Synergetic Environments for Mathematical Development: Fact or Fiction – Myth or Reality?

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The demands of society and citizenship of any nation in the 21st Century seem immense. Citizens of any country are required to handle a pace of change that is ever increasing in speed and complexity. Unfortunately many world citizens are challenged by the needs of basic survival and day to day living. Others sometimes fail to appreciate the richness of a world of peace and tranquillity. Facilitating the development of basic functional skills, and beyond, in students of the fast-paced twenty-first century seems fraught with challenge and frustration. Some are fortunate to have the aid of technology; yet for others this is an extreme luxury.

This paper will discuss a humanistic view of the international climate of education, the growth of the term numeracy and developments within the western world of mathematics education for the young learner. Models of action to foster the development of an effective learning environment will be discussed together with proposed amendments. The learning environment at the beginning of a new millennium provides an extra opportunity to evaluate what has previously been attempted and what may yet come for the learner. Can an atmosphere of pessimism and disillusionment be turned to one of optimism, hope and dreams?

The learning environment for educators at this millennia time does provide tremendous opportunity for extra reflection and evaluation. However, the millennium world and climate and requires its citizens' to be able to handle change at a much more rapid pace of change than ever before. Technology in all areas of life is responsible for much of that. Citizens are now required to have much more than basic skills to be full citizens of the world community. They are required to have literacy skills which are far broader than basic reading and writing; an older definition of literacy.

The international discussion for a broader definition of literacy to include numeracy began in 1990 at the World Conference on Education for All in Thailand, which issued a declaration stating that: -

> "These needs [learning needs] comprise both essential learning tools (such as literacy, oral expression, numeracy and problem solving) and the basic learning content (such as knowledge skills, values and attitudes) required by human beings to be able to participate fully in development, to improve the quality of their lives, to make informed decisions and to continue learning."[1]

This was followed in 1996 with UNESCO's International Commission on Education for the Twenty-First Century. The Commission requested that Member States of the United Nations make available resources to foster partnerships and action which would serve peace and mutual understanding by emphasising the value of education as a demonstration of a desire to live together as active members of a global village. Since that time various countries around the world have had their own follow-up Commission. Canada's Commission titled its' report "Learning Together throughout Our Lives" which was passed on to other partners of the Canadian educational community which included national and provincial teacher groups.

Around the world there is little difference between definitions of numeracy. The level of proficiency of language that now needs to be used has increasingly incorporated numeracy to form a broader and timely definition. The definition referred to here will be that developed by the British Columbia Association of Mathematics Teachers (BCAMT) and adopted by the British Columbia Ministry of Education. Numeracy can be viewed as "…the combination of mathematical knowledge, problem solving and communication skills required by all persons to function successfully within our technological world."[2] Therefore the literate citizen of the 21st century is asked to have abilities that utilise written information of all kinds in order to function in society to achieve their goals and from a humanistic perspective, those of other individuals and societies, and to develop their knowledge and potential Increasingly from the early 1990's attention and research has studied and evaluated the learning of young children in their early years. Early childhood

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[1] Delors, Jacques, Ed., *Learning: The Treasure Within – Report to UNESCO of The International Commission on Education for the Twenty-first Century*, Paris, UNESCO Publishing, 1996, p.25.

[2] British Columbia Association of Mathematics Teachers, Numeracy Brochure, (1999)

studies have long indicated the early years of children are a time of profound change. Indeed the new Principles and Standard for School Mathematics issued by the National Council of Teachers of Mathematics (NCTM) in April 2000 states "At no other time in schooling is cognitive growth so remarkable." [3] This increased attention has not just confined itself to one particular area, either early childhood studies or literacy or mathematics education. Studies and programmes have long been in existence in many parts of the world to help young children to learn; Reading Recovery programmes have been adopted in many educational jurisdictions in BC, Canada; Head Start and Smart Start programmes take place in many regions of the United States.

Societally the value placed on supporting the young learner is being understood and appreciated more such that awareness is growing about the commonalties between the areas of study and research. It has been agreed among researchers for some time that the early years of development from before birth to age six affect learning, behaviour and health not just in the early years but throughout life. The newer awareness and recognition is particularly noticeable politically on both national and international stages around the world. Indeed governmental jurisdictions within Canada are working together on research activities, which have been designed to assist governmental departments to formulate policies and action plans.

Of particular note is a longitudinal study taking in Canada, the Understanding the Early Years - Helping our Children Succeed, taking place in a number of communities across Canada. This community based research project is funded by the federal department of Human Resources Development Canada (HRDC) and Statistics Canada. It is significant that the study is a community-based project, with three important questions as its focus: - How many children are ready to learn at school by age six? What challenges did they face? How can parents, communities and governments help children succeed?

It is recognised that parents and guardians cannot "educate" their children alone. Support is needed from the wider community and society in creating values and action plans that will foster the development and learning of young children. Included in this initiative are community agencies, parents, guardians and teachers who have been working together to look at how well young children are doing, and how each partner in the community can play a role in helping children develop and learn. Indeed it is regarded that: - "Community involvement in this initiative recognises that parents and guardians are the most important people in children's lives. Parents and guardians are responsible for the care, nurturing and protection of their children. They make decisions regarding their children's health, education and well being. They are their children's first teachers". [4]

The teachers role in this study is for kindergarten teachers to complete a questionnaire on each child in their class based on their observations: Early Development Instrument which measures how well children are doing at the group level, not at the individual level. It is particularly notable that the Instrument has ten questions that specifically relate to the learning and development of numeracy skills. [5]

The specific topic of early numeracy development is very timely not just in British Columbia but in many countries around the world. The United Kingdom has its' national programme, The National Numeracy Strategy, and the Australian has the Early Years Research Project in the state of Victoria. Many other regions around the world have similarly been paying attention to numeracy development in the early years. Most of these initiatives have been preceded by research which has given greater insight into how much children are learning even before they are able to communicate symbolically their ideas. Increased recognition it being paid to the logic that is behind young children's answers and actions.

Mentioned earlier, the new Principles and Standards document of the NCTM has indeed now separated the early years of children's development into a separate grade band of Pre-kindergarten to Grade Two. It was felt that it would be possible to more specifically examine children and their mathematics learning and develop content that would be appropriate for, and of interest to, children of these ages. In addition, it was felt that discussion of the transition from informal understandings and the more formalised

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[3] National Council of Teachers of Mathematics, *Principles and Standards for School Mathematics*. Reston, Virginia, April 2000, p.75.

[4] Human Resources Development Canada & Statistics Canada, *Understanding the Early Years: Helping our Children Succeed,*
Brochure (2000).

[5] The Canadian Centre for Studies of Children at Risk, *Early Development Instrument, (2001)*.

mathematics that takes place in "traditional" school settings could take place. It is important for the success of any undertaking to contextualise the environment in which endeavours are undertaken, both in the formative research stages and in any subsequent action plan that might be developed. Much can be learned, however, from similar undertakings elsewhere thereby allowing for succinct utilisation of resources in the local context. And potential gains can be significantly enhanced by consideration of the overall climate of endeavour both globally and nationally. The Delores Commission cited earlier saw education charged with a global responsibility: -

"Education thus has a special responsibility to exercise in the building of a more mutually supportive world, and the Commission takes the view that educational policies should forcefully reflect that responsibility. Education must help to engender a new humanism, one that contains an essential ethical component and sets considerable store by knowledge of, and respects for, the cultures and spiritual values of different civilisations, as a much-needed counterweight to a globalisation that would otherwise be seen only in economic or technological terms. The sense of shared values and a common destiny is in fact the basis on which any scheme for international co-operation must be founded." [6]

Such is proving to be the case in BC, Canada. Although small in comparison to the British and Australian initiatives, the Early Numeracy Research Project (ENRP) is very much in accord with the needs and interests of the young student in British Columbia in the global context of early childhood development. The ENRP began as an initiative of the BCAMT to highlight the importance of a successful start to mathematics learning for all children, but especially children at risk. Following the June 1999 report of the BC Mathematics Task Force, proposals were sort for projects that addressed early or emergent numeracy. Beginning in January 2000, the ENRP has recently completed stage one of the three year research-based project which is the first project of its' kind in Canada. Heather Kelleher of the University of British Columbia, is principal co-ordinator of the ENRP, which has established five goa ls: -

1. Examine current research and practice in early mathematics teaching and learning to establish What constitutes early numeracy and how best to assess, recognise and support its development, particularly for the at-risk learner.
2. In light of current research an practice in the area of early numeracy, develop, pilot and refine strategies for assessing levels of numeracy of grade K\1\1 students and for recognising at–risk learners.
3. In conjunction with the assessment work and in light of current research and practice, use action research to develop, pilot and refine instructional strategies appropriate to supporting the numeracy development of K\1\2 at-risk learners.
4. Develop an instructional resource package for teachers to support the numeracy development of at-risk learners in the classroom.
5. Develop a companion program for parents to use in supporting the development of numeracy at home.

To date the BC Ministry of Education has allocated $100,00 for completion of this project with in-kind support from UBC and each of the currently six participating school districts involved in the project. At the end of the first stage of the ENRP, work is currently between goals two and three stated above. Materials for assessment and instructional components will be field tested to wider group than the original six school districts beginning in September 2001. Perhaps the richest area for potential gain however, is to come in the third year of the project when goal five, the companion programme for parents, is further developed.

It is without dispute that parents are a valuable resource in supporting their children's early learning years. As such it would seem easy to give parents some suggestions, perhaps some resources, and get them to help their children learn. Yet the general optimism of such calls for parental support in mathematics learning of the 1990's has not lead to as much improved student learning and success as might have been expected. Blending the two together would not have seemed much of a problem. Why and where did the optimism subside?

Recent research has however pointed towards some significant areas for serious reflection for mathematics educators (e.g. Anderson [1998]; Peressini [1998]). As teachers were given more resources with which to

[6] Delors, Jacques, Ed., *Learning: The Treasure Within – Report to UNESCO of The International Commission on Education for the Twenty-first Century*, Paris, UNESCO Publishing, 1996, p.50.

educate students for the technological world of the coming twenty first century parents were even more distanced then previously seen with perhaps one of the most intimidating curriculum subjects to many parents, mathematics. Both Anderson and Peressini argue that the promise of the 1990's failed because the projected roles that parents could take and perform in mathematics reform and support did not take into account the parents perspective and needs, and were too abstract. Peressini goes as far as to suggest that the National Research Council portrayed parents as stumbling blocks for reform in mathematics, and likewise students themselves were to blame because they failed to recognise the importance of a sound mathematics education. What is clearly pointed out however, is that the professionalisation of teachers and standardisation of the mathematics curriculum created further distance between parents and meaningful support to their children's learning.

The last thing that is wanted for successful student learning is the alienation of *any* of the three key partners in learning; namely student, home and educator. Rather than have a top-down approach from mathematics educators, as the supposed experts, an approach where the needs and roles of all parties are considered and respected would seem logical. As a first step Anderson believes it is essential that there be a reduction in teachers claims to authority and that a validation of parental contributions be made. Communication must be two-way and mutually respectful.

Although there are a variety of models for developing communication between home and school, the model which demonstrates most promise for fostering the development of early numeracy skills, is that proposed by Mick Coleman and Charlotte Wallinga for general family involvement in early childhood (Coleman and Wallinga 2000). The potential for success in the interpersonal approach proposed by Coleman and Wallinga is clearly demonstrated in the use of Abraham Malow's exemplar presentation of human needs. It provides a basis for understanding families' interactions with educators and administrators. Maslow uses a premise of five basic human needs, as set out in figure one, organised in a hierarchy by which individuals set life goals.

Maslow's Hierarchy of Needs

1. Physiological Needs
   High priority is placed on the most basic physiological or survival needs, e.g. clothing, food and housing.
2. Safety Needs
   Safety needs can be both emotional (e.g. insecurity, emotional abuse) or physical e.g. physical, neighbourhood, crime.
3. Belonging Needs
   Once safety and survival needs are met a search is begun for a sense of belonging with others and also for a sense of acceptance.
4. Esteem Needs
   Considered a higher-order need, esteem makes a person strive for a sense of self-confidence, accomplishment and assertiveness.
5. Self-actualisation Needs
   The last and highest order need in Maslow's hierarchy has two characteristics, self-confidence and creativity. It is demonstrated through assertion of rights and informed, creative suggestions and respectful questioning of the status quo.

Figure 1

Coleman further suggests that training be given to educators to facilitate the development of family involvement programmes (Coleman 1997). Taking the time to come together to discuss family involvement and to develop a mutually respectful family involvement philosophy allows for common ground to be found. This will in turn allow an important message to be sent throughout a school and community that family involvement is highly valued. From this philosophy statement, a list of distinct goals and methods by which to achieve these goals can be established. Included in the formation of goals should be a statement of the roles and responsibilities that each of the partners of learning has. Once these steps have been taken it would not be difficult to establish specific tasks or activities with which families can assist their children's development.

Developing a Family Involvement Programme

Step 1
Brainstorm with a mixed group of educators and parents the type of family-involvement programme that suits a particular context (school).
Responses are very much dependent on the needs and interests in the setting and allow for an understanding of shared values as well as diverse needs .
Step 2
After the initial step the partners are ready to identify the key goals that will define their FI programme. By having some goals and questions group discussion is more focused and meaningful.
Step 3
Once the needs and interests have been formed into some defined goals it is possible to develop a philosophical statement by which the FI Programme can operate.
Step 4
Develop some specific activities and suggestions which can support a child's learning both at home and at school.

Figure 2

By using a process, as suggested with the four steps above, firmly grounded in Maslow's hierarchy of needs the potential for enhancement of a student's early numeracy development is clearly demonstrated. Mutual respect and clarity of roles is clearly demonstrated at every stage to all the learning partners.

There are is no shortage of suggestions for specific activities that families can use to enhance mathematical development but only recently have activities been suggested for the development of early numeracy, and many do not reflect the needs of all learning partners according to Maslow's hierarchy of needs. Many parents who would be taking part in a humanistically styled family involvement programme would not have been raised with the broader view of mathematics, now in general use, at least in the western world. It is essential therefore that suggestions for support activities be based even more in a relevant and real-world context. The more that activities for the young learner are reflective of their own lives, and that of their parents, the more likelihood are both the child and parent to become engaged and stimulated by the task. Liedtke (2000) appropriately suggests that rather than specific activities, that the young learner be engaged with regular household activities with their family rather than in specific mathematical activities. Communication, listening and speaking, using both the language of the young learner and the appropriate adult language of a situation (e.g. how many do we have, what do we need to add?) will allow children to see that often there is more than one correct answer. It will allow them to develop a sense of numeracy appropriate to *their* world.

It is essential that teachers, including mathematics educators, do not lay sole claim to being *the* authority on learning or on the content of the said learning. If anything it is parents who should be claiming that they are their children's first teachers. Educators are continuing a task already begun. Liedtke (2001) eloquently expresses a humanistic sentiment that "Fostering the development of numeracy is a precious gift than can be nurtured by parents."[7] Technology, funds or resources do not limit the contribution that a parent can make. It is not limited by geographic location, but rather by the recognition and acknowledgement that their support to their child and the child's development with early numeracy is truly a cherished gift that can last a lifetime.

Early numeracy lays a foundation for hope within education. By beginning early in a child's life to nurture a fundamental area of learning preventative than prescriptive measures are taken. Too many students at all ages and stages of their education, and too many adults throughout their lives are not given an opportunity to develop an accurate awareness and some skills about a tremendously enriching topic, mathematics. Numeracy programmes around the world, those already in progress United Kingdom and Australia, and those that may be established need to actively consider the vital contribution and insights that parents can provide at the start ad throughout the process. When considering everyone's needs Maslow sees

[7] Liedtke, W.L., *"Fostering Numeracy: Parents of Preschool Children Can Play an Important Role"*, Canadian Children, Spring 2000.

the potential to turn around challenge and frustration. "Courage and hope can succeed upon nihilistic despair when mixed in with patience, modesty, humility, hard work and the sense of brotherly community"[8]

How much better to begin in unity than to eventually arrive at this point. May the following poem by an unknown writer leave a sense of hope.

Unity

I dreamed I stood in a studio
And watched two sculptors there.
They clay they used was a young child's mind
And they fashioned it with care.
One was a teacher, and the tools they used
Were books music and art;
One was a parent with a guiding hand
And a gentle, loving heart.
And when at last their task was done,
They were proud of what they had wrought.
For the things they had moulded into the child
Could be neither sold nor bought.
And each agreed they would have failed
If they had worked alone,
For behind the parent stood the school.
And behind the teacher, the home.

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[8] Maslow, Abraham, *"Humanistic Education"*. Journal of Humanistic Psychology, Sum. 1979, v19.n3. p24.