This item was submitted to Loughborough's Research Repository by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Aspects concerning the acquisition of a technical vocabulary in primary schools: a study of the terms "axle" and "shaft" and their use by children and teachers

PLEASE CITE THE PUBLISHED VERSION

PUBLISHER

© Loughborough University

LICENCE

CC BY-NC-ND 4.0

REPOSITORY RECORD

Parkinson, Eric. 2019. “Aspects Concerning the Acquisition of a Technical Vocabulary in Primary Schools: A Study of the Terms "axle" and "shaft" and Their Use by Children and Teachers”. figshare. https://hdl.handle.net/2134/1402.

Aspects concerning the acquisition of a technical vocabulary in primary schools: a study of the terms "axle" and "shaft" and their use by children and teachers

Eric Parkinson
Canterbury Christ Church University College

Abstract
The development of a technical vocabulary by primary children engaged in design and technology tasks is an aim expressed within a range of curriculum documents in the United Kingdom. From this position, this paper explores the basis of what appears to be an assumption within the field of curriculum leadership that primary children can construct an "appropriate" technical vocabulary and that teachers can lead them in this process.

The study explores aspects of specialised language acquisition by children and adults via survey evidence collected in institutions in the county of Kent, UK. A relatively small data field yielded quantitative evidence of the linguistic choices made by children. This evidence is underpinned by other studies from research activity in the UK and Sweden.

The evidence suggests that children are perhaps reluctant to use "correct" terms, and employ their own linguistic constructions instead.

Evidence from adults, such as primary teachers and student teachers, suggests that those people able to influence children in the transfer between informal and formal, technically-derived language do not seem to have an accurate knowledge of some terms themselves.

Keywords: language , mechanisms, primary

Background

The development of a technical vocabulary for primary age children is one of the stated intentions of government curriculum documents across the United Kingdom. In England and Wales (DFE 1995) it is written that pupils should be taught "to use the appropriate vocabulary for naming and describing the equipment, materials and components, and processes they use" (p. 61) and this view is echoed in the Environmental Studies 5-14 programme in Scotland (SOED, 1993, p.49) and by the Department of Education for Northern Ireland (DENI,1992, p. 6).

Clearly, within the context of the UK there is a consistent message that the naming of elements of design and technology concerning parts and processes is valued.

However, there may be indications that some teachers are failing to deliver a sound technical vocabulary, since on the basis of evidence in England and Wales, the government inspection body OFSTED (1995) suggests that in infant schools (Key Stage 1) "..technical vocabulary was rarely developed adequately." (p.6)

This study attempts to identify, through qualitative and quantitative means, the extent to which both pupils and teachers are conversant with some elements of a technical vocabulary.

Specific items from a technical vocabulary: shaft and axle

Two terms have been selected for scrutiny, "axle" and "shaft", since these are central to a broad field of activity in the domain of

mechanisms to which children are exposed through the span of the primary years in UK schools.

Shafts in particular are important as a means by which force and motion are conveyed through the stages of a gear train, where pairs of gears on shafts may effectively compound distances travelled and forces applied.

Stein and Poole (1997) list the terms shaft and axle within a modern source book to support design and technology activity for teachers. They suggest that axle and shaft are amongst "some unfamiliar words that children may encounter" (p. 41). Perhaps by implication the authors are also suggesting that these are terms with which teachers should be conversant in order to have a level of background knowledge beyond that of the children they teach. In another recent teacher resource publication, Johnsey (1998) only mentions the term "axle" and not "shaft" in the context of mechanical control situations. Regarding the development of an appropriate vocabulary, Johnsey directs the reader to an onward resource (DATA 1995) from the UK-based Design and Technology Association, and indeed it is appropriate and timely that this organisation has produced such a useful guide as a means of supporting primary teachers regarding definitions of some key terms used in Design and Technology activity. Within the terms that DATA believe may be encountered in classroom activity or as background knowledge for teachers the following definitions are offered:

> "Axle—Rod on which one or more wheels can turn" (p.22)
>
> "Shaft—A rod which transmits motion" (p. 25)

These technical terms, like many others, are of course a form of textual shorthand. For example, instead of referring to " wheels which have machined or cast grooves disposed in regular fashion around their periphery so they may interact with similar wheels in order to convey motion through the act of rotation" we simply talk about "gears".

In a similar way, the terms shaft and axle are loaded in meaning.

It is worth acknowledging at this point that the terms shaft and axle do not seem to be items of as widely shared meaning as the brief DATA corpus might indicate. Within major corpora, axles may variously be ascribed properties in which they are seen to turn or to be rigid so that other components may turn upon them. Nonetheless, even axles which are offered a looser meaning in respect of being fixed or rotating are usually qualified. Engineers may refer to "live" axles for example.

For the purposes of this article, the DATA definitions are held as accurate, save for the further qualification that in the purest sense, a shaft transmits motion only by rotation.

Qualitative and anecdotal evidence on use of technical language in schools

There has been a limited number of studies on pupil use of technical terms in primary design and technology. In a study on children and their use of technical terms whilst engaged in a problem-solving setting focused upon making mechanisms in LEGO Technic, Bennett (1996) records that

> "It was interesting to note the reluctance or inability of the children to use the technical vocabulary in discussions. Axles were variously called 'stick things'...'spars' ..... 'that bit there'.... 'Little things- what's it called?' .....and yet this did not necessarily diminish the children's practical capabilities or willingness to explain their understanding."
> (p. 228)

In a similar mechanism-related setting for studying primary-age pupil behaviour with mechanisms, Schoultz (1997) reinforces this view of children choosing to use their own terminology, and offers an explanation from the perspective of *technological* language not being seen as a *native* language. Schoultz records:

> "The pupils in the study used few words from the technological field, instead they used words like that one, this one, this

> stick and that spike etc. This is not unusual as technology for many people is a long list of words and terms which have been extracted from their context." (p.28)

From limited evidence such as this, it appears that whilst children may be at ease working on mechanism-related tasks, they seem to do so without the apparent need for standard, dedicated terminology.

Evidence from institutions in Kent, UK

Data collected from a small sample of institutions in Kent, UK, supports the view that pupils, and their teachers, employ limited application or understanding of the technical terms axle and shaft. To assess pupil and adult understanding of these terms, and the principles behind them, specially produced timber artefacts featuring a wheel attached to a red shaft and a wheel which could turn on a yellow axle were utilised.

Samples of adults and children were randomly selected from co-operating institutions. The subjects were asked to explore the artefact and then give names to the yellow and red components.

Children's responses

Children's responses regarding the naming of parts, the core of the study, was in many ways secondary to their reaction to the artefact itself. Most children wanted to provide a name—and from within that perhaps a context, for the whole artefact. The wheels may have been offset on opposing corners of the artefact, with only one wheel evident on each rod, yet nonetheless many children ventured "*this is a car isn't it*?" Some went further and added that "*some wheels are missing*".

The children seemed unwilling to accept the detachment and abstraction required to focus on individual components. These, it seemed, had to be related to the *whole artefact* and, to the children, the device was "incomplete" without a name or purpose.

From a small sample of children (n=18) in UK primary years 5 and 6, only one child referred to the fixed and moving rods as a "shaft". No children used the term "axle". The most frequently used terms were "piece/ bit of wood" (5 responses, -- two for the shaft and three for the axle) and "stick" (4 responses--- two each for the shaft and axle).

A slightly larger sample (n= 31) was collected from younger children. These were drawn from UK primary years 3 and 4. The pattern of data reflected that found with the previous sample. The most frequently used term was "wood" (15 responses,--seven for shaft and eight for axle) and "stick" (11 responses,--seven for shaft and four for axle). No children employed the terms "axle" or "shaft".

The sheer *range* of words used by children as descriptors was extensive in both samples, and provided a glimpse into the diversity and richness of language upon which the children were able to draw. This might be interpreted as indicating a stage in concept development in which, according to Vygotsky (1986), the children were able to use concrete and factual bonds to associate with components, rather than adult abstractions and logic.

Data from adults—a comparison

Data were also collected from serving teachers for purposes of comparison. Volunteers from two primary schools (n=28) teaching the 5-11 age range in Kent, UK, kindly participated.

The overwhelming finding was that adults preferred to use the term "axle" for both the yellow axle and red shaft. This data from serving teachers was further supported by data volunteered from students (n=108) in the first few weeks of a primary teacher training course at a higher education institution in Kent. Again, the overwhelming response was that of the use of the term "axle" to describe both the yellow axle and red shaft. In fact, for the red shaft, 46% opted for the pure term "axle" whilst a further 20% used the term, but in qualified form such as "moving axle". For the yellow axle the use of the term "axle " was slightly less emphatic,

with 24% using the unqualified pure term and a further 26% using it with qualification.

Analysis and some conclusions

Clearly this study is indicative only, given the small sample sizes employed and some fundamental weaknesses in the data - gathering mode utilised. Children were asked, for example, to name parts of artefacts which were introduced into classrooms without the benefit of a background context and in situations in which individual children merely responded to questions rather than had a chance to engage with the artefact as active groups.

As part of their response to the shaft-and-axle artefact, the children could be seen to be developing what might be described as "informal labels" on encountering novel processes and components. Moreover, classroom behaviour, consistent with the observations by Johnsey (1998), suggests that besides written and spoken language at the heart of this paper, even body language has a part to play. This appears to extend or substitute speech as a transfer medium for ideas. Johnsey notes that "Hand gestures can describe the dimensions and shape of a model and how parts of it function and move. The method is a quick and effective way of communicating ideas to others and of manipulating an image held in the mind's eye" (p. 62).

A significant factor to consider regarding the complex overall picture of language acquisition is that of *assumptions* about the use of use of everyday language. Rix and Boyle (1995) for example, raise the issue of children having *alternative* meanings for *everyday* words. The notion of alternative meanings leads to another strand in the understanding of learning and key role of language, for areas such as primary science have left a significant mark on the research landscape with ideas on constructivism. This rests on the notion that learners assemble their own frameworks of meaning (Driver et al, 1985) in order to explain the circumstances of their surroundings. Moreover, scientifically incorrect, yet plausible explanations may lead to the development of alternative frameworks. These must be challenged and appropriately reconstructed if scientific ideas are to take root and flourish. From this perspective, a parallel line of enquiry can be followed, for if it is accepted that children may construct their own explanations and consequent meaning, then it may follow, given the interaction of meaning and language, that they may construct elements of their own language too, including perhaps an array of "informal labels" supported by the qualification of concrete descriptors.

Halliday (1975) brings a further dimension to the notion of informal labelling. In describing "macro-functions" of language, distinctions between functional components of the semantic system are made.

One of these macro -functions within the semantic system refers to "interpersonal" components. This function is characterised by participation in a speech event where elements of personal judgements and attitudes can exert effects on listeners. Is this process also at work when informal labelling is undertaken? Within the nuances of spoken language, then *how* things are said may be as relevant as *what* is said. "*Little things- what's it called*? and '*stick things*' may convey interpersonal overtones into the informal labelling process.

Lave (1991) adds another dimension to this aspect by taking a de-centred view between the polarity of constructivism and individual and socially shared cognition. Jean Lave suggests that children may develop language and learning within what is termed "situated social practice" (p.67).

Perhaps the role of pupil *participation* needs further exploration with a greater emphasis on organisational strategies. These may enable pupils to situate themselves both as observers and as managers with responsibility for practical activity (Lave & Wenger 1991, Rogoff 1995). This perspective as a basic notion concerning the transfer of knowledge, underlines the point that it is the transfer between situations of, say, "observer" and

"responsible organiser" that allows participants to construe relations between purposes and meanings. Indeed, Rogoff describes this process in a profound way as being "... inherently creative, with people actively seeking meaning and relating situations to each other" (p. 159). Recognition of the situated learning environment perhaps has a role to play in children's encounters with mechanism where new language learning opportunities abound and teachers may organise classroom activity so that children may act perhaps as "designer" and "builder" to gain situated experiences.

What is the place of dedicated technical terms in language acquisition at primary school level ?

This study highlights a number of issues.

Firstly, from the formal curriculum perspectives cited at the start of this paper, it would seem that the possession of appropriate technical terms is seen as a desirable aim.

Second, there is some inconsistency in the very definition of technical terms themselves. One cannot be completely sure what "right" terms actually are!

Finally, from limited research evidence based on observations of what children do in schools, children appear to want to use their own terms rather than prescribed ones and demonstrate a facility for constructing terms based, for example, on perceptions of form and function. This in itself may be a valuable learning experience which can serve to develop technological capability.

What effect does all this have on the development of literacy within the primary classroom? It may be that children are not necessarily "technologically deprived" if their technical vocabulary is not as sound as curriculum documents might incline us to believe to be desirable. Perhaps the technical "home grown labels" that may be produced by children within the design and technology "situated community of practice" contribute to a growth of understanding that is, as yet, not recognised nor understood. A body of further evidence from primary classrooms, especially that derived from action-research by teachers, certainly needs to contribute to the overall picture. Perhaps the pursuit of a true technical vocabulary at an early age is, to an extent, undesirable and "special" terms are best used in the more refined atmosphere of secondary education. Here technology-dedicated staff can use appropriate terms and convey these to children consistently within relevant contexts.

One is left to question the effect of children constructing "inappropriate" linguistic frameworks due to the "misuse" of technical terms by their teachers. Perhaps the apparent semantic and linguistic drift of shaft and axle can be attributed to this.

References

- Bennett, R. (1996) 'An investigation into some Key Stage 2 children's learning of foundation concepts associated with geared mechanisms'. *The journal of design and technology education*, 1, 3, 218-229.

- Design and Technology Association (1995), *Design and technology—technical vocabulary for Key Stage 1 and 2*, DATA, Wellesbourne.

- Department of Education for Northern Ireland (1992), *Technology and design. Programmes of study and attainment target*, DENI, HMSO, Belfast.

- Department for Education (1995), *Key Stages 1 and 2 of the National Curriculum*, Department for Education, HMSO, London.

- Driver, R., Guesne, E. and Tiberghien, A. (1985), *Children's ideas in science*, Open University Press, Milton Keynes.

- Halliday, M. A. K. (1975), *Learning how to mean: explorations in the development of language*, Edward Arnold, UK.

- Johnsey, R. (1998), *Exploring primary*

design and technology, Cassell, London.

- Lave, J. (1988), *Cognition in practice: mind, mathematics and culture in everyday life*, Cambridge University Press, Cambridge.

- Lave, J. (1991) 'Situated learning in communities of practice'. In Resnick, L.B., Levine, J. M. and Teasley, S.D. (eds) *Perspectives on socially shared congnition*, American Psychological Association, Washington, 63-82.

- Lave, J. and Wenger, E. (1991), *Situated learning: legitimate peripheral participation*, Cambridge University Press, Cambridge.

- OFSTED-Office for Standards in Education (1995), *Design and technology. A review of inspection findings 1993/94*, HMSO, London.

- Rix, C. and Boyle, M. (1995) 'I think I know what you mean'. *Primary science review*, 37, 19-21.

- Rogoff, B. (1995) 'Sociocultural activity on three planes'. In Wertsch, J.V., Del Rio, P. and Alvares, A. (eds) *Sociocultural studies of mind*, Cambridge University Press, Cambridge, 139-164.

- Schoultz, J. (1997) 'Pupils talk and write about simple mechanisms'. In Ager, R. and Benson, C. (eds) *International primary design and technology conference—a celebration of good practice, volume 2*, CRIPT at University of Central England, Birmingham, 26-30.

- The Scottish Office Education Department (1993), *Environmental studies 5-14*, The Scottish Office Education Department, Edinburgh.

- Stein, G. and Poole, P. (1997), *A Primary teachers handbook—design and technology*, Folens, Dunstable.

- Vygotsky, L. (1986), *Thought and language*, A. Kozulin (ed and Trans.), Cambridge, The MIT Press, Mass, USA.