



HAL
open science

Being told or finding out or not: A sociological analysis of pedagogic tasks

Jeremy Burke

► **To cite this version:**

Jeremy Burke. Being told or finding out or not: A sociological analysis of pedagogic tasks. CERME 9 - Ninth Congress of the European Society for Research in Mathematics Education, Charles University in Prague, Faculty of Education; ERME, Feb 2015, Prague, Czech Republic. pp.2989-2994. hal-01289715

HAL Id: hal-01289715

<https://hal.science/hal-01289715>

Submitted on 17 Mar 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Being told or finding out or not: A sociological analysis of pedagogic tasks

Jeremy Burke

King's College London, Department of Education and Policy Studies, London, UK, jeremy.burke@kcl.ac.uk

Pedagogic tasks can be considered as a resource for engaging an audience and manipulating their apprenticeship. Different strategies can be deployed according to the pedagogic aim and what constitutes competence in the practice being pedagogised. The position taken here is that message acquirers will assume a degree of authority in the practice and the degree to which that is achieved is dependent on the possibilities made available in the task(s) set. A sociological analysis recognises that the engagement between author and audience in a pedagogic relation will lead to a distribution of message across positioned acquirer voices; the argument presented here seeks to map those possibilities in an explicit way. Texts on trigonometry are taken to exemplify this.

Keywords: Social Activity Method (SAM), pedagogic strategy, pedagogic tasks, textbooks, trigonometry.

There has been concern expressed about the use of textbooks in school mathematics teaching from a number of perspectives including a preponderance of procedures and calculation rather than conceptual development (Dole & Shield, 2008) allied with an authority position assumed in the author voice (Herbel-Eisenmann & Wagner, 2007). Whilst procedures are frequently used in mathematics practices there are other features which are available to make up a broader competence. My argument is based on the premise that in a pedagogic relation acquirers of the practice may have a range of subjectivities made available: a high level would be indicative of attaining some recognition as an adept in the practice and a low level suggests a degree of dependency (e.g., Dowling, 2009, p. 244). My concern here is the pedagogic strategies deployed in mathematics teaching may lead to the availability or restriction of access to some independent competence in the practice. My analysis is sociological insofar that I am concerned with social strategic action within pedagogic relations.

I wish to draw on Dowling's (2013) Social Activity Method (SAM) in which he outlines the practice being pedagogised as the yet to be acquired esoteric domain. The esoteric domain is recognisable through strongly institutionalised (I+) signification. In school mathematics texts I+ expression will include a specialised use of words, algebraic notation, technical diagrams or graphs. The expression will link to I+ mathematics content. The esoteric domain practice is realised through an assemblage of strategies that includes procedures and instrumentation, but also interpretive action including "discursive definitions, principles, theorems [...] and] visual exemplars" (Dowling, 2013, p. 332). For further recent work in SAM see Dudley-Smith (2015), Olley (2015) and Burke, Jablonka and Olley (2014).

DISCURSIVE SATURATION

In Dowling's (1998) study of the very widely used School Mathematics Project (SMP) scheme in the UK, which was provided in sets of books, colour coded according to a 'level' of ability attributed to the readers. Here he found that there were different textual strategies played out in the Yellow (highest) and Green (lowest) series. Of particular note was a difference in the degree to which the texts provided access to the esoteric domain. A key distinction was between strategies which make the principles of the practice explicit within language (high discursive saturation) and those which are tacit in this respect (low discursive saturation) (Dowling, 2013, p. 322).

Textbooks, as extensively used resources, provide a good indicator of the specificity of classroom practice, and gives an indicator of the intensity of discursive saturation provided in a pedagogic message. For this reason, I have looked at a current, widely used, textbook series focused on the General Certificate of Secondary Education (GCSE) examination set for

school students aged 16 years across England. The GCSE examinations are set and administered by examination boards one of which is Edexcel. The books I am referring to are from the Heineman/Edexcel texts, 1996 and the Pearson/Edexcel texts, 2010. The earlier series were divided into three tiers Higher, Intermediate and Foundation and the later series into Higher and Foundation, which, like the SMP books, construct a body of potential readers as having different 'ability'. I have taken, here, an example from the introduction to trigonometry from the Higher tier Books where there appears to have been a shift between the Heinemann/Edexcel texts (Pledger & Kent, 1996) and the Pearson/Edexcel texts (Pledger & Cummings, 2010) in terms of the discursive saturation of the texts.

Trigonometry

In the first chapter on trigonometry the 1996 book provides a detailed exposition based on a unit circle, generating three functions $\sin x$, $\cos x$ and $\tan x$. The limits of the range of the functions are introduced and then their application to right angled triangles. The hypotenuse of the triangle in the unit circle becomes analogous to the scale factor of enlargement which in turn explains the ratio $\sin x = \text{opposite} / \text{hypotenuse}$ and so on. The text here is DS+, making relatively explicit the form and structure of trigonometric functions. I notice that the strategy in this book is also integrative of the esoteric assemblage (in providing the non-discursive visual resource to work in relation to the well specified theorems and procedures). There is, then, more *interpretative* work to be done by the ideal reader compared to the *proceduralisation* exemplified in the next paragraph

In the more recent Pearson/Edexcel textbook each chapter is written to a template where the topic is introduced largely referring to esoteric domain content. The presentations are focused on stepwise procedures for answering word problems, with call-out text boxes pointing where to do calculations, where to 'remember' certain steps or conditions and so on. The book provides an introduction to trigonometry thus:

Key Points

- The hypotenuse (hyp) of a right-angled triangle is the longest side of the triangle and is opposite the right angle. The other two sides are named adjacent and opposite. The

side opposite an angle is called the opposite side (opp)

The next side to this is called the adjacent side (adj)

- Here is a right-angled triangle with its hypotenuse of length 1.

The length of the opposite side (opp) in this triangle is known accurately and is called the *sine* of 70° and is written $\sin 70^\circ$.

Its value can be found on any scientific calculator. Not all calculators are the same but the key sequence to find $\sin 70^\circ$ applies to many calculators.

(Pledger & Cummings, 2010, p. 383)

This text is considerably more limited than in the earlier book. There is no detail about what trigonometry is or where it comes from, as in the earlier text. It provides abbreviations and reference to calculator generated values, perhaps a literal 'black box'. A little later the book offers SOHCAHTOA to help memorise the three specified trigonometric ratios. The exercise that follows this introduction directs the use of a calculator to find the value of the trigonometric function given an angle, for example,

Use a calculator to find the value of

- a) $\sin 20^\circ$
- b) $b \cdot \sin 72.6^\circ$
- c) $c \cdot \cos 60^\circ$ [...]

(ibid, p. 385)

This text provides more *procedural* work utilising both discursive (e.g., the procedural definitions of trigonometric ratios) and non-discursive (e.g., a calculator) resources, than the 1996 text.

In both of these books there is a pattern of introducing new content with an explanatory text of some form. Stacey and Vincent (2009) looked at modes of reasoning deployed in these introductions but they differentiated between, "a set of instructions that ex-

plain, for example, how to set up a stem-and-leaf plot ... [and] a deeper sense of explanation and connection involving derivation, justification and/or proof of a new mathematical result.” This is consonant with my findings, but I shall argue that I have provided a finer analytical purchase on the strategies deployed.

OSTENSIVE AND RESERVED PEDAGOGIC MODES

One way of approaching a lesson plan is to consider what task will be set with which the audience can engage, and what prior introduction is needed in order to facilitate the engagement with the task. This presents a task as a two stage process of presentation and activity. In these texts, and those referred to by Stacey and Vincent, the content is *introduced* before the task activity. The task activity is anaphoric in relation to the pedagogic presentation: that is the presentation may make sense only through the task that follows it. The pedagogic mode, in these texts, is to point to the *how* or *why* attributes of the topic, which is redolent of Wittgenstein’s description of *ostensive* explanation, pointing at the content and providing the expression, Wittgenstein (2009, 17§28). Wittgenstein also considers some limitations of “ostensive explanation” and here an alternative is conceived as a cataphoric pedagogic mode, where the task activity refers to the detail yet to be explicitly given. I turn now to an example of this, drawn from a different text altogether.

Shadows

Ollerton (2002, p. i) argues for an apparent freedom that is afforded teachers by not using a textbook in order to wrest “control away from authors of schemes and texts”. Instead he offers a range of “starting points and extension ideas”. Typical of these is a task, ‘Shadows’, included in the Association of Teachers of Mathematics (ATM) *Points of Departure*, vol. 4, as follows:

63. SHADOWS

A child is standing near a lamppost. What happens to the child’s shadow

- if the child walks directly towards the lamp-post
- if the child walks in the other direction [...]

ATM (1989)

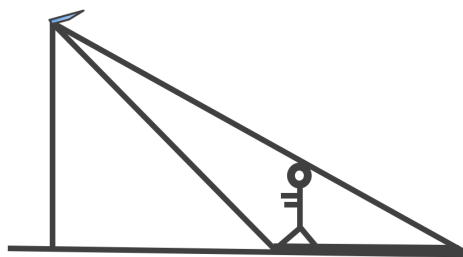


Figure 1

Here the introduction is minimal. A diagram is given showing how the shadow is formed, but other than that there is no prior guidance. In terms of a pedagogic task there has been little action on the part of the author. There is no explanation given as to what to do next. There is no procedure to follow. There is no answer at the back of the book. What then might be expected of a student engaging with such a task? It could be addressed through taking various examples, perhaps using a dynamic geometry package. Or it may lead to a recognition of 3 different triangles which are all similar and consequently have the same ratio of sides. In this case, the focus would be on a tangent ratio, and recognising that as the distance from the lamppost changes, so does the angle of elevation. However, that the similarity of the triangles maintains the ratios of the sides is fundamental in theorising trigonometry, in which case the task becomes DS+, that is the principles are made explicit.

This appears to be the obverse of the example from the GCSE textbooks. Instead of an ostensive explanation there is none given in advance of the *situation* presented. There may have been prior lessons on finding areas, or on strategies, such as Polya’s heuristics, for dealing with “investigations”, but these are not available from the text in this case.

The point to note is that there is still a pedagogic relation. The authorial voice sets a task, and there is little option but for the audience to engage in some way with it, and I rather suspect that Mike Ollerton’s pupils, also, cannot opt out. This is because, as Bernstein (2000, p. 32) proposes, there are (at least) two discourses: the one relates to the disciplinary discourse (instructional) and the other a non-disciplinary discourse (regulatory). The latter will typically position the instructional author as the authority in respect of the disciplinary discourse also (Burke, 2011). The pedagogic relation is maintained even without an ostensive explanation. I consider this to be the case of a *reserved* pedagogy. The principles of evaluation

of the practice are still retained by the author who will determine whether the performance of the audience is adequate. The ATM book does not provide any ‘answers’ and the opportunity is provided for definitive statements of coherence and arguments for solutions to questions developed in response to the situation. This would constitute a move towards a highly discursively saturated text (DS+), albeit one that is produced in the first instance through the engagement with the task.

However, whilst this has the appearance of the open text (Eco, 1984) it is not ultimately a *writerly* text (Barthes, 1974). The closure will come in the evaluative judgment of author, although this has been held in reserve for the duration. I will return to the discussion of the open task.

Tarsia

The three examples given outline tasks which are differentiated in terms of the discursive saturation of the texts produced, either as prior presentations or as performances based on engagement with the task. A fourth example will suffice to complete a schema. There is a widely used task activity referred to as Tarsia puzzles where students tessellate parts of a larger design according to the connection between two statements given on the sides of two pieces. An example of a puzzle requires pairing trigonometric identities, and here the blogger reports that pupils were keen to (Roy, 2013). Another example is given on the National Centre for Excellence in the Teaching of Mathematics (NCETM) website of a triangular puzzle constructed from 16 equilateral triangular pieces. A teacher says:

I produced a triangular Tarsia puzzle for my class on the topic of number sequences. The questions consisted of number sequences with two missing terms [...] I gave out the puzzle to the students with no input at all and was specific in not providing any initial assistance. Although some students were disconcerted at first, they

soon settled to the task and quickly solved the puzzle. (NCETM, 2010)

The task has no prior introduction from the teacher, so similar to Shadows, there is a reserved pedagogy. However the reservation appears to have lasted a relatively short period of time as the student “quickly solved the puzzle”. The solution does not, as it stands, lead to making the principles of the ‘solution’ clear. In fact the teacher notes that students use a strategy of answering easier questions first suggesting a probabilistic response to the final questions. The task activity consists of a set of components to be assembled, but this is a DS- text.

PEDAGOGIC TASKS

I am now able to show these four tasks as pedagogic strategic engagements in a SAM type schema. The horizontal axis distinguishes DS+ and DS- discourse. The vertical axis distinguishes the pedagogic mode as Reserved or Ostensive.

The cells now give a typification of a strategic process of task engagement. With reference to the 1996 trigonometry text, there was a clear exposition of the principles followed by word problems including some of an analytical nature. The text was DS+ and the pedagogic mode was ostensive. This can be characterised by the anaphoric relation *exposition and problem*. The more recent GCSE textbooks had a rapid demonstration of how to find the value of a trigonometric function using a calculator and the application of SOHCAHTOA, followed by exercises using a calculator. This I am showing as *demonstration and drill*. The ‘Shadows’ task, on the other hand had a cataphoric task-pair relation. The task had no prior introduction other than the situation. However the production, following engagement can be considered in the form of a composition, which in mathematical terms would include an argument for both the strategy adopted and the coherence of any statement – ‘discursive definitions and principles’ (Dowling, 2013, p. 332) The task offers access to the esoteric domain

Pedagogic mode	Discourse	
	DS+	DS-
Reserved	situation/composition	components/assembly
Ostensive	exposition/problem	demonstration/drill

Figure 2: Pedagogic tasks

albeit through the action of engagement with it. I have termed this pair as *situation and composition*. The final cell is exemplified in the Tarsia task, with no introduction and little development of esoteric domain principles, comprising the presentation of *components to be assembled*.

The scheme does not fix action around pedagogic tasks. Empirically there will be activity by both the practice adept and the audience being potentially apprenticed to the practice. There can be moves between the task instantiation and the task activity. The way that the task is read will also depend on a number of factors.

READER THEORY AND CUEING

Weinberg and Weisner (2011) are concerned with how students use a textbook and develop an analysis which contrasts the intended, implied and empirical reader of the text. They note that whilst the text constructs an ideal reader the empirical reader may not conform with expectations. The pedagogic tasks outlined above may be responded to in a way which seeks to change the strategy initially promoted. The teacher in the Tarsia report observes that the “students were disconcerted”. Weinberg and Weisner note that undergraduate mathematics students might look for a rule or procedure to guide them through their task activity. If the opening presentation had been in exposition mode, the students might respond as though it was a demonstration. Similarly the presentation might be in one format, but a response from the reader might lead to a change. In the Shadows example, the situation was given and a response could be to raise a question, “What should I do now?”. Such a response is also strategic. Maintaining a reserved pedagogic mode the response to the cue to close down the task would be to ask a question in response. This could be as bald as, “What do you think you should do?” More productive questioning might be along the lines of Brown and Walter’s (2004) ‘What if?’ and ‘What if not?’ If the response was to provide a procedure, ‘compute the ratio of the height and base of the triangles’ the move would be towards demonstration and drill.

Weinberg and Weisner also draw on the idea of Eco’s open text where the invitation is for the reader to compose in response. This is the appearance of tasks such as Shadows, but the task is given in the context of a mathematics classroom. The text is already subject to its setting, and the reader expectation of (minimally) a mathematics classroom will also be a feature of a reader response. I wish to argue that the text is not open and that the relation between the author and reader is pedagogic – whether it is the author of the textbook or the empirical adept.

The form of responses to cues might be considered as further questioning to maintain a reserved DS+ strategy or simply a correction to maintain an ostensive DS- strategy. In the other two cases, then an explanation maintains an ostensive DS+ strategy and a hint a reserved DS- strategy. This is shown in Figure 3.

Herbel-Eisenman and Wagner (2007, p. 8) are also concerned about the positioning of students within mathematics textbooks and they provide a framework to examine “the way a textbook might influence a mathematics learner’s experience of mathematics.” The analysis is based on “the social positioning experienced by students” (ibid, p. 10).

They are careful to note that an analysis of a text does not give an unequivocal reading of the positioning effect on the reader. This is consonant with Dowling and Burke (2012) who pointed out that the various gendered representations in mathematics textbooks appeared not to have had an effect on girls out-performing boys in GCSE, at least up until 2010 when the format of the exam was changed. It seems likely that the pedagogic tasks deployed will have more of an effect on outcome, which is perhaps why the later Pearson/Edexcel texts provide, almost uniformly, tasks formed from demonstration and drill strategies which have been associated with a gradual rise in the number of GCSE passes at grade C and above over recent years. The ‘effect’ on learning mathematics might be different from an effect in terms of a wider social difference in other settings.

Pedagogic mode	Discourse	
	DS+	DS-
Reserved	situation/composition/question	components/assembly/hint
Ostensive	exposition/problem/explanation	demonstration/drill/correction

Figure 3: Pedagogic tasks and adept cuing

Stacey and Vincent (2009) in their study on reasoning in school mathematics textbooks concluded:

...the critical point for developing students' mathematical reasoning is whether they understand that some modes of reasoning are indeed part of the acceptable range of reasoning in mathematics, whilst others serve a local pedagogical purpose, such as helping them remember a rule, building connections between topics, making mathematics plausible. Textbooks could more often make these distinctions explicit, and in so doing, give students a stronger sense of mathematical justification. (Stacey & Vincent, 2009, p. 287)

Indeed textbooks could be more explicit about the strategies they are deploying but it is also perhaps as critical that mathematics teachers have some clarity about the resources they are using. The current Pearson/Edexcel textbook adopts, almost entirely, a pedagogic strategy of demonstration and drill, similar to the observations of Dole and Shield rather than distinctive, contingent strategies observed by Stacey and Vincent. The schemas I have given provide a coherent description of the process of interaction and pedagogic strategy in pedagogic tasks, demonstrated here through mathematics texts. They might also prove to be productive in classroom contexts to analyse the process of task presentation and student engagement in terms of whether they are being told, or they are finding out, or if there is a ubiquity of procedure.

REFERENCES

- Association of Teachers of Mathematics (ATM) (2007). *Points of Departure 4: An ATM Activity Book*. Retrieved from www.atm.org.uk [Original work published 1989].
- Barthes, R. (1974). *S/Z*. Oxford, UK: Blackwell.
- Bernstein, B. (2000). *Pedagogy, Symbolic Control and Identity: Theory, Research, Critique*. Oxford, UK: Rowman & Littlefield Publishers.
- Brown, S. I., & Walter, M. I. (2004). *The art of problem posing*. Hove, UK: Psychology Press.
- Burke, J. (2011) Call out the Troops: classrooms, discipline and authority. In J. Dillon & M. Maguire (Eds.), *Becoming a Teacher: Issues in Secondary Teaching*, (pp. 185–197). Maidenhead, UK: Open University Press.
- Burke, J., Jablonka, E., & Olley, C. (2014) Mathematical Modelling: Providing Valid Description or lost in Translation, *Proceedings of the British Society for Research into Learning Mathematics*, 34(1), 31–36.
- Dole, S., & Shield, M. (2008). The capacity of two Australian eighth-grade textbooks for promoting proportional reasoning. *Research in Mathematics Education*, 10(1), 19–35.
- Dowling, P.C. (1998). *The sociology of mathematics education: Mathematical myths/pedagogic texts*. London, UK: Falmer Press.
- Dowling, P.C. (2009). *Sociology as method: Departures from the forensics of culture, text and knowledge*. Rotterdam, The Netherlands: Sense Publishers.
- Dowling, P.C. (2013). Social activity method (SAM): A fractal language for mathematics. *Mathematics Education Research Journal*, 25(3), 317–340. DOI 10.1007/s13394-013-0073-8
- Dowling, P. C., & Burke, J. (2012). Shall We Do Politics or Learn Some Maths Today? Representing and Interrogating Social Inequality. In H. Forgaz (Ed.), *Towards Equity in Mathematics Education* (pp. 87–103). Berlin, Germany: Springer.
- Dudley-Smith, R. (2015). Discriminatory networks in mathematics education research. In Krainer, K. & N. Vondrová (Eds.), *Proceedings of CERME9* (this volume).
- Eco, U. (1984). *The Role of the Reader: Explorations in the Semiotics of Texts*. Bloomington: Indiana University Press.
- Gove, M. (2013) *Curriculum, exam and accountability reform*. Oral statement to Parliament retrieved from <https://www.gov.uk/government/speeches/curriculum-exam-and-accountability-reform>.
- Herbel-Eisenmann, B., & Wagner, D. (2007). A framework for uncovering the way a textbook may position the mathematics learner. *For the Learning of Mathematics*, 27(2), 8–14.
- National Centre for Excellence in the Teaching of Mathematics (NCETM) (2010). *What makes a good resource*. Retrieved from <https://www.ncetm.org.uk/resources/20337>.
- Ollerton, M. (2002). *Learning and Teaching Mathematics without a Textbook*. Derby, UK: ATM.
- Olley, C. (2015). School mathematical modelling: developing maths or developing modelling? In Krainer, K. & N. Vondrová (Eds.), *Proceedings of CERME9* (this volume).
- Pledger, K., & Cumming, G. (Eds.). (2010). *Edexcel GCSE Mathematics a Linear Higher: Student Book*. Harlow: Pearson.
- Pledger, K., & Kent, D. (Eds.). (1996). *Edexcel GCSE Mathematics Higher Course* Oxford: Heinemann Educational.
- Roy, J. (2013). *A Trig Puzzle*. Retrieved from <http://crispymath.com/news/2013/3/9/a-trig-puzzle>.
- Stacey, K., & Vincent, J. (2009). Modes of reasoning in explanations in Australian eighth-grade mathematics textbooks. *Educational Studies in Mathematics*, 72(3), 271–288.
- Weinberg, A., & Wiesner, E. (2011). Understanding mathematics textbooks through reader-oriented theory. *Educational Studies in Mathematics*, 76(1), 49–63.
- Wittgenstein, L. (2009). *Philosophical Investigations* (4th ed.) Chichester, UK: John Wiley & Sons.