

TALKING POINT:

WHAT DOES RESEARCH SUGGEST ABOUT EARLY DEVELOPMENT OF GRAPHICACY?

IN SUMMARY

- Young children develop drawing and writing simultaneously as part of graphical and cognitive development and should be encouraged to explore flexible and context-dependent meanings of their invented marks
- It is important to allow students to invent and explore their own early representations of data and not impose conventional representations on them
- Students should invent and move fluidly between different representations and their structures, shapes and narratives
- Students should be encouraged to make 'object graphs' and substitute items for counted objects as well as representing them in collections, as part of exploring counting through representation of categorical data
- Students can practise understanding and using graphs, charts and tables to persuade and explain
- It is important to consider design and ethical considerations as part of graphicacy

Use of graphical symbols to represent, record and communicate counts

Making 'data'	Making shared meaning	Data grouping / reduction
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1

Graphicacy has been defined as 'the ability to understand and present information in the form of sketches, photographs, diagrams, maps, plans, charts, graphics and other non-textual two-dimensional formats'³. From very early on (2 or 3 years old) children's discovery of the potential of their marks to make meaning is the beginning of graphicacy and the root of mathematical graphics⁴. Graphicacy encompasses the flexibility to represent multiple, often complex meanings (e.g. a cross can mean a kiss, count or tally, add or multiply, letter of the alphabet, or wrong/delete/close) – context is important. Drawing, writing and children's mathematical graphics seem to develop simultaneously rather than any one being a precursor to another⁴. Teachers should understand the interweaving mechanisms which drive representational thought: both 'graphical' and 'cognitive' development are closely bound up in children's graphics, representations and inscriptions (visual materials)⁵ and an environment which encourages one also supports the other⁶.

IMPLICATIONS: Young children develop drawing, writing and mathematical graphics simultaneously and early (age 2-3 onwards)

Teachers should help students explore multiple, contextual and simultaneous meanings of early mathematical marks, signs and symbols

Teachers should support students' freedom to explore representational thought in their own ways as part of intertwined graphical and cognitive development

2

Students start thinking about graphs by grouping real objects and can be encouraged to make object graphs of different attributes; both selecting and seeing those attributes is not trivial and requires the ability to see objects as a ‘collection, rather than intact’⁷. They may substitute counted objects by using Post-it notes, other objects or counters as ‘embodiments’^{8,9} and classify drawn objects in ‘graphic collections’ (pictures without order) before moving on to classifying them through consistent criteria¹⁰. It is important for students to explore these visual elements of counting as they move towards abstraction and not to impose conventional representations on them⁷.

IMPLICATIONS: Students can be encouraged to make object graphs by considering different attributes of object collections, to substitute for counted objects and draw these objects in collections as part of play

It is important to allow students to explore their own ways of representing and not impose conventional representations on them too early

3

As they begin to be more familiar with various pictorial (hand drawn and tech-supported) representations, students should be encouraged to invent and play with recording data, making their own graphs, to help them develop metarepresentational competence (the ability to generate, critique and refine representational forms)¹². Moving fluidly between different types of representations allows students to be aware that data visualisation tells a story, and each type of representation puts a subtly different slant on that story: graphs have ‘narrative power’¹¹. Tallys, charts and tables may similarly help to reveal patterns, talking points and unexpected regularity in data sets¹, and it is recommended that students begin with (although shouldn’t be restricted to) categorical data representation, as it has only one dimension of quantity to consider^{9,12}. Young children need help seeing structure; they are likely to have difficulty knowing what to leave in and what is redundant information⁷.

IMPLICATIONS: Students should be encouraged to develop skills of generating, refining and critiquing different representations

Students should be able to move fluidly between different types of representation and use them to explore pattern, shape and regularity

Early on, students begin with counting, representing and comparing categorical data but need not be wholly restricted to it

Teachers should support students to see structure, considering decisions of what to leave in and out of representations

4

As students become aware that representations can be used to communicate data to others, they should develop a sense of the ethical and design considerations of creating representations that ‘do the best job of telling the story simply and fairly’^{13,2}. Designing representational forms is of importance within as well as outside of mathematics; it is ‘every bit as much at the core of science as experiments’². Students should develop a ‘repertoire of invented inscriptions and representations’ and have opportunities to use them to persuade or explain as opposed to being taught traditional representations without understanding when and why they are used⁷.

IMPLICATIONS: Students should be encouraged to consider carefully both design and ethics when creating representations for communication

Students can practise using mathematical graphics with understanding, to persuade or explain

‘One can regard a graphical display as an act of communication – like a narrative, or even a poetic text or work of art’¹

Friendly, 1999

‘Students often come to know ‘how to graph’ without understanding what the graphs are for or why the conventions make sense’²

DiSessa et al, 1991

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