

***“Incorporating Environmental Immersions to Learning Community linked courses in Mathematics and Geography”***

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**Abstract:**

The learning community between GEO2000 “Physical Geography” and MAC1105 “College Algebra” during the fall semester 2008-01 at MDC Hialeah Campus linked two disciplines and two departments from different campuses and the cooperation as a facilitator of the Earth Ethics Institute in an instructional practice that is intended to reinforce the competencies of the two courses by the application of the concepts in a real case scenario of principles of measuring, analysis of variable interaction and the observation of the environment. The students performed practical approach to scenarios explained in the classroom, including a service learning activity in favor of the community and the motivation of the students produced a positive effect in the academic results that in similar courses taught separately was not experienced and not expected given the typical performance for the instructors’ courses taught independently. The differences between the mean of responses and the percent of positive responses in the student feedback survey as well as the differences in the grade distribution review are significant at the 0.05 level, what supports the effectiveness of the practice of curricular link of mathematics courses to other disciplines with quantitative reasoning objectives.

Theme: Educational Research

Key Words: Learning Community, Environmental Immersions, STEM Education

## ***1) INTRODUCTION***

There is certain trend to advise students to take the mathematics requirements very independent from the science or related courses, due to the belief that students with poor expectations in quantitative reasoning may perform low in a semester with another science or related course to mathematics.

The belief that the inclusive practice of the principles of a mathematics course in a same semester curricular arrange with another discipline which uses quantitative reasoning to argument may produce good result, brought the idea to form the learning community of MAC1105 “College Algebra” with GEO2000”Physical Geography” in the MDC -Hialeah Campus fall semester 2008-01.

The instructors usually teach the courses independently and the match occurred when two AMATYC Institute projects were developed by them.

Final Report, March 2008

### **Foundations for Success National Mathematics Advisory Panel**

- .....”Limitations in the ability to keep many things in mind (working-memory) can hinder mathematics performance.
  - Practice can offset this through automatic recall, which results in less information to keep in mind and frees attention for new aspects of material at hand.
  - Learning is most effective when practice is combined with instruction on related concepts.
  - Conceptual understanding promotes transfer of learning to new problems and better long-term retention” .....

<http://www.ed.gov/MathPanel>

During two years, the Math advisory Panel worked in the nation: Review of 16,000 research studies and related documents. Public testimony gathered from 110 individuals.

Review of written commentary from 160 organizations and individuals, 12 public meetings held around the country. Analysis of survey results from 743 Algebra teachers

There is enough scientific evidence cumulated that lead to the previous point, just consider the following research that occurred in our country during the last three years: **Foundations for Success National Mathematics Advisory Panel.**

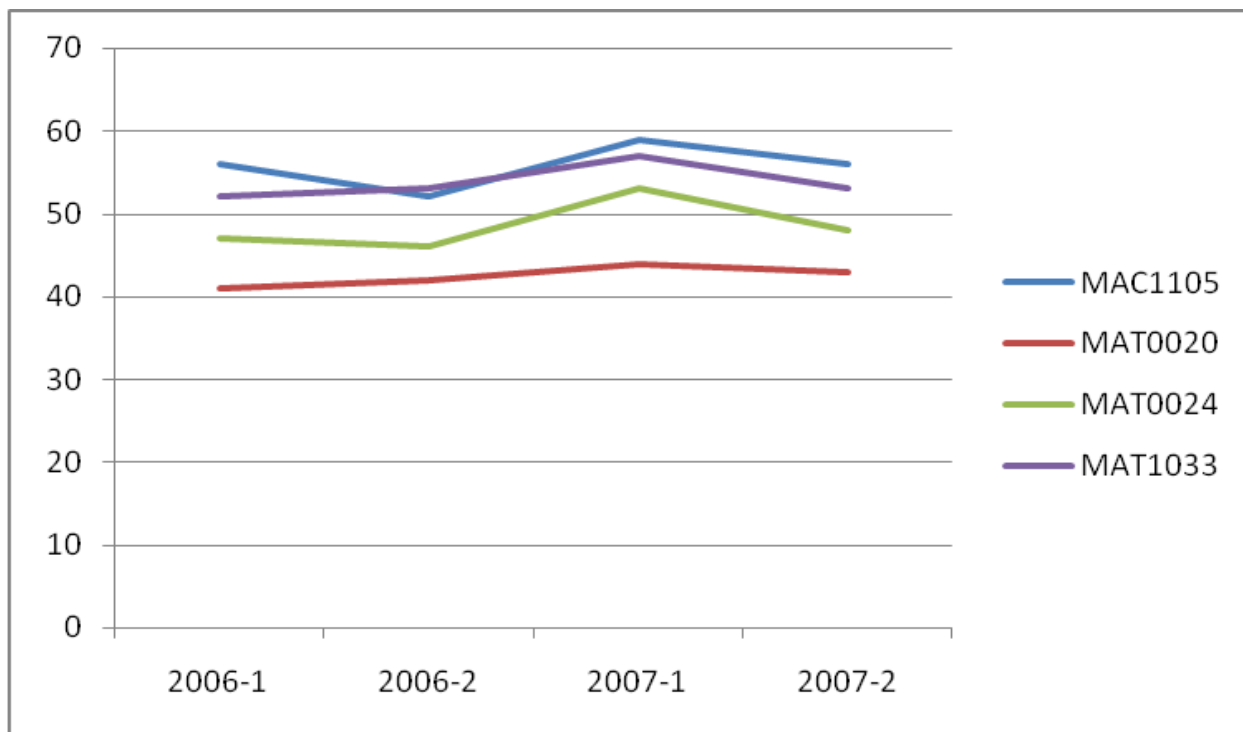
## 2) *Methods*

This experimental study is intended to:

- To increase student engagement in the instructional process by facilitating the association of the learning outcomes in different disciplines reinforcing the common topics in competencies.
- To increase motivation of students and the acquisition of quantitative reasoning skills, when the solution of an example in class has potential environmental, technical and social extended impact in a real life application.
- To improve the student success rate as well as the student pass rates in critical courses, by the effect of the multidisciplinary approach to the solution of problems and cooperative discussions.
- Improve retention and enrollment in critical courses by effective multidisciplinary and college – wide coordinate interaction.

The following factors produce interest in the experimental study:

- *Underprepared students in need of intensive instructional techniques, produce a demand for motivational instructional engines.*
- *In order to investigate avenues to better serve the students, faculty at MDC research best practices in teaching learning strategies.*
- *According to the MDC Mathematics Discipline Annual Report for the academic year 2007-08(Fig 1) the performance of several math courses is affected to levels of the pass rate under 60 %.*
- *While MAC1105 “College Algebra” is not currently the worst case scenario; it is not showing a consistent positive trend.*



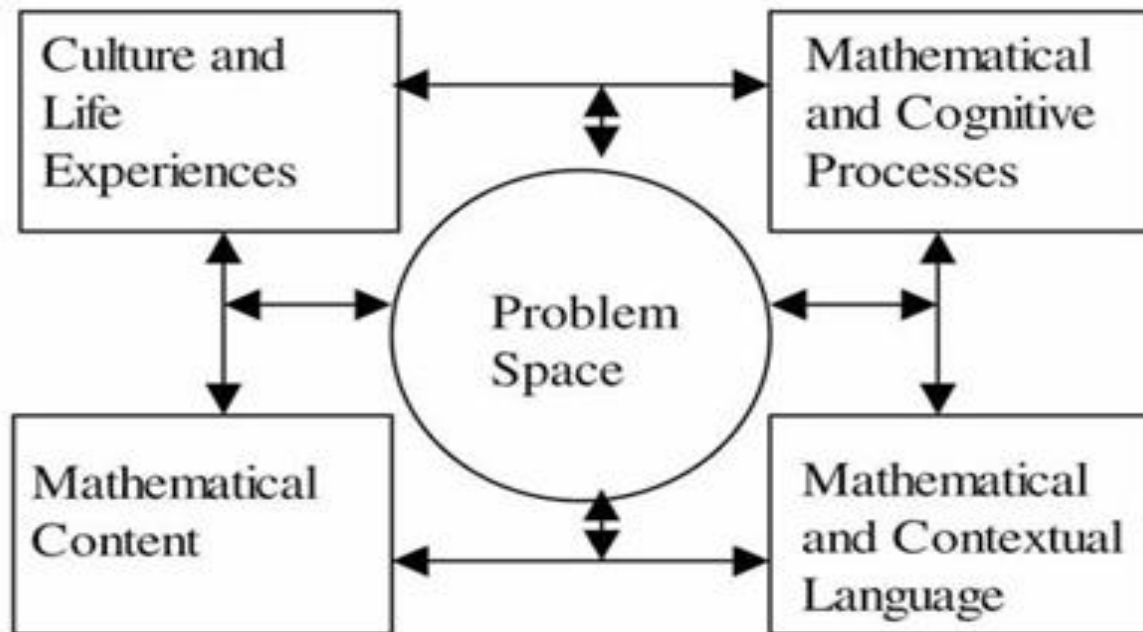
**Fig 1. Pass Rate(%) MDC Mathematics Discipline 2007-08 Academic Annual Report**

There is certain trend to advise students not to take their mathematics requirements with science or other math related courses, due to the belief that students with poor expectations in quantitative reasoning may perform low in a semester with another science or related course to mathematics.

The idea to link a math course with a science course using quantitative reasoning became the foundation of our learning community MAC1105 “College Algebra” with GEO2000”Physical Geography” MDC -Hialeah Campus fall 2008-01.

From this perspective, other authors studied the meta-reflective interactions in the problem space, the cognitive demands, as follows:

Meta-reflective interactions in the problem space. Cognitive Demands and Second-Language Learners: A Framework for Analyzing Mathematics Instructional Contexts, Campbell, et al. Mathematical Thinking & Learning, 2007, Vol. 9 Issue 1, p3-30, 28p, 1 chart, 3 diagrams p9



**FIGURE 2** Meta-reflective interactions in the problem space.

The authors of this study participated in several previous projects related to Math across the Curriculum, sponsored by the AMATYC Summer and Winter Institutes

The preparation of the exercises to extend the interaction of the quantitative reasoning competencies to the multidisciplinary learning community was outlined and constructed in such an institute.

The framework to produce the Learning Community was possible with the support of the college-wide interaction, the collaborative work of the instructors and the support of the Earth Ethics Institute.

Analysis of the competencies:

### **MAC1105**

Competency 5: The student will demonstrate knowledge of functions from a numerical, graphical, verbal and analytic perspective.

### **GEO2000**

Competency 5: The student will be able to analyze the regional concept by:

- a. demonstrating knowledge the area analysis tradition.

- b. identifying the region's locations, spatial extent and boundaries.
- c. evaluating the factors that differentiate the regions as functional or formal.

Note: GEO 2000 Competencies 2, 3, 4 show compatibility with MAC1105 Competency 5, as well.

### 3) *Data Analysis*

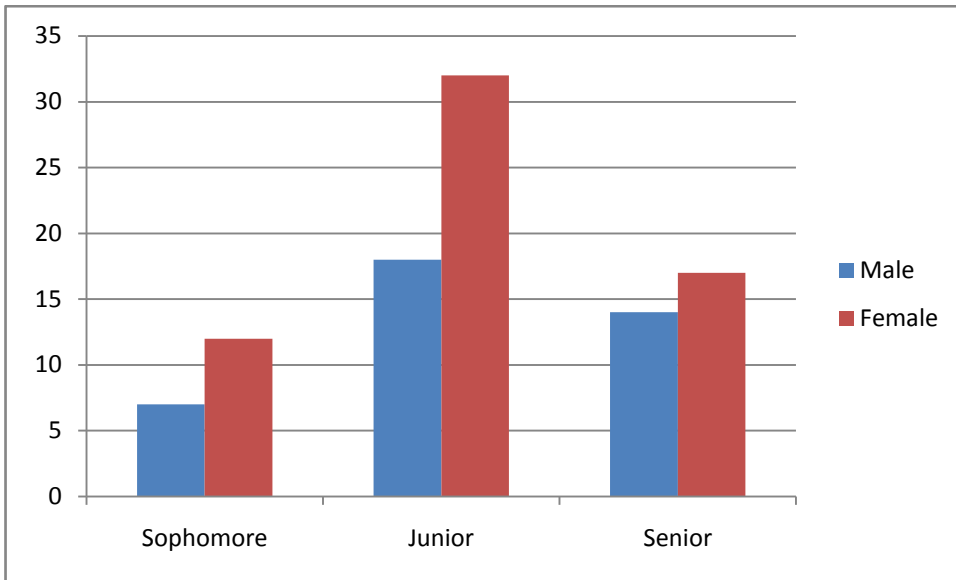
3.1)The study consisted in the learning community for the MAC1105 ref # 481380 and GEO2000 ref # 500955 as an experimental group of common students and control groups of independent instruction of the courses in MAC1105 ref# 481373 and GEO2000 ref# 343421

The Action Plan had a delay due to the complexity of the interaction to make the learning community with the targeted population, which made up, conveniently last Fall 2008.

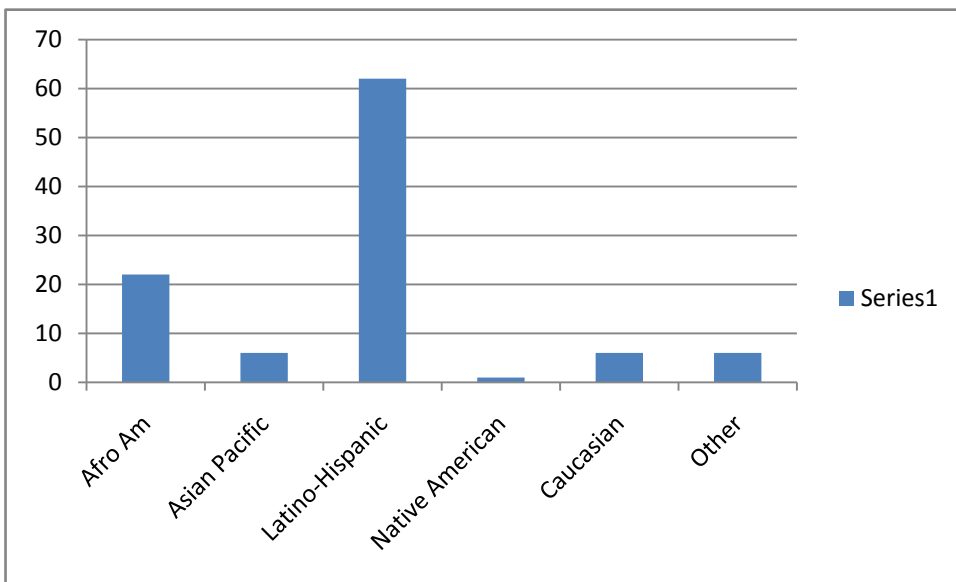
- The population under study was a learning community to serve dual enrollment students from MATER Academy. The learning community includes the presence of both instructors in both disciplines. The study group consisted in the learning community for the MAC1105 ref # 481380 and GEO2000 ref # 500955 as an experimental group of common students and control groups of independent instruction of the courses in MAC1105 ref# 481373 and GEO2000 ref# 343421.

The experimental group was formed as described in the following figures 3 and 4.

It is remarkable the consistency of the targeted population with the MDC-Hialeah Campus typical students.



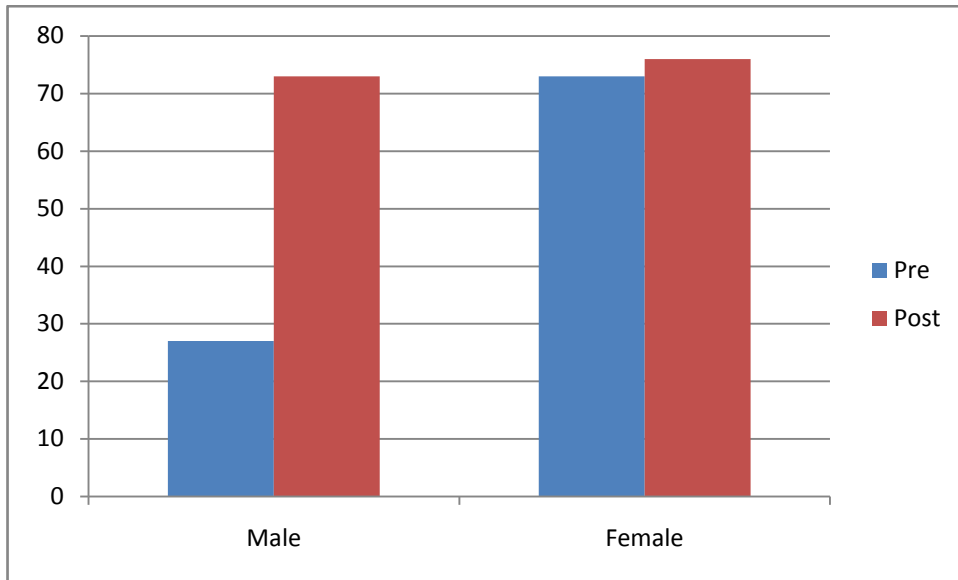
**Fig 3. Gender structure in targeted population**



**Fig 4. Ethnicity structure of the target population**

**3.2) Assessment of the students' opinions**

- The intentionality of the activity was declared to the students who prepared their experiment log.
- The conditions of the instructional time of the activity was a key factor
- The students were assessed by a pre and post survey, showing the logical change of the population across the semester in Fig 5



***Fig 5. Gender structure of the pre- post survey***

- A Pre-Post survey of the participating students' opinions was applied in compliance with the AMATYC, MAC<sup>3</sup> project.
- The survey includes twenty one questions related to the students' perception of skills and or learning outcomes. Those questions were responded in the Pre and the Post applications, as well as ten questions related to the understanding and gains or improvements during the course.
- Also, the evaluators recorded gender, age group and ethnicity, keeping the privacy but recording apart of their identification number that lead to matching the pre and post surveys.

### *3.3)Summary of the AMATYC Survey*

- According to ANOVA (two factors) at 5% significance level there is no significant difference among the questions.
- There is a high significance among the responses to each question.

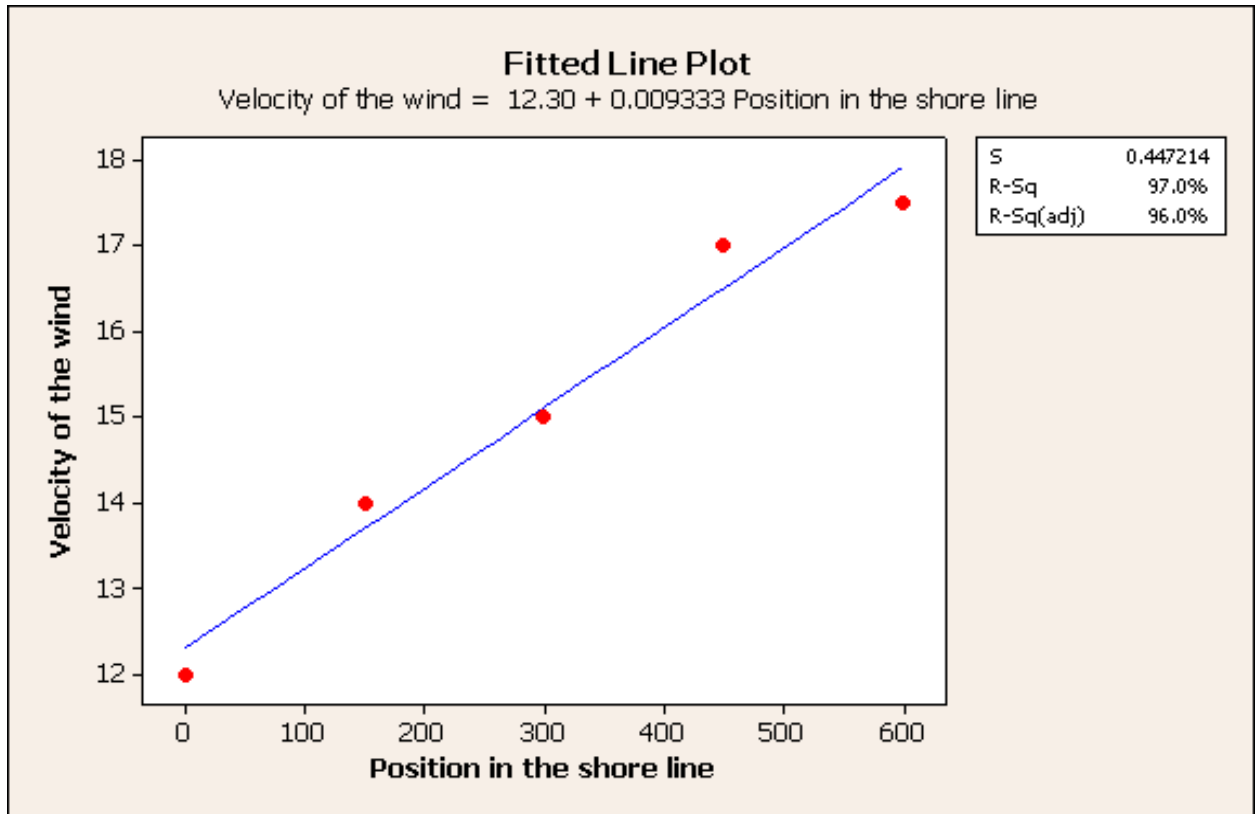
It implies that the questions were not weighed, while the answers obviously show the students opinion.

### *3.4)Teaching strategies*

- During the fall replication, integrative instructional methods were applied to the students in the combined subjects.

- The environmental immersion consisted in a data collection of the velocity of the wind, air humidity, temperature and position, and the observational study of the sea grass

Humidity	Velocity Wind (mph)	Water Temp. (F)	Shore sand Temp. (F)	Air Temp (F)	Position in shore (ft)	Amount of life collected (units)
87	12	71	84	74	0	15
87	14	72	83	75	150	22
86	14	72	83	77	300	28
85	17	77	85	80	450	35
88	18	78	88	82	600	30



*The definition of Quantitative Reasoning might not be interpreted related to a course like GEO2000, but the reality of the situations that students find when they entered in the environmental immersion is definitely a real application of the following definition*

The application of mathematical concepts and skills to solve real-world problems. In order to perform effectively as professionals and citizens, students must become competent in reading and using quantitative evidence and applying basic quantitative skills to the solution of real- life problems( 3).

### 3.5)Students Feedback Analysis

- A comparative analysis (t – test )of the average response and the positive responses was conducted between the experimental and the control groups
- The results are significant at the level of 0.05 with p-values of 0.028 and 0.014, respectively for the sample size of 27 students under analysis, which support that the opinion of the students favor the application of the immersion.

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### 3.5) Analysis of the grades

Course	Reference #	Pass Rate %	Success Quotient %	Retention Rate %
MAC1105(LC)	481380	75	78	96
GEO2000 (LC)	500955	100	100	100
MAC1105 (control)	481373	61	80	76
GEO2000 (control)	343421	92	92	100

**Fig 6. Descriptive comparative Grade Distribution Review for the experimental and for the control groups**

**Fig. 7 Grade Distribution**

	MAC1105 W/o LC Ref# 481373	GEO2000 W/o LC Ref # 343421	MAC1105 W/ LC Ref# 481380	GEO2000 W/ LC
A	1	9	0	24
B	3	2	4	1
C	16	1	14	0
D	2	0	5	0
F	3	1	0	0

W	8	0	1	0
W/I	0	0	1	0

The differences are significant even between categories of grades, at the 0.05 level

The display of the general grade distribution offers the effect of the immersion over the learning in the subject compared versus the case in which the subject is taught separately and without immersions.

#### **4) Concluding Remarks:**

The study shows the influence of the instructional effective interaction over the quantitative reasoning skills, and this effect can be measured from the both sides of the learning process as follows:

#### **IMPACT ON STUDENTS**

- Decrease math anxiety
- Positive learning attitude
- Recognition of math in daily life
- Lifelong appreciation of math
- Positive experience in math courses
- Perception that math is relevant
- Development of quantitative reasoning

#### **IMPACT ON INSTRUCTORS**

- Collaboration- cooperation
- Enhance of departmental campus vision
- Improve teaching strategies.
- Generalization of conclusions

#### ***RECOMMENDATIONS:***

- To introduce the Method of Test Item analysis to consolidate the results of the opinion surveys
- To replicate the study involving a sample in the IAC to extend the results with double interactions of MAC1105 and MAT1033 together with GEO 2000 and PSC1515
- To continue incorporating the Earth Ethics Institute environmental immersions to courses with potential risk in motivation of students

#### ***REFERENCES:***

1. Bestard, Rodriguez: "Course syllabi for MAC1105, GEO2000 MDC-Hialeah Campus, Fall 2008.
2. Bestard, J: "The T-link Project" AMATYC Summer Institute, Leavenworth, WA, Aug, 2006.
3. Diefenderfer, et all: "Interdisciplinary Quantitative Reasoning" Hollins University, VA, 2000.
4. Rodriguez, Bestard: "The Global Warming awareness and the environmental math instruction at the MDC-Hialeah Campus. AMATYC Winter Institute, Miami Beach, FL January 2007)