

Supporting independent learning and conceptual development



By Mike Ollerton

Page 1 of 4

30 March 2015

INTRODUCTION

Working with vectors is applicable for KS4/KS5 students. However the independent learning strategies offered can be adapted for any concept and used with other key stages.

One strategy to support independent learning is to ask students to find out some information prior to a first lesson about a concept which is going to be worked on in the following lesson.

My intention is for the teacher to change her/his role from instructor to facilitator; from one who explains how mathematical concepts work to one who helps students find out about and discusses the various constructs involved. To exemplify this I use the concept of vectors.

When we look at an index of a textbook we are likely to see the following list which appears in the left hand column of the table below:

Items in a textbook about vectors	Reduced list of basic ideas about vectors
<ul style="list-style-type: none">• Addition of• <u>Angle between</u>• Component form• Definition• Direction• <u>Dot product</u>• Equal• <u>Equation of a line</u>• Magnitude• Modulus• Multiplication by a scalar• Negative of a• <u>Perpendicular</u>• Position• Resultant• Scalar product of a• Subtracting• <u>Unit</u>• Zero	<ol style="list-style-type: none">i. Addition ofii. Component formiii. Definitioniv. Directionv. Equalvi. Magnitudevii. Modulusviii. Multiplication by a scalarix. Negative of ax. Positionxi. Resultantxii. Scalar product of axiii. Subtractingxiv. Zero

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Page 2 of 4

30 March 2015

In the right-hand column is a reduced list which I can ask students to find out about. All such information can be found via the internet or a textbook or another student.

Prior to the first lesson, therefore, I ask students to find out about three or four of the items in the “reduced list of basic ideas” as shown. The items underlined in *red* are ones I would not ask students to explore; this is because, in the first instance, they only need know about the basic ideas of vectors; the others can be developed in future lessons once they have a good grounding of the basic ideas (in the right hand column)

I share the items out so each student is asked to find out about three or four of the ideas. I need to ensure each one is duplicated so each idea will be considered by more than one student.

For example student A could be asked to find out about i, vi, x, student B to find out about ii, vii and xi etc.

i.	Addition of	vi.	Magnitude	x.	Position
ii.	Component form	vii.	Modulus	xi.	Resultant
iii.	Definition	viii.	Multiplication by a scalar	xii.	Scalar product of a
iv.	Direction	ix.	Negative of a	xiii.	Subtracting x
v.	Equal			iv.	Zero

In the lesson I ask each student to explain one fact they have found out about vectors. As they do so I write a précis of each offering on the board; thus collecting together students’ collective knowledge about vectors. This process may take 30 or so minutes and will de-pend upon whether there are disagreements or if some students do not understand another’s explanation.

In the next part of this lesson I can pose a problem such as:

How many vectors can be made on a 9-dot grid? How many on a 16-dot grid?

How many on an n^2 -dot grid?

Some 9-dot and 16-dot grids appear at the end of this document and can also be used to further investigate the *red* listed items:

- [Perpendicular vectors](#)
- [The vector equation of a line](#)
- [Angle between two vectors](#)
- [Unit vector](#)
- [The dot product of two vectors](#)

If students have access to a cube they could also write vectors in the i, j, k format and investigate how many different vectors on a 1 by 1 by 1 cube or a 1 by 1 by 2 cuboid.

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Page 3 of 4

30 March 2015

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Page 4 of 4

30 March 2015

