Modular Mighty Magz

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Funded By Arthur Vining Davis Fund SURG Grant

Portfolio Design

Space Efficient:

- Since storage is a big concern for toys in classrooms, Modular Mighty Magz folds up into a convenient carrying case that can be easily stored behind a shelf or narrow space.

Reduces Waste of Excess Storage Materials

- To save on materials, the play space double functions as the carrying case.
- The magnetized bottom board doubles as a play surface and is recessed on the opposite side to hold the magnetic wooden blocks and aluminum support bars. Since the board is magnetized it helps hold and secure the blocks in the case as well.
- The metal play surface serves as the case cover to hold the blocks and aluminum support bars in place.
- The only materials that are not used in play and stoarge are the straps to hold it together, carrying case for the aluminum support bar pins, and spacer to keep the blocks from sticking to the metal case cover or making it difficult to open and pull apart the case.

What Does Modular Mighty Magz Do?

Collaboration

- **Play Space**
  - The play space is designed for four children where they are forced to either share the space or work collaboratively to fill the area with structures.
  - There is no designation of an individual play space unless two or fewer children use the toy.
- **Strength of Magnets**
  - The magnets are more powerful than any common magnet toy on the market. Depending on the strength of the children, the larger blocks could require two children to pull them off the steel plate.

Magnetic Concepts

- **North and South Poles**
  - This toy is purposefully marked abstractly with different color woods (cherry and walnut) to distinguish that the two opposite poles attract while similar poles repel.
  - Cherry is the north pole and walnut is the south pole.
- **Attracting**
  - There is a very strong attraction between the magnetic blocks, reinforcing this concept.
  - Children can make the blocks jump together by slowly inching them together from a distance. This allows them to see the attraction.
- **Repelling**
  - There is a very strong repulsion due to the strength of the magnets inside the blocks.
  - Children quickly realize by the strength of the magnets and blocks that opposite poles do go together. This is reinforced by the colors of the woods (cherry and walnut).
  - Children can see the repulsion by not being able to put similar poles (similar woods) together or pushing the blocks around the floor with the blocks repelling.
- **Sticking To Other Objects**
  - Magnetic blocks will stick fairly strongly to other objects that are magnetic.
  - Child could easily pick up small objects that are magnetic.
  - There is an aluminum support bar on the play space that the child may discover is not magnetic, reinforcing magnetic versus non-magnetic objects.
- **Magnetic Fields**
  - Since the blocks have very strong magnets, children can make the blocks repel and use a circular motion to feel the limits of the magnetic field.

What Do You Get?

Blocks: 76 wooden magnetic unit blocks. 20 (2" x 2" x 1" squares), 8 (2" x 4" x 1" rectangles), 4 (2" x 6" x 1" rectangles), 4 (2" x 8" x 1" rectangles), 16 (2" x 2" x 1" triangles), 16 (2" x 4" x 1" triangles), and 8 (special direction 2" x 2" x 1" squares).

Play Space: One stainless steel plate for free-form play. One point magnetized wooden board. All magnets are pointing with north toward the ceiling of the room. Two aluminum support bars with four pins to attach them.

Storage: Two luggage straps to hold the case together. One pocket for pin storage that attaches to the luggage straps. One felt board separator to keep the blocks and case from sticking together.

Play With Modular Mighty Magz

The Experiment

Experiment Goal: To investigate whether young children's collaborative play and learning about magnetism could be enhanced by open-ended play with an innovative type of magnetic unit blocks that teachers could use in conjunction with an explicit lesson about magnetism.

Promote Collaboration:

- Collaboration is one of the four C's (Critical Thinking, Communication, Collaboration, Creativity) in *Learning and Innovation Skills*, which is one of the four main components in the framework of goals for 21st century skills (Partnership For 21st Century Skills, 2011).
- Section 25.4.1 in *Pro-Social Relationships With Peers* - During free choice children should be able to initiate play with 2-3 peers, participate in cooperative learning activities to complete desired tasks, or play with 3-4 children for a sustained period of time (Pennsylvania Department of Education, 2009).

Surpass Local and National Standards of Magnetic Concepts:

- Section 3.2b.4 in Physical Sciences - Children are expected to be able to talk about concepts of magnets, explain what happens near magnets, and distinguish items that are magnetic and non-magnetic (Pennsylvania Department of Education, 2009).
- PS2: *Motion and Stability: Forces and Interactions* - In Section PS2.B, 2nd graders are expected to know that objects can change motion or shape when they touch or collide. 5th Graders are expected to know that the orientation of magnets depends on what forces act on them and that magnets need not be in contact to push or pull. 8th Graders are expected to know the terms attract and repel. 12th Graders are expected to know about magnetic fields (National Research Council, 2011).

Participants

- 23 Four-Year-Olds (12 Males, 11 Females with M = 4 Years, 10 Months) and 14 Kindergartners (8 Males, 6 Females with M = 5 Years, 7 Months) recruited from the Carnegie Mellon University Children's School.

Experiment

- Children were given a pre- and post-test interview that asked questions about magnets and magnetic fields, magetic poles, and magnetic versus non-magnetic objects.
- Children were given a group teacher lesson that covered the concepts in the pre-post test interview.
- Children were randomly placed in groups of four to play with either Modular Mighty Magz or Mega Magz for 15 minutes directly after the group teacher lesson.

Results

Magnet and Magnetic Field Questions:

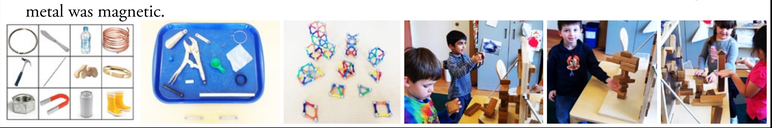
- Four-year-olds and kindergartners improved by about two points out of nine with the teacher lesson, $F(1,33) = 49.11$ and p-value < 0.01, but neither toy was more helpful in improving these concepts.
- None of the children playing with Mega Magz, but three children who played with Modular Mighty Magz correctly answered "what is a magnetic field" and "show me the magnetic field" questions. Either the concept is too hard for this age or further testing could reveal Modular Mighty Magz can improve this.

Magnetic Pole Questions:

- Four-year-olds improved by about one point and kindergartners improved by about two points on a scale of -3 to 3 with the teacher lesson, $F(1,33) = 16.01$ and p-value < 0.01, but neither toy was more helpful in improving these concepts, .

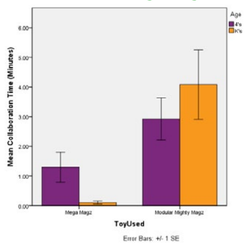
Magnetic Vs. Non-Magnetic Object Questions:

- Four-year-olds improved by about a half a point out of twelve and kindergartners improved by about one point out of twelve.
- Marginally significant three-way interaction between test, age, and toy used, $F(1,33) = 4.06$ and $p = 0.052$.
- Age was marginally significant, $F(1,33) = 3.52$ and p = 0.07.
- Follow-up tests revealed no interaction with toy used or score difference between pre- and post-test interview for four-year-olds, p-value > 0.05.
- Follow-up tests revealed a significant interaction between test scores and toy used for kindergartners, $F(1,12) = 4.92$ and p-value < 0.01.
- Kindergartners who played with Modular Mighty Magz outperformed children who played with Mega Magz, $t(7) = 2.97$ and $p = 0.02$ (pre-test M = 9.00 and SD = 1.31, post-test M = 10.75 and SD = 0.89). They improved on correctly identifying aluminum, copper, and gold was non-magnetic. The children playing with Modular Mighty Magz had an aluminum bar as a supporter of the play space to test as non-magnetic, they tended to be running around the room testing what was magnetic with the powerful blocks, and they constantly were faced in their visual field with a steel plate to play on, reinforcing that metal was magnetic.



Collaboration:

Age Groups' Time of Collaboration of Mega Magz Vs. Modular Mighty Magz



- Children significantly collaborated longer with Modular Mighty Magz than Mega Magz, $F(1,33) = 13.40$ and $p = 0.01$. This increase may be due to the play space forcing them to share, since there was no clear distinction of an individual play space.
- Some of the more powerful blocks required weaker children to work together to remove them with Modular Mighty Magz.

References

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