INTRODUCING MATRIX ANALYSIS CONCEPTS TO ELEMENTARY SCHOOL STUDENTS

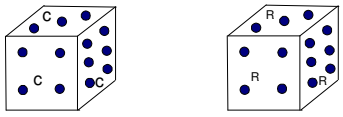
Richard Aston, Ph.D., P.E.
Associate Professor (Retired)
East Tennessee State University
33 Barney St. Wilkes-Barre, PA 18702
570-829-3163
astonrj@yahoo.com

ABSTRACT

As a part of science, technology, engineering, mathematics (STEM) programs, an introduction to matrix analysis concepts for first through fourth grade students is presented. A six-by-six matrix of columns and rows is printed and given to the students. Cooperative skills are encouraged by making teams and playing the game of Bingo using the matrix. The effect may be to help the student realize arithmetic can be used to achieve a goal other than just performing the operation; and the language of matrix analysis is introduce on an elementary school level. This has been done for 3 years in an after-school program, "The Center of the Village" for inter-city children. Surveys are completed by administrators to assess the pedagogic and ethical values of this. Responses of the students are documented.

MATRIX ANALYSIS CONCEPTS

An introduction to matrix analysis concepts for first through fourth grade students is achieved by having them play Bingo. A six-by-six matrix of columns and rows is printed and given to the students. In the simplest case, the rows and columns are numbered 1 through 6. Dice, one marked with a C for column and another labeled R for row, are thrown by the student, who is than required to add the two resulting numbers and write their sum in the matrix element at the intersection of the row and column.



ADDITION BINGO

	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						

- Throw Dice
- Add the numbers that appear
- Write the sum where the correct Column and Row cross

As the students master this, the difficulty is increased by using larger numbers, or introducing subtraction or multiplication. The purpose is to give them experience with mental addition, subtraction and multiplication. Also the terminology of the mathematical matrix is introduced. Further, the concept that the elements of the matrix contain numbers resulting from, sometimes complex mathematical operations is introduced, however subliminally, to these young people. Perhaps this will make it easier, and more natural for them to learn matrix analysis in the future.

To introduce larger numbers of columns and rows, four dice can be used; and the student would need to add two of them to identify the proper operational numbers up to twelve. We haven't gone this far with the 1st through 4th students we have.

	1	2	3	4	5	6	7	8	9	10	11	12
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

TEST CASE

To test these ideas, we have formed teams of children of mixed ages. As a team they cooperate and come up with correct matrix element and the number it should contain. Obviously most of the calculation is done by the older, or stronger students, and the others observe, learn and are motivated. To fit this into twenty minute sessions, called rotations by the center, a bingo is called if three matrix elements in a row, column or along a diagonal are filled. The winners are rewarded with a little more candy than the losers. For a twenty-minute game three in a row counts as a bingo.

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ADDITION BINGO

	1	2	3	4	5	6
1						
2		4				
3			6			
4				8		
5						
6						

- Throw Dice
- Add the numbers that appear
- Write the sum where the correct Column and Row cross

Team 1

Team 2

CONCLUSION:

The staff and adult volunteers of the Center of the Village generally agreed that the math bingo game was effective in particular in building math skills and teaching team participation in grade levels 1 to 4. Their comments included that kids learn to work together; older children can and do help the younger; and peer tutoring/ collaboration takes place. There is some sense that the younger children have a little less opportunity in showing their skills then that the older ones, who are more aggressive. Staff people did not find a problem with having children play a gambling game like bingo, as it is often used in an educational setting. The children were eager to play the game. More details on the responses of the adults and students appear in the survey results given in the Appendix.

APPENDIX: MATH BINGO GAME SURVEY (Responses)

A paper about the Math Bingo Game, played as a rotation at *The Center of the Village,* 2 Lockhart St. Wilkes-Barre, PA 18702 after school program, is accepted for presentation at a regional conference of the American Society for Engineering Education (ASEE) meeting at Hofstra University on Long Island New York this Fall. We request your help in evaluating this activity by filling out the following survey.

Do you think the math Bingo game is helpful to students?
First Grade Yes 3 No 1
Second Grade Yes 4 No 0
Third Grade Yes 4 No 0
Fourth Grade Yes 4 No 0

What aspects of the procedure are effective at the following levels such as

The game,
First Grade Yes 3 No 1
Second Grade Yes 3 No 1
Third Grade Yes 3 No 1
Fourth Grade Yes 3 No 1
Building math skills,
First Grade Yes 3 No 1
Second Grade Yes 4 No 0
Third Grade Yes 4 No 0
Fourth Grade Yes 3 No 1
Learning to participate as a team
Kindergarten Yes 4 No 0
First Grade Yes 4 No 0
Second Grade Yes 4 No 0
Third Grade Yes 4 No 0
Fourth Grade Yes 4 No 0
What are the advantages of having the teams contain children of various grade levels and ages?
Kids learn to work together

Older children can and do help the younger.
Peer tutoring/Collaboration
Older children assist younger ones.

What are the disadvantages of having the teams contain children of various grade levels and ages?

Older kids get mad at the younger if they get the answer wrong
Older children tend to give answers without giving younger ones a chance
Older ones, more advanced, shout the answer before the others have a chance
Younger children do not fully participate.

What kind of problem is there with:

Having children learning a gambling game like bingo:

none
no problem. Bingo is well used in an educational setting.
They don't know it's a gambling game
Developing a winners and losers mentality
none
teaches life lesions
It should be considered as having fun and trying hard.
Dice roll = luck/skill

Working mostly for a reward like candy

none
something to look forward to
Extrinsic rewards may diminish intrinsic.

What sort of feed back about the math game have you received from:

Your observations

The kids seem eager to solve the math problems so the team can win.
The children really enjoy it.
It's learning while having fun
It also allows teammates to encourage other members of their team.
The Stress of competition
Children are engaged and enjoying it.

Students

They look forward to getting the prizes
Kids enjoy it.

Colleagues

They cheer on the kids as a team. They congratulate the kids to work as a team & they congratulate all the kids for trying!
Rows/Columns math standard for second grade

Parents

The children tell them how they won a prize for solving math problems

Please make any comment you wish about The Math Bingo game at The Center of the Village.

Great job, Richard! Keep up the good work.
Children have a fun time in a learning activity.

BIOGRAPHICAL NOTE

Richard Aston taught Electrical Engineering and Biomedical Engineering Technology for 27 years at several colleges, retiring from East Tennessee State University in 2002. He published three engineering text books, including *Principles of Biomedical Instrumentation and Measurement*, distributed by Prentice Hall, still in use since 1990. You may Google *Medical Imaging Equipment Theory, Aston* for his free book. He was granted a PhD degree from Ohio State University in 1969.