Teaching kinematics in the optimum number of dimensions

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Kinematics has almost always been introduced in one dimension. This seems to have been more or less universally assumed to be the simplest way, with little explicit deliberation. This paper will share a teaching sequence starting in two dimensions, arguing that this might well, provide a more fruitful route into the tautological complexities of kinematics.

Some of the affordances exploited will be relatively recent, due to the current culture and availability of mapping and tracking technologies, and the increasing familiarity with aerial footage of journeys. In fact, records and plans for journeys form a thematic context for the development, connecting kinematics to the lived-in world of the child. Other suggested affordances will be conceptual and more evolutionary, as the barriers to thinking with vectors and about accumulations are now much lower if the potential for pedagogical support in representational and measurement technology is exploited fully. But perhaps the most significant reason to consider a change is that current practices and explanations could be improved: the words and representations currently deployed by teachers do have a tendency to lead them off down the wrong tracks, and to engage in convoluted circumlocutions which are hard for even those familiar with the topic to decode (for example: "the negative acceleration was increasing"). The spatialising of duration in Cartesian graphs, together with a strong reliance on this representation often presents further tripwires for learning. There are no guarantees here, and practice is rather resistant to change, but perhaps new thinking and new tools might make the topic more accessible: more children could then reason more fruitfully if given access to new tools for representing, reasoning and predicting.

The paper will be way of a suggested 'teaching experiment' as a contribution to the didactical debate about how to best represent physics to young people: here in the United Kingdom, children would first meet these ideas formally between the ages of 11 and 16 years old. The sequence and associated resources are designed to be deployed in commonly available circumstances, for everyday laboratory and classroom teaching.

The basis for the suggestions lie in the decade in my current role, particularly drawing on diagramming to support shared reasoning, work done in dynamical modelling systems, such as in Advancing Physics, and familiarity with the range of approaches to teaching about motion implemented internationally.