be introduced, and then the opposite argument claiming that there is no such positive effect will be reviewed. A comparative description of the two points of view will then be presented. Finally, proportional level of time-on-task in a number of countries will be discussed in order to compare the data in these countries with that of the present study.

### **Arguments for Positive Effect**

Many studies have shown that the time pupils spend learning has a positive effect on their achievements. For example, Maggs and Morgan (1986) argue that they found a positive relationship between the amount of time a pupil spends on task and the number of tasks completed. Further, Bennet (1987, p.51), in his discussion of the “opportunity to learn” model said, “The amount of time a pupil spends actively engaged on a particular topic is seen as the most important determinant of achievement on that topic.”

In her study, Croll (1988) points out that:

The attempts to measure the association between time-on-task and pupil achievement have led to a wide variety of results. Nevertheless, although the strength of associations varies considerably across the different studies, there is a consistent pattern of positive correlation. (p. 90)

Not only does time have to be spent on learning but the pupils also need to be actively engaged in the task. Galton (1987) stressed that studies since the 1970s offer firm evidence to suggest that if teachers want to improve pupils' performance, they must offer warm, highly structured teaching designed to ensure the active engagement of pupils on their tasks.

The environment is also a contributing factor in the pupil learning. Mortimore, Sammons, Stoll, Lewis, and Ecob (1988) reported that a work centred environment is one of the factors that make the school effective. Taylor, Frye and Maruyama (1990) conducted a study to investigate the effects of time spent on reading at school and at home on the reading achievement of intermediate grade students. The study concluded that the amount of time spent on reading during the reading period in the classroom contributed significantly to the reading achievements of students. The study also revealed that, even among good readers, time spent reading at school made a difference in terms of students' improvement in reading.

### Arguments for Neutral Effect

Karweit (1983) reported that the relationship between time use and student achievement is poor. Karweit (1985) further argued that the effects of exposure time on achievement are relatively small. Karweit (1984) also suggested that:

Time is a necessary, but not sufficient, condition for learning. Learning takes time, but providing time does not in itself ensure that learning will take place...

Time spent is not so consistently related to achievement as it may seem. (pp. 33-35).

Hastings and Schwieso (1995) conclude that “Time-on-task is not a measure of learning but of the distribution of time across activities ... It is important to note that time-on-task cannot be taken as an indication of the quality of task engagement” (p.289).

While there is some disagreement about the relative value of time in relation to learning the intersection of this issue needs to be comparatively explored. It appears that there are two different points of view regarding the effect of time on learning and pupils’ achievement. Some researchers argue that there is a positive effect of time on learning, whilst others refute such an effect.

I agree with Karweit (1984) in her suggestion that time is a necessary, but not sufficient, condition for learning. In other words, as Leach and Tunnecliffe (1984) put it, “It is not the amount of time allocated to academic work that is important, but rather the ways in which that time is used” (p. 128).

He also agrees with Fredrich and Walberge (1980) that time spent on learning is only a modest predictor of achievement. This means that time is important and essential for learning but there are other variables that also influence learning. Time can play a role in the achievements of the pupils only if it is used in a proper way.

### **Time Spent on Classroom Teaching**

There are many examples in the research that discuss the issues of time-on-task and classroom teaching. Veenman, Lem and Winkelmolen (1985) recorded time-on-task levels among Dutch primary grade pupils as being between 66% and 80%. Merrett and Wheldall (1987) reported the levels among British primary and secondary school pupils to be 69.68%.

Conversely Mortimore et al. (1988) suggested that the total proportion of time spent not interacting rose from 15% in the first year of school to just over 21% in the third year. Part of this time

was spent dealing with external interruptions, such as pupils delivering messages or requesting help. On a broader scale Galton, Simon and Croll (1980) found that teachers spent 56% of their time interacting with individual pupils, 8% interacting with groups of pupils, 15% interacting with the whole class, and 22% without interaction.

Finally, McPake, Harlen, Powney and Davidson (1999) found in a study carried out in Scotland that teachers spent 82% of their time on teaching and related activities. However, recording and assessing pupils' work were rarely observed. Non-curricular activities took 18% of teachers' time in the classroom.

This broad range of results across these studies indicates that time-on-task is highly rated but the issue of non-learning periods also varied and could prove vital in this study of time-on-task .

## **Research Questions**

The study aims to answer the following questions:

1. What proportion of time do primary teachers in Kuwait spend on-task in the classroom?
2. What proportion of time do primary teachers spend on-task according to the following variables: teacher gender, school location, subject matter and class size?
3. What proportion of time do teachers spend in different kinds of interactions with pupils?

## **Sample**

Ninety-one third and fourth grade primary teachers participated in this study. Twenty-seven of them were male and 64 were female. Twenty-eight of the female teachers taught in boys' schools and the other 36 taught in girls' schools. Participating

teachers represented a simple random sample. They came from three educational areas: the Capital (26), Farwaneyah (35), and Al-Ahmadi (30). They taught three different subjects: Mathematics (33), Science (25), and Arabic (33).

## **Method**

An observation was conducted to find out what time was spent on actual teaching (time-on-task) in the classroom. A structured technique was used to monitor classroom events. These events were classified into two kinds: time-on-task and teaching directions. Each type had many items, and these items were listed in a checklist. In total there were ten items in the observation list, and 91 observations were made. The observation items have been adopted from the IEA classroom environment study (Anderson, Ryan & Shapiro 1989). The original observation items were first discussed with other colleagues in the College of Education, University of Kuwait, to check their validity and suitability for the local Kuwaiti culture, and consequently some modifications were made.

The observation of 91 teachers took place within two months from 1<sup>st</sup> February to 1<sup>st</sup> April 2000. In order to analyse the data collected by the observation a comparison of two independent sample proportion techniques was used.

## **Results**

The results of the study will be presented in the same order in which the research questions were presented.

### **Proportion of time primary teachers spend on-task in the classroom**

Time-on-task of the whole sample and for all teachers participating in the observation is shown in Table (1). It shows that the time that teachers spend on verbal interaction (teaching) amounts to 60.3% of the total class time, and the remaining time is spent on other activities such as class control (17.4%), non-verbal

(silent) interaction with pupils (17.3%), and wasted time (5.0%). By adding up verbal interaction time to non-verbal interaction time, we realize that the proportion of the total time teachers spend on teaching amounts to 77.6%, or 35 minutes of the whole class time (45 minutes), while wasted time adds up to 22.4% (10 minutes of class time).

Table 1. Time-on-task in General

Time-on-task	%
Time spent on disciplinary activity	17.4
Time spent on verbal interactions	60.3
Non-verbal interactions	17.3
Wasted time	5.0

**Proportion of Time Primary Teachers Spend On-Task According to Some Variables**

**Teacher gender variable.** The results (see Table 2 below) show that there are statistically significant differences between male and female teachers as to the time they spend on class control and verbal interaction. Female teachers spent more time in class control (20%) than male teachers (9.7%). On the other hand, male teachers spent more time in verbal interaction (66.8%) than female teachers (58.1%).

Table 2. Time-on-task According to Teacher Gender Variable

Time-on-task	Male	27	Female	64	Z
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	Sum	%	Sum	%	
Time spent on disciplinary activity	24	9.7	146	20.0	3.685 <sup>a</sup>
Time spent on verbal interactions	165	66.8	424	58.1	-2.421 <sup>a</sup>
Non-verbal interactions	43	17.4	126	17.3	-0.053
Wasted time	15	6.1	34	4.7	-0.881
Total	247	100.0	730	100.0	

Note. Statistically significant at 0.05 percent level.

**School location variable.** The findings illustrated that there are statistically significant differences between teachers in the Capital and Farwaneyah Educational Areas on the one hand, and those in Al-Ahmadi Educational Area on the other as far as times spent on class control and verbal interactions are concerned. Teachers in Al-Ahmadi Educational Area spent over a quarter of class time (25.3%) on class control and just over half class time (52.4%) on verbal interaction. Teachers in the Capital and Farwaneyah Educational Areas spent significantly less time on class control

(12.7% and 12.8% respectively), and significantly more time on verbal interaction (63.3% and 66.0% respectively).

**Subject variable.** The time spent on verbal interaction is almost similar to that spent on non-verbal interaction among teachers of Mathematics, Science, and Arabic. Science teachers spent more time on class control, but the differences are not statistically significant. The only statistically significant differences are in wasted time (no-interaction), where Math teachers are found to waste more time (7.9%) than Science and Arabic teachers.

**Class size variable.** The study demonstrated that the time teachers spent on task does not vary a lot according to class size. They spent almost the same times on class control and verbal and non-verbal interactions, regardless of whether they teach a class that includes 25-30 pupils or 31-35 pupils. There is a statistically significant difference, however, as far as the wasted time is concerned, where it increases when class size is between 25-30 pupils.

### **Proportion of Time Primary Teachers Spend in Different Kinds of Interaction with Pupils**

Table 3 shows the teaching direction of the verbal interaction that occurs in class between teachers and pupils. Since we have already stated in table (1) that the time spent on verbal interaction is 60.3% of total class time, we will focus here on the teaching direction during that time. Generally speaking, the time teachers spend on verbal interaction with pupils (be it on individual, group, or class teaching) is 68.1% of total class time, which means that teachers spend more than two third of total class time talking to pupils in one direction, whereas pupils are given just under one third of class time (31.8%) to interact through answering questions posed by teachers or similar activities.

A closer look into the teaching direction from teachers to pupils reveals that teachers spend the largest portion of time on class teaching (40.5%), followed by individual teaching (23.3%), and then by group teaching (4.3%).

As for pupils' interaction with teachers, it is noted that the class as a whole interacts most (15.1%), followed by individual interaction (13.5%), and then by group interaction (3.2%).

Table 3 Time Spent on Teaching Direction in General

<b>Teaching Direction</b>	<b>Percent</b>
Teacher to student	23.3
Teacher to group	4.3
Teacher to class	40.5
Student to teacher	13.5
Group to teacher	3.2
Class to teacher	15.1

**Discussion**

**Time-on-Task.** Primary school teachers in Kuwait spend 77.6% of total class time on teaching activities (verbal & non-verbal), while wasted time amounts to 22.4%, as it has already been shown. Time-on-task in Kuwaiti schools, regardless of its quality, is similar to that in UK schools (Mortimore et al 1988, Galton et al 1980) and Scottish schools (McPake et al 1999).

Furthermore, the present study has shown that time-on-task according to teacher gender variable indicates that the time spent by female teachers on non-curricular activities, such as class control or wasted time with no interaction, amounts to 25% compared to 15.8% in the case of male teachers. This could be due to the fact that female teachers need more time to control the class than male teachers do, and this affects time-on-task. The relatively longer time that female teachers spend on class control may indicate that either they face more problems in class control than their male counterparts, or that the methods they use in class

control are different from the methods used by their male colleagues. Male teachers, for instance, may rely on tough tactics that enable them to control the class relatively faster, while female teachers may resort to more lenient tactics that may take longer to bring about results.

Time-on-task according to school location shows that there are statistically significant differences between teachers in the Capital and Farwaneyah Educational districts on the one hand, and teachers in Al-Ahmadi Educational district on the other. These differences indicate that school location affects time-on-task in the classroom. The Capital and Farwaneyah are urban areas, while Al-Ahmadi is a rural Bedouin area. Results indicate that it might be easier to control classes in urban areas than it is in rural or Bedouin areas.

As for time-on-task according to subject variable, it has been found that Math teachers waste more time than other teachers in the classroom. This finding is rather surprising given the importance of Mathematics, and the concentration that this subject requires from teachers and pupils, yet wasted time has been found to be as high as 8%.

This study has shown that, generally speaking, class size has no effect on time-on-task. However, this finding should be treated cautiously because of the closeness in the number of pupils in the observed classes. The average number of pupils in classes between 25-30 pupils was 28, and the average number of pupils in classes with more than 30 pupils is 32. Therefore, the numbers are quite close and the difference cannot be considered high. However, had there been classes with less than 25 pupils, our results would have probably been more reliable.

**Teaching Direction.** Observations of teaching direction in primary school classrooms in Kuwait show that teachers use about 70% of class time talking from one side (teacher to pupil), leaving about 30% only for pupils' participation. This reflects the instruction and lecturing methodology used commonly in Kuwaiti

schools. Moreover, the time used by the teacher on talking to pupils is mostly spent on class teaching, whereas group teaching, as the study has shown, is hardly evident among the sample studied.

## **Conclusion**

This study aimed at answering four specific questions relating to the subject of time-on-task. It found that Kuwait teachers, on the whole, spent 77.6% of class time on teaching (verbal and non-verbal interaction), whereas the remaining time was spent either on class control or wasted without teaching. Results were also considered for the variables of teacher gender, school location, subject matter, and class size.

As for school location, it has been found that teachers in urban areas (the Capital and Al-Farwaneyah) spent more time on teaching and less time on class control than their counterparts in rural and Bedouin areas (Al-Ahmadi).

Teachers of the three subjects observed (Math, Science, and Arabic) spent similar times on task (verbal and non-verbal interaction). Math teachers, however, have been found to waste more time teachers of the two other subjects. Class size has shown no effect on time-on-task in this study.

On the other hand, it has been shown that primary school teachers in Kuwait spend about two thirds of class time talking in one direction (teacher to student), whilst pupils are given the remaining third to ask/answer questions, etc.

The results derived from the present study can be usefully applied in the field of teacher education in Kuwait. The results could be used as a subject in the in-service training. Some useful topics could be selected from this study such as the proportion of time Kuwaiti primary teachers spend on-task in the classroom and the proportion of time teachers spend on different kind of interactions with pupils.

Pre-service and in-service training could incorporate discussion on some of the behaviours of effective teaching that have emerged from the time-on-task results in an effort to guide student teachers towards a more effective teaching style. Finally the school inspectors in Kuwait could use the results of this study to guide their teachers to focus more on the quality of teaching inside the classroom and to pay more attention to the time while they are teaching in order to minimize the wasted time.

The researcher recommends that the Ministry of Education in Kuwait hold a training course for primary teachers in how to use group styles of teaching in the classroom, as the study has shown that its hardly evident among the primary teachers in Kuwait. The researcher believes that female primary school teachers should learn more about the skills of allowing more pupil participation, diversifying their teaching methods, and using class time in a more useful way. These skills are essential for both male and female teachers, but they are more urgent in the case of female teachers because there is an official policy in Kuwait that aims at making all primary school teachers in Kuwait female by the year 2005. This necessitates more concentration on raising the professional standard of female teachers through training them on group and individual teaching methods, allowing more time for pupil participation, encouraging self-learning, and so on.

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## Dual Language Classrooms: Acquiring a Second Language Through Science Content Study

Anna Mazzano and Jacalyn Willis

*Many schools in the United States are facing the challenges of educating large numbers of limited English proficiency students. Even though bilingual education and dual language education have been part of the educational system for a very long time, the controversy about the effectiveness of various kinds of language education is still an important issue in school systems in the USA. Language-study programs have been in place throughout the nation's history but most of them have not succeeded in their goal of teaching English to students for whom English is not their first language. Likewise, goals of teaching second languages to native English speakers have not been broadly successful. The rise of multinational corporations, the increasing importance of international trade, and the American dependence on global relationships, has awakened Americans to the need to teach second languages to English-speaking Americans, yet the workforce to do this job is not prepared.*

*We propose that by adding the teaching of engaging and relevant subject content such as science, and utilizing teaching methodologies that address diverse learning styles, students learn the languages more effectively than when the focus is solely on language acquisition. The PRISM (Professional Resources In Science & Mathematics) Centre of Montclair State University is assisting school districts in implementing dual language science programs that model effective approaches. When students are involved in hands-on activities*

*and investigations in two languages, students learn science content as well as a second language. The PRISM staff support such programs by providing teacher training in science content and pedagogy as well as language instruction in English and Spanish. Teachers enhanced in language and science instruction are the workforce through whom PRISM fosters the development of after-school enrichment “dual language science programs” that include careful curriculum planning, field trips, and parental participation.*

### **Some Educational Challenges in the USA**

Since colonial times in the USA, children have been taught foreign languages. The use of languages other than English in the curriculum has often been a matter of discussion and controversy. The rise of multinational corporations, the increasing importance of international trade, and the overwhelming influx of immigrants to the United States have all contributed to a renewed awareness of American dependence on global relationships. In addition, schools in the USA are increasing in numbers of students every year, through both births and immigration. Of the total number of students, a great percentage is linguistically and culturally diverse. Teachers throughout the United States are faced with the challenge of educating children with limited English skills. There is also the larger question of foreign language instruction in the United States, which has seldom been vigorously promoted. In a country that is becoming more diverse every day, and in a world that is changing quickly, the citizens of the United States should consider more foreign language instruction, not less. Although foreign language study has been a regular part of secondary school curricula, the emphasis has not been on truly bilingual educations (Cummins & Swain, 1986). Sometimes bilingual education has been a special feature of some private and public school programs in the nation's long-term history, but never a broad common goal. Further limiting the possibilities for bilingual education, is the “English Only” movement that started in California a few years ago and has spread

to other states. Most of these states have opted for no bilingual education for Limited English Proficiency (LEP) students. All of these factors have contributed to handicapping the language proficiency of students in the USA, leaving them in a disadvantaged position relative to students from other countries that value foreign language study.

## **RESEARCH OVERVIEW**

The 1979 President's Commission of Foreign Language and International Studies was the first of a series of commissions on education to highlight the serious situation created by the lack of foreign language skills among Americans (Curtain & Pesola, 1988). Its specific recommendations included the urging of language study in the elementary school and the development of curricula dealing with other countries and cultures. Today, in the United States different programs focus on the development of the teaching of foreign languages.

### **Approaches to language education.**

There are two major approaches to language acquisition. The first involves **bilingual education programs**. These programs are designed for language minority students whose first language is other than English. The students in the bilingual classrooms are from the same language minority group but differ in language proficiency. In the early years, students receive instruction in their first language while they also attend lessons in "English as a Second Language." As the program progresses, English instruction is increased to not more than 50% of their total hours of instruction while the first language is maintained.

The second involves **dual language programs**. These programs have been established in many schools across the United States. In these programs children develop language proficiency by receiving instruction in English and another language in a classroom that is usually composed of half native speakers of English and half native speakers of the target language. While researchers of dual language describe a great deal of variability that

exists between different dual language programs, they also indicate that most dual language programs have these three goals in common (Lyon, 1988):

1. Help students develop high levels of proficiency in their native and a second language.
2. Enable students to perform at or above grade level in academic areas in both languages.
3. Assist students in acquiring positive cross-cultural attitudes and enhanced levels of self-esteem.

In both programs, bilingual and dual, language is taught with strict language separation. Simultaneous translation is discouraged; gestures, eye movement, visuals, and concrete materials are encouraged in these settings. Given the high levels of cultural and academic diversity in US schools, there is interest in knowing whether one type of program (bilingual or dual language) is more effective than the other. For foreign language speaking students, is it better to be placed in a monolingual class where they will be exposed only to English instruction and “sink or float” in the system? For monolingual English speaking students, do the disadvantages of a dual language program outweigh the advantages of the opportunity to succeed in international business?

Researchers (Snow, Met & Genesee, 1989) found that developers and teachers of dual language programs stress the importance of students learning language primarily through content. These researchers suggest that language is best developed within a content-based curriculum, rather than as the focus of classroom instruction. With appropriate second language instruction, students can achieve academically at higher levels in the second language than if they had been taught in the second language only. Thus, students who learn content in one language can be expected to demonstrate content knowledge in the second language, as they acquire the language skills to express that knowledge. Also, the social interaction combining native speakers of the language and learners of the language in the same setting,

promotes opportunities for language acquisition and development. Students can help each other and exchange ideas and solutions to problems, further improving language skills. This approach supports the ongoing development of the students' native language skills while a second language is being learned.

### **Importance of content.**

It has become increasingly evident in the decades since the first Canadian language immersion programs were implemented in the 1960's that language is learned best when it is the medium of instruction rather than the goal of instruction (Krashen, 1994). Children who learn language as they work on academic tasks engage in purposeful discussions within meaningful contexts. In other words, students explain, describe, solve problems, and ask questions about social studies, math, science, and so forth (Met, 1985). In dual language settings, students learn language while learning content, because there is a real need to communicate while engaged in content-related tasks. Dual language students tend to learn language better than those who study the language as a subject alone.

These programs aim to achieve both language and content acquisition, and have generally effective academic goals. The dual language curriculum is content based and focuses on the development of strong academic achievement in both languages. Because students learn content through a language they do not speak natively, techniques that make instruction more comprehensible are preferred. The strategies teachers use most often include experiments or hands-on activities, thematic units, peer interaction, multiple cues that give students additional chances to master concepts, and "whole language" approaches.

### **Applications.**

Dual language programs have many advantages for minority as well as majority students, making these programs a natural match for teaching in communities with high populations of non-English speakers. Montclair State University's PRISM (Professional

Resources In Science & Mathematics) is an academic centre within the University that supports the implementation of various school and professional development programs. Recently, the staff of PRISM has established dual language school-day and after-school programs in science. PRISM provides dual language science professional development institutes, workshops, and curriculum advising.

Several local school districts have large Hispanic communities that include many children for whom English is a second language. The dual language science project includes teachers and students from elementary grade levels. The children and teachers are already part of a bilingual setting in their schools and neighbourhoods. After-school enrichment projects are supported by grant funding obtained by PRISM and matched by funds from the schools. The funds pay for extra work done by the teachers, their dual language curriculum materials, the hands-on science materials, and their professional development sessions. Each after-school project is managed by a team of two teachers overseeing one group of 30 students. At least one team member is a native Spanish-speaker, and the team designs the specific units of science investigation and the parent and student programs. The program design allows for considerable flexibility and variability among school teams so that they may take ownership of their program. The project is designed to have a ripple effect, impacting entire classes beyond the scope of the customary after-school programming. Since the dual language program is content based, the program offers inviting and exciting ways for the teachers to re-tool their science content understanding as well as language skills in both English and Spanish, and try new approaches in a non-threatening environment.

PRISM after-school science programs have always included components of professional development, excellent science curriculum, school implementation teams, after-school science clubs, and Saturday field trips with parents. Because the professional development of teachers is very important to the success of the program, teachers in the dual language science programs are required to attend training in the areas of:

1. Science content and hands-on, inquiry-based science teaching approaches.
2. Dual language teaching methods and techniques, including the methodology of teaching language through content.
3. Inquiry and constructivism: that is, learning through investigation, posing questions, gathering information, finding patterns, formulating hypotheses, and always starting from prior knowledge to construct new concepts.
4. Creation of teaching materials for second language instruction, oriented toward content as well as the language.

Because dual language programs present their content in a language that students are learning, language teachers need to include hands-on activities and materials that support the content to be learned. PRISM, in conjunction with CAZ Literature, a teacher-run language curriculum design group, has designed workshops to train teachers to teach science content in a second language. Teachers from different school districts have participated in workshops on a variety of science units. Some units that have been converted effectively into dual language modules include standard curriculum components such as: “Weather & Seasons,” “Parts of the Body & Senses,” “Rocks & Minerals,” and “Plants & Soils.” All the units are inquiry-based, meaning that students learn to predict, formulate hypotheses, pose questions, graph data, measure, keep journals, and share their findings. In the dual language program, all is done in a second language. These units are also supported with language arts, social studies, and math materials, since science is taught in conjunction with other content areas.

PRISM professional development workshops are organized to guide the teacher teams in managing and designing their school programs. The teacher participants actively learn in the workshops through hands-on activities, making predictions, and posing

questions. Workshop instructors take the role of facilitators. They begin by assessing participants' (teachers') preconceptions, then building new concepts on past experience. They use concrete materials, pose questions and/or problems to encourage inquiry, help teachers reflect on their own thinking, and encourage the evaluation of their own findings. Participants often play the role of students and go through the process that students follow in order to learn new concepts. Since science is an active process, most students and teachers enjoy learning science and become very involved in the content they are learning while they are immersed in a second language. At the end of the workshops, teachers usually express their excitement at how many engaging activities they are able to do in a dual language class without decreasing the quality and depth of the science content. Below are some comments from teachers who participated in dual language science professional development workshops:

“This workshop helped me have a better understanding of how to integrate science into the world language program through hands-on activities.”

“Today’s workshop gave me great ideas on how to incorporate science in the classroom and create a fun and interesting lesson.”

“The presenters stressed their presentations on content that is very useful because [it] reinforces what the students are learning in the classroom. The activities were hands-on which motivate the students to get involved and get the most vocabulary and use of the target language.”

Teachers recognized that students will become engaged in these activities and will learn new concepts because the teachers themselves were engaged during the training.

## **Conclusion**

Dual language teachers need to be extensively trained in both content (such as science) and pedagogy. Professional development

cannot be a quick solution to be accomplished in a few sessions. Extended professional development should be implemented in depth over a period of years, so that teachers have the time to be trained and apply what they have learned. In addition, professional development ought to include coaching and classroom mentoring. Assisting teachers in their own environment, with their own students, is a strategy that helps teachers become more confident. Mentoring and coaching offer the opportunity to interact, share ideas, and receive feedback from more experienced professionals, an exchange that is much needed to train better teachers. If regular school-day or university-based contexts do not work for re-tooling teachers, then another opportunity can be created by offering after-school program development with associated incentives and support services. Creative solutions are important in preparing teachers to become effective in the classroom, a necessary first step to meet the challenges of our constantly changing world.

“All children can learn” may be true in a variety of learning contexts, but it seems that this truism may not apply in the case of learning a second language fluently. All children can learn a second language, perhaps, if educators provide the necessary conditions to help students become proficient in a second language. Many language programs fail not because students cannot learn a second language but because teachers are not trained properly, because administrators are not aware of the benefits of learning a second language, and because parents are not well informed of the advantages of learning another language. If dual language proficiency is to be achieved, then authorities, administrators, teachers, parents, and communities must become aware of the advantages, methodologies, and needs for learning a second language and must get more involved in schools to help implement language programs.

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