1. Problem statement

To design an interactive multimedia learning environment to help 4th - 8th graders visualize a coordinate system in one, two or three dimensions to be used to learn various number, algebra, geometry, and data analysis concepts.

2. Motivation

2.1 Learning standards
Illinois Learning Standards 6-10 (all of the mathematics standards) require graphing in a coordinate space in one application or another. The proposed coordinate system would be useful for all of these activities. Moreover, the proposed system would be useful for the following NCTM standards: Number & operations, geometry, algebra, measurement, data analysis, and representation.

2.2 Difficulty in visualizing coordinate systems
Math students often learn the algorithm for doing something without a good conceptual visualization. Coordinate systems, beginning with the number line and continuing to 2 and 3-dimensions are a perfect example: we learn the recipe for adding and subtracting positive and negative integers without visualizing moving left and right on the number line. Similarly we learn to plot points without visualizing intersecting number lines or the resulting grid. Finally, 3d space is impossible for most students because of the lack of fundamental visualization of simpler spaces.

3. Method

Students are immersed in a coordinate system projected onto a large portion of the classroom. 1 dimension will be explored using a number line running along the floor; a 2 dimensional system consists of a graph covering a large area of the floor, and a virtual 3d space can be visualized using a pair of projectors and passive 3d glasses. Practically any lesson in number sense, algebra, geometry, or data analysis that can profit from a visual representation (almost all) would benefit this tool. For example, points can be located, distances measured, experimental data plotted, simple relations and functions investigated, geometric definitions can be studied, and linear transformations can be performed.

4. Interface

A brightly colored sphere, resembling a billiard ball with various control buttons, would be the primary interface. The sphere is tracked in the room, so the system always knows its position in the current coordinate system. The ball would be carried to the desired location and an "enter" button would be pressed to enter the current point onto the grid. A few other buttons would be present for setting the origin, the number of coordinates, linear transformations, and other control features. A small speaker may also be incorporated for auditory feedback. The system and ball are linked via a wireless connection.