The development of a new taxonomy for graphicacy

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Abstract

Graphicacy as an aspect of everyday life is demonstrated by highlighting the wide range of professions in which it plays an important part. It has emerged as a concept in many countries in relation to the development of school curricula, and its origins in Australia, South Africa, the UK and the USA are described. Prior research concerning the testing of levels of graphicacy is described. Previously published typologies and a long-established taxonomy for graphical literacy by Fry are discussed before presenting a newly developed taxonomy for graphicacy, which has been designed to facilitate full curriculum audits. Examples are given of how design and technology education contributes to teaching aspects of this new taxonomy, and hence to the general education of children.

Key words

graphicacy, graphical literacy, visual communication, learning, ability test

Overview

This paper reports research undertaken to gain an understanding of how graphicacy can affect students’ learning. Initial research sought to understand the meaning of graphicacy and how it appeared in the school curriculum. A new research tool takes the form of a taxonomy of graphicacy, developed to understand the skills needed to understand and create drawings, how these can affect students’ learning abilities and hence of the importance of design as a ‘third culture’.

1. The importance of graphicacy

‘Making and interpreting marks, is fundamental to all peoples and cultures. Drawing is extraordinarily versatile and has a huge repertoire of forms and uses. It is an intellectual activity that links sensing, feeling, thinking and doing.’ (Baynes, 2008)

When Baynes (2008) asked people from different professions the question ‘why draw?’ these were the key reasons given:

• it is an essential part of the work of imagining;
• constructing and managing production;
• to explore ideas;
• communicate key points to other people;
• highlight features;
• set out a structure;
• support calculations for technical details;
• planning and organising.

In a world where information is often technical and time is often short, visual images potentially offer a direct, fast, effective and efficient way of communicating. Consequently as a society, and as the growth of the use of the Internet continues, where often websites use images and animations to support or bring forward messages, we are becoming ever more dependent on visual images.

Baynes gave a rich list consisting of 107 professions (Figure 1) in an inventory of some of the people who use images and drawings in their work. In addition, analysis of the Quick on the Draw exhibition itself, revealed 26 further professions. Figure 1 illustrates these 133 professions, having in bold some of the perhaps least expected ones to be using images.

2. The emergence of graphicacy

Research into graphicacy, or visual literacy, has emerged in a number of countries around the world. The conceptual history has yet to be fully tracked, but there would appear to have been at least two primary starting points: the work of Balchin and his colleagues in the UK in the 1960s and the work of Fry in the USA in the 1970s. These are described below, as well as the developments in South Africa and Australia being noted as examples of graphicacy’s wider reach.

Graphicacy in the UK

The general term used in the UK is ‘Graphicacy’, which after an extensive literature review appears to represent the basic skill of communicating through visual images. The word graphicacy has emerged as a natural development to stand ‘next to literacy, articulacy and numeracy’ (e.g. Balchin, 1976:85) which
Some of the people who use drawing in their work taken from the Quick on the Draw exhibition

Advertiser, animator, archaeologists, architect, architectural historian, astrologer, astronomer, artist, automotive designer, author, accident reports, air hostess, biologist, blacksmith, botanist, builder, boat builder, burial grounds, building survey.
Cabinetmaker, calligrapher, carpenter, cartographer, cartoonist, city planner, chemist, civil engineer, choreographer, clown, composer, computer programmer, company chairman, computer scientist, conservator, costume designer, court artists, communications designer, Decorator, designer, draughtsman, drainage engineer, director.
Editor, electrician, embroiderer, engineer, entrepreneur, environmentalist, ergonomist, explorer, executive, electronic engineer.
Fashion designer, filmmaker, football coach, forger, forensic artist, failure analyst, furniture designer.
Geographer, geologist, graphic designer, garden designer.
Heating engineer, historian, hairdresser, horticulturalist.
Industrial designer, illustrator, interior designer, inventor.
Jewellery designer, joiner.
Landscape architect, letter cutter, lighting designer, landscape gardener, land registry.
Make-up artist, mapmaker, mason, mathematician, meteorologist, motorist, magazine illustration, management consultant.
Naval architect, navigator.
Office manager.
Painter, pattern cutter, pattern maker, physicist, planner, plumber, product designer, product development, product innovation, timber merchant, print maker.
Radiographer, road engineer, road markings painter, researcher.
Scene painter, sculptor, sign writer, soldier, stage-set designer, statistician, store manager, surgeon, sky writer, systems engineer, structural engineer, social worker, silversmith.
Tattooist, teacher, textile designer, therapist, tree surgeon, toy designer, truck driver, telephone engineer, train system (map), theatre costume designer, Vehicle designer, veterinarian.
Weaver, war artist, window cleaner.
Zoologist.

Figure 1: The professions who use drawings identified in the Quick on the Draw exhibition (2008)
can be considered to be the basic skills which underpin our school curricula.
When the word graphicacy first appeared in the mid-1960s in a journal paper published by Balchin and Coleman (1965), it was presented in a geography context. Balchin later defined graphicacy as ‘the communication of spatial information that cannot be conveyed adequately by verbal or numerical means alone’ (1985:8). The term struck a strong resonance and influenced academics both in the UK and other countries, across a range of subject areas.

**Graphicacy in the USA**

In New Jersey, Fry (1974) talked about ‘literacy in graphs which was beginning to approach word literacy’ (383). He used the term ‘graphical literacy’ to describe ‘the ability to read and write (or draw) graphs’, and defined a graph as ‘a two dimensional visual representation of a concept in a nonverbal or at most partly verbal form’ (390). Supported by the view that ‘pictures, maps and other types of graphs have been used throughout the ages, since or before written verbal language (383)’, he proposed that ‘reading teachers are well equipped to take active educational leadership in graphical literacy because they already have many skills that are readily transferable’ (385). Taking a similar view and using parallel examples, Tierney, Readence & Dishner from Boston, wrote in 1990; ‘graphical literacy’ is defined as the ability to interpret charts, maps, graphic, and other pictorial presentations used to supplement the prose in textbooks, non-fiction trade books and newspapers. Aldrich and Sheppard (2000) included a more

**Figure 2: An illustration of some of the forms of images included in graphicacy taken from Aldrich and Sheppard (2000)**
extensive list of some of the forms of images included in graphicacy, which have been represented in Figure 2.

**Graphicacy in South Africa**
In South Africa, Wilmot completed research work in the mid-1990s, which was strongly influenced by the work of Balchin and Coleman, amongst others. Wilmot’s work at the time was focused on graphicacy and primary school children, and it became very influential on the design of the South African educational system. Graphicacy was incorporated into the primary school curricula as one of the four basic skills children should be taught, along with literacy, numeracy and articulacy. In her report Wilmot describes graphicacy as ‘a complex form of communication in that it utilises some form of symbolic language to convey information about spatial relationships’. Van Harmelen, who worked closely with Wilmot for some time, took a geography perspective on the topic (influenced by Balchin) and suggested that ‘(g)raphicacy is the language the geographers use for the form of communication concerning space, place and time’. (2002:5)

**Graphicacy in Australia**
Another view taken around this area was from the Senate Standing Committee on Education and the Arts in Australia (1981:48). It was said that ‘non-verbal communication is equally a fundamental part in social life, as visual learning directs students toward an understanding and appraisal of the mass media’. They talked about integrating visual learning in the school curriculum as they believe visual competence is necessary in many school subjects.

**Common perspectives**
In the literature reported so far, everyone is in agreement that ‘each of the four modes of communication can be an aspect of learning or part of the application of what has been learnt. Balchin in 1996 used the terms ‘incoming’ or ‘outgoing’ to describe these, ‘according to the direction of the flow’; different terms have been used to explain these, for example Fry, (1974:388) used the terms reading & comprehending and drawing; and Catling (1995) and Molyneux and Tolley (1987) used encoding and decoding information in graphic form.

In general, most of the views expressed on the area of graphicacy, share the same beliefs on the importance of graphicacy as a basic skill and the need for it to be included in the school curriculum along with literacy, numeracy and articulacy. A very successful analogy used by Balchin to describe its importance was ‘graphicacy should be the fourth ace of the pack’ (Balchin “& Coleman, 1965, p.85). The fact that it has been identified and studied in numerous different countries, including Australia, Brazil, Canada, Denmark New Zealand, South Africa, Switzerland, the UK and the USA; many of whom have asked for Balchin’s 1965 journal paper to be reprinted at some stage, indicates the strength of the common ground surrounding the concept of graphicacy and its potential to support curriculum development.

**3. Research concerning graphicacy**
Research has been conducted concerning the relationship of graphicacy to cognitive development (e.g. Spencer, Blades & Morsley, 1989), in particular spatial ability (e.g. Wilmot, 2002) and gender differences (e.g. Boardman, 1990). Prior research has also explored the importance of graphicacy in education e.g. the balance of text-based and visually-based resources within educational materials and its importance for learning (Verdi et al, 1996), the significance of graphicacy in the presentation of quantitative information in an educational context (Jones et al, 2000) and the emerging research agendas associated with computer generated images. These present too wide a scope to be included here, but prior research on testing graphicacy levels which directly relates to the development of taxonomy has been included.

**Testing graphicacy levels**
In relation to general graphicacy, some tests have been developed for different age ranges to test some areas of graphicacy. However, only one test has been introduced to test exclusively graphicacy skills.

A Basic Graphicacy test was put in place for secondary school children in the UK. After piloting, the Associated Examining Board consulted with a group of educationists and industrialists and put together the Basic Graphicacy Test, to supplement general educational qualifications such as GCSE. The Basic Graphicacy test was one out of ten Basic tests produced by the Board. These were:

1. Basic Applications of Science.
2. Communication skills.
4. Geography.
5. Graphicacy.
6. Health Hygiene and Safety.
7. Life Skills.
9. World of Work, complementary.
10. Geography for Tourism and Leisure (complementary paper).

The test was first introduced in 1985 and covered areas which ‘employers regarded as essential for a very wide range of jobs in different areas of industry or commerce’ (Basic Test Syllabus, 1996:1). The definition used by the Board to describe graphicacy...
TEST IN BASIC GRAPHICACY

ASSESSMENT OBJECTIVES

(a) signs and symbols commonly used to instruct, advice or warn;
(b) information and numerical quantities represented in graphical form;
(c) diagrammatic forms commonly used to represent planned sequences;
(d) methods of representing three-dimensional objects in two dimensions.

TEST CONTENT

1. Signs and symbols (20 marks)
   (a) Symbols used on domestic materials, appliances and equipment. Including textile
       care labelling symbols. Control symbols on kitchen equipment and symbols
       commonly used on domestic electronic equipment
   (b) Public information signs and signs affecting pedestrians and cyclists. Including
       warning, information and direction signs and street markings. Refer to Highway
       Code.
   (c) Prohibition, warning, mandatory, hazard and risk warning signs. Including fire,
       toxic, corrosive, radiation, electric shock and protective clothing warnings.
   (d) Pictorial markings on goods or packaging. Including handling instructions for
       fragile, vulnerable or dangerous goods.

2. Charts and graphs (25 marks)
   Understanding and construction will be required, including elementary calculations,
   throughout this section.
   (a) Bar charts, proportional bar and pie diagrams, pictograms. Examples taken from
       any source.
   (b) Graphs. Significance of the choice of scales. Reading information from graphs
       but not mathematical equations.
   (c) Patterns of contours, isobars and isotherms. Cross-sections will be included.
       Basic interpretation only of meteorological charts.

3. Flow charts and circuits (25 marks)
   (a) Block Diagrams and flow charts to represent familiar operations. The standard
       symbols for Terminal, Process, Decision and Preparation. Operations may
       include school routines, home or leisure activities, transport and travel, data
       processing and other similar examples.
   (a) Circuit diagrams - Including illustrations from the flow of liquids, gases, electricity
       and traffic. Associated technical knowledge will not be required.
   (b) Operational sequences. Including assembly instructions given graphically.

4. Three-dimensional representation (30 marks)
   (a) Maps and plans - Practical use of maps, street and building plans and their
       associated symbols. Ordnance Survey maps at scale 1:50 000 Second Series.
   (a) Orthographic representation and pictorial sketches - Transposition between
       orthographic and pictorial: use of grid paper. Simple perspective only.

Figure 3: Objectives and content of the test in basic graphicacy by the Associated Examining Board
Drawings used in different trades and professions taken from the Quick on the Draw exhibition


Figure 4: Some of the key types of images identified by Baynes (2008)

was ‘Graphicacy embraces all forms of diagrammatic presentation used to communicate information that cannot be conveyed clearly or conveniently by words or mathematical notation alone’ (Basic Test Syllabus, 1996:2). The aim of the course based on the syllabus was to help develop basic knowledge, understanding and skills in graphic forms of communication appropriate to the needs of school leavers entering employment and/or further education. The test’s objectives and content are shown in Figure 3.

The tests were withdrawn from the education agenda almost as suddenly as they appeared, with no apparent explanation or reason. After conducting a small survey with 6 postgraduate design students, it became apparent that the test was cultural dependant (as some of the postgraduates asked to complete the test were non-UK natives and had consistent mistakes). When it came to symbol understanding and reading it was evident that even if the students had not come across the specific symbols before, they were expected to make associations with other symbols and use prior knowledge to decipher their meaning. The questions relating to technical drawings were challenging, suggesting the need of very high ability for them to be completed successfully; perhaps too high for the average 16 years old student.

4. Typologies of graphicacy

In order to identify where graphicacy fits across the curriculum and how it is developed through teaching, literature has been studied reporting the different types of images that exist and are used.

Baynes (2008) listed 49 types of drawings used in different professions (Figure 4.), which he considers to be the key types of images most commonly used i.e. technical drawing, diagrams, photographs etc.

Balchin (Figure 5) grouped images into categories similar to the ones extracted from Baynes(2008) (Figure 4). However there are also differences. For example Balchin lists highway symbols, health and safety symbols and symbols on electrical equipment and Baynes only used the category of symbols. As Balchin stated, ‘the full range of graphicacy is immense and we are confronted with its manifestations almost continuously’ (1996). His list includes some categories of these manifestations and examples of one category are named (Cating’s list of 38 map types is used in Figure 5).

Within her book, Hope (2008) identifies the functions of drawings, the skills involved in reading and/or creating them
and the different forms of drawings. These are brought together in Figure 6. This list aids in placing graphicacy across the curriculum, as she gave extensive examples which could be also seen as:

1. Identifying learning objectives (skills involved/developed).
2. Relevant tasks to be completed (functions of drawings).
3. End products (forms of drawings).

A similar approach has been taken in the analysis, by the author, of the research found in The Campaign for Drawing yearly booklets (2001-2007), depicting different types of drawings and skills required to understand and/or create those drawings (Figure 7).

5. Fry’s taxonomy of graphs

Fry (1974) went a step further and put his ideas into a taxonomy for graphical literacy, made up of 6 categories (Figure 8). He presented a cross-curricular perspective and his suggestions of where types of graphs could be used in teaching (incorporated into Figure 8) included, in no particular order: history, literature, business, sports science, computer programming, management, mathematics, engineering, architecture, art and advertising.

Such taxonomy and the earlier typologies are useful, but need to be modified and adapted in order to provide a structural framework suitable for current research.

Figure 8 Taxonomy of graphs as described by Fry (1974)
All the typologies of different kinds of drawings and their purposes (Figure 7) have contributed to the development of the taxonomy described in section 6.

6. The need for new taxonomy

Twenty eight years ago Fry published a wide-ranging taxonomy categorising the images according to the type of information represented i.e. quantitative, spatial, lineal etc. He illustrated examples probably following the images most commonly used in academia at the time. As times have moved on, the internet has emerged and computer drawing tools have become more common in schools, the nature of drawing in the school curricula has changed, i.e. use of colour, photographic and 3D images. Hence there is a need for an updated taxonomy. Since the new taxonomy has been put together as a research tool to map graphicacy, and ultimately to support the measurement of the levels of the skills and abilities to communicate through visual images, the categories have been organised so as to accommodate all types of images, which are used to cultivate the same or similar learning outcomes. For example, the images under the category of graphic art could be used as a tool/ aid to help people visually explore, understand themselves and the world around them and demonstrate this understanding. In addition, an essential new category has been created to accommodate the new technological developments which deal with computer images. This new taxonomy (shown in Figure 9 and described in the next section) is a modern,
Thinking and learning through drawing: in primary classrooms

Functions of Drawing
Springboard, place-making, thought-holder, dynamic, evolving, informing, developing thinking, support, develop and expand thinking and enhance learning, develop and record thoughts and creative ideas, ubiquitous, multi-purpose, multi-faceted, multimedia, multicultural, multi-meaningful, express relationships; physical (size, scale, position in space), abstract (expressing theoretical concepts), analogue (London Underground map), symbolic representation, generate ideas, means of objectifying an inner image, support thinking in process, enhance reflection and evaluation, convey meaning, feeling, knowledge, insight and inventiveness, generating ideas, developing ideas, developing personal response, investigating form, understanding function, modelling ideas, concepts and relationships, clarifying ideas, observations and relationships, representing abstract concepts, mapping relationships, analysing concepts, establishing patterns, developing understanding, questioning observations, manipulating key concepts and relationships, developing narrative, communicating to others.

Skills involved/developed
Observational skills, discernment of similarities, differences and patterns, recognition of scale, proportion, relationships, hand-eye coordination, motor skills, knowledge and understanding of materials, tools and techniques, development of visual literacy, language, evaluative and critical skills, formation of personal viewpoint, willingness to change and adapt, higher-order analytical skills, meta-cognitive reflective and analytical capabilities, multimedia communication skills.

Forms of drawings
Decorate a sculpture, graffiti, architectural drawings, sketches and first drafts of half-considered ideas, well-finished products that closely mirror an observation, random marks, lines, patches of colour, text items as well as drawing, including numerals and other symbols, analogues of concepts and relationships, expressive of deep emotion, purposefully dispassionate, possibilities of production in another medium, developing and communicating personal or shared meaning, exploratory of materials and techniques, parts of a series that develops ways of communicating ideas, symbolic, semiotic, metaphoric, metonymic, analogical, allegorical, paracosmic, for private pleasure, a social art, or public view

(These ideas have been represented by Danos, taken from Hope, 2008:1-15)

Figure 6: Functions, skills and forms of drawing brought together from Hope's book (2008)
Different kinds of drawings serve different educational purposes.

Drawing types

Analytical drawing, Annotated drawings.
Bird’s eye view.
Cartoons, Computer generated images.
Design drawings, Diagrams, Doodles.
Elevations, Exploded views.
Gestural drawings.
Narrative drawings.
Maps.
Observational drawings.
Plans, Projections (isometric, oblique, orthographic).
Schematic drawing, Scribbles, Sequence drawings.
Serial vision studies, Sketches, Speed drawings, Story boards.
Technical drawing.

Educational purposes

<table>
<thead>
<tr>
<th>Perception</th>
<th>Communication</th>
<th>Manipulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observe</td>
<td>Symbolise</td>
<td>Dream</td>
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<td>Record</td>
<td>Narrate</td>
<td>Imagine</td>
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<td>Investigate</td>
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<td>Analyse</td>
<td>Negotiate</td>
<td>Test an idea</td>
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<td>Synthesise</td>
<td>Instruct</td>
<td>Transform</td>
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<td>Contemplate</td>
<td>Specify</td>
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<td>Remember</td>
<td>Codify</td>
<td>Solve a problem</td>
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<td>Reflect</td>
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<td>Respond emotionally</td>
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Figure 7: Types of drawings and their educational purposes gathered from The Campaign for Drawing yearly booklets (2001-2007)

cross-curricular framework which could be used to explore graphicacy across all years of secondary education.

Taxonomy designed for full curriculum audits

From a cross-curricular textbook analysis, the literature review and Fry’s taxonomy, a new taxonomy has been proposed, which can be used to identify graphicacy, where and how it is used.

Each one of the seven categories represents a type of images which requires specific type of skills in order to be read, understood and created. Terms from Fry’s taxonomy have been taken where they still seemed appropriate to help accommodate the updated categories. The seven categories are as follows:

1. Pictorial – Graphic art: The graphic art category includes images which are used to help people visually explore and understand themselves, the world around them and how they respond or feel about it. Images produced within this category fall in the same category as those from Fry’s taxonomy under the title ‘Pictorial’.

2. Pictorial – Drawing: A drawing is described as an analytical, well finished product that closely mirrors an idea or observation, often used to obtain a full understanding of that which is being observed. The type of drawings produced
Figure 8: Taxonomy of graphs as described by Fry (1974)

1. Lineal graphs—Sequential data
   a) Simple Lineal—For example, a time line or simple nonbranching flow chart can be used in history, literature (a story line), or directions.
   b) Multiple Lineal—Parallel lines. For example, a set of three time lines that show terms of office of presidents, with a parallel line showing inventions, and a third parallel line that shows the reigns of English Kings or queens.
   c) Complex Lineal—Complex lines that have branching, feedback loops, and diverse data. For example, a computer programmer's flow chart, a process chart, or a hierarchy chart for a business or governmental organisation, a genealogy chart, or a sports tournament elimination chart.

2. Quantitative graphs—Numerical data
   a) Frequency Polygon—gives continuous data, can best show trends. For example, a normal distribution curve, growth curves, stock market fluctuations.
   b) Bar graph—gives discrete data points, can best show the difference between two amounts. For example, it can contrast the size of enrolment for three different years.
   c) Pie graph—best shows percent by various areas.
   d) Complex numerical graphs—Engineering graphs, multiple data graphs, higher mathematics graphs. For example, graphs drawn in log-rhythmic units, multiple line, or multiple variables.

3. Spatial graphs—Area and location
   a) Two-dimensional—Represent something flat. For example, road maps, floor plans, football plays.
   b) Three-dimensional—Represent height or depth plus length and width. For example, a map with contour lines showing mountains or valleys, mechanical drawings, or building elevations that accurately show dimension.

Basically, spatial graphs show the location of a point or the location and size of a line (one dimension), area (two dimensions), or volume (three dimensions). By use of special indicators or multiple graphs, different time periods can be shown.

These ideas have been represented by Danos, taken from Fry Edward, 1981
4. Pictorial graphs—Visual concepts
   a) Realistic—More or less what the eye would see
      without significant distortion or elimination of
detail. Can have an angle or point of view, selection
of subject matter, selection of composition, back-
ground, and content. For example, photographs or
realistic drawings single or multiple color.
   b) Semipictorial—A recognizable image but with
      noticeable distortions in form, color, content, or
      omissions of detail. For example, most Picasso
      paintings, schematic drawings showing cutaway
      or exploded engine, cartoons, or outline draw-
      ings.
   c) Abstract Pictorial—Highly abstracted drawing
      which, however remote, has some basis in visual
      reality. For example, a single line across a space
      might represent the horizon; a vertical line, a per-
      son; a series of squares, a row of automobiles.
      Abstract drawings or graphs nearly always re-
      quire some context, verbal explanation, or prior

5. Hypothetical graphs—Interrelationship of ideas
   a) Conceptual graph—An attempt to communicate
      abstract ideas by using lines, circles and other
      forms, with or without words or symbols. For exam-
      ple, a philosopher who labels the sides of a triangle
      ‘truth, beauty, justice’; a theoretical model of the
      reading process with boxes labelled ‘short-term’ and
      ‘long-term.’
   b) Bar graph—Gives discrete data points, can best
      show the difference between two amounts. For ex-
      ample, it can contrast the size of enrollment
      for three different years.

6. Spatial graphs—Area and location
   a) High verbal omission—On the borderline between
      having some graph qualities and being purely
      verbal would be a typical outline with main idea
      and supporting details, or posters and advertise-
      ment composed with different sizes and styles of
      types that show emphasis or are aesthetically
      pleasing.
   b) High numerical omission—Arrangements com-
      posed mostly of numbers, such as statistical ta-
      bles, are omitted.
   c) Symbols are omitted because, for all practical
      purposes, they are the equivalent of a word. Typi-
      cal examples are reuses or glyphs (like the out-
      line of a man on a restroom door, a cross on a
      church building, and road sign arrows).
   d) Decorative design—Design whose main pur-
      pose is decoration, not conveying concepts, are
      omitted.

Combinations—Nearly any kind of graph can be combined. An example of a combination would be a mechanical drawing,
which is a type of spatial graph (3b), but which could approach the reality of a picture (Section 4, Pictorial). Another example
would be a bar graph, which is quantitative (2b), but which can use drawings or photographs of images; for example, car produc-
tion is seen as many little cars piled on top of each other.

Information taken from

384 Journal of Reading February 1981 Fry Edward
These ideas have been represented by Danos, taken from: Fry Edward, 1981
<table>
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<th>Taxonomy: Graphicacy in the curriculum</th>
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<td>By Danos Xeni, 2008</td>
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1. **GRAPHIC ART; PICTORIAL**
   - ART
     - LIFE DRAWING
     - LANDSCAPE
     - PORTRAITS [1]
     - STILL LIFE

2. **DRAWING; PICTORIAL**
   - DRAFTS
     - SKETCHING
     - DRAWING

3. **DIAGRAMS; PICTORIAL**
   - ANNOTATED
   - ARCHITECTURAL
   - ENGINEERING / TECHNICAL
     - PROJECTIONS (ORTHOGRAPHIC, OBlique, ISOMETRIC)
   - EXPLODEd
   - PERSPECTive

4. **SEQUENTIAL; LINEAL**
   - CARTOONS
   - STORY BOARDS
   - FLOW DIAGRAM
   - SPIDER DIAGRAM / BRAINSTORMING

5. **SYMBOLIC; QUANTITATIVE / ABSTRACT**
   - CHARTS and GRAPHS
   - SYMBOLS

6. **SYMBOLIC; SPATIAL**
   - MAPS
   - PHOTOGRAPHS
   - ADVERTISEMENTS [2]

7. **CAD (Computer Aided Design)**
   - COMPUTER AIDED IMAGES
   - 3D VIRTUAL IMAGES

This category represents:

To help people visually explore and understand themselves and the world around them, how they respond or feel about it.

Usually the item produced is a finished product itself.

Well finished products that closely mirror an idea/observation. This is a means to achieve/get to the next stage.

Technical diagrams to define clearly features, details and/or requirements such as relationships, processes, components.

Illustrate the sequence of a thought, process or story. Image follows a relative sense of direction.

Symbolic representation of data information and/or warnings.

A representation of a message, a person, a scene or an area.

2. 2Dimensional and 3 Dimensional images created with the use of computer software.

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Figure 9: A new taxonomy of graphicacy, by Danos 2008 (non-referenced images are taken from Baynes (2008) Quick on the Draw)
Figure 10: Examples of how DT contributes to teaching and learning graphicacy (Images are referenced at the end of the paper)
from this category also fall within the ‘Pictorial’ category described in Fry's taxonomy.
3. Pictorial – Diagrams: Diagrams are usually technical in content and are used to define clearly features, details and requirements such as relationships, processes and components. Once more, the type of diagrams produced from this category fall within the ‘Pictorial’ category described in Fry's taxonomy. The focus of these 3 categories is the different learning outcomes one can achieve from each one.
4. Sequential: Sequential images illustrate the sequence of a thought, process or story by following a relative sense of direction. The logic behind the way these images are constructed is the same the graphs described by Fry under the title ‘Lineal’. The graphs under Fry's title ‘Hypothetical’ are also included in this category.
5. Symbolic – Quantitative/abstract: Quantitative or abstract symbolic illustrations are involved with data information and information transfer such as symbols. Part of the images included in this category, are the same as those in Fry’s taxonomy under the title ‘Quantitative’.
6. Symbolic – Spatial: Spatial symbolic images represent in a literal manner a message, a person a scene or an area. Fry places maps under the title ‘Spatial’. Photographs and advertisements could be placed under the title ‘Pictorial’ when using Fry’s taxonomy.
7. CAD (Computer Aided Design): Computer aided design includes all of the above categories. From an incoming (reading) perspective, similar skills are likely to be required as above. From an outgoing (creating or applying) perspective, the skills required will depend on the sophistication and complexity of the software package used. This area is not covered in Fry’s taxonomy.

The taxonomy could at a later stage also be used as a guide to build tasks for learning and testing graphiacy skills and levels (Figure 9). The taxonomy will be used for curriculum audits and the categories will be developed or added to as such studies reveal is necessary.

7. Design and technology’s contribution to the development of graphiacy

Many subjects contribute to the development of graphiacy, e.g. art and design, mathematics, geography; design and technology as a subject is also highly graphiace. Figure 10 demonstrates through graphical examples how incoming and outgoing skills are taught and tested within the subject, indicating its wide ranging contribution and involvement with the development of this area of human capability. Some examples are:

1. Graphic art; Pictorial: Incoming: In food technology, images from the graphic art category could be used while learning about traditions of different countries by analysing, for example, Christmas cake decorations.
Outgoing: In textiles, images could be developed to apply learning about patterns by creating a design to be repeatedly printed on material.
2. Drawing; Pictorial: Incoming: In product design, observing and re-drawing existing examples of technical drawings could be used to enhance the learning of the correct way of producing such drawings.
Outgoing: In product design, drawings are often produced to create and develop ideas.
3. Diagrams; Pictorial: Incoming: In textiles, exploded diagrams could be very useful to give a detail explanation of the parts comprising an item.
Outgoing: In food technology, students could be asked to label and annotate images to show understanding of various features, such as the 5 senses.
4. Sequential; Lineal: Incoming: In food technology posters of step-by-step processes could be very helpful as it enables students to remind themselves of the next step while completing their individual work.
Outgoing: In systems and controls a flow chart is a common tool which could be used to illustrate a process or program written.
5. Symbolic; Quantitative: Incoming: In textiles symbols are widely used, giving maximum amount of information on the smallest label possible.
Outgoing: In systems and controls the ability to illustrate a circuit is very important, as it allows for creating and developing ideas.
6. Symbolic; Spatial: Incoming: In structures, the study of existing structures in photographs could be very beneficial when learning about forces and structures. Outgoing: In graphic products, it is essential to have the ability to use photographs to portray the final product.
7. CAD (Computer Aided Design); Incoming: In product design, computer aided images could be used in the classroom to study ergonomics.
Outgoing: In resistant materials 3D computer software could be used during concept development, to help test and finalise the idea

8. Conclusion

Graphiacy is clearly identified as an everyday life skill and requirement, almost regardless of age, status or profession. Summarised prior work provides an idea of how widely spread the concept of graphiacy is, and some areas of interest from different disciplines are identified. Through analysis of existing taxonomies and numerous drawing type inventories, a new, modern taxonomy has emerged suitable for extensive, cross-curricular research concerning graphiacy. Initially cross-
curricular mapping of where it is taught and when its understanding is demonstrated are the targets but eventually it will be used to support the measurement of levels of competency in graphicacy. To demonstrate the important role that education in design and technology plays, examples of how it contributes to teaching and demonstrating understanding of each category of the taxonomy are given.

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