Comprehension monitoring, metacognition and other mysterious processes

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Introduction

While reading some particularly densely written background material before writing this article I noticed that it was becoming increasingly difficult for me to concentrate on what I was reading. My mind kept drifting to other, lighter, topics and several times I came to with a jerk to realise that I had understood nothing of the several paragraphs I thought I had read'. In the language I shall use in this article, this was a metacognitive experience, and my comprehension monitoring had alternately lapsed and kicked into action. These terms are probably unfamiliar to many people, yet the processes to which they refer have been increasingly demonstrated to be of special importance in intellectual development and in the operation of many intellectual activities, in particular that of reading. This article will explore the areas of metacognition and reading, focusing in particular upon comprehension monitoring, before briefly reviewing the practical ways in which teachers might respond to these insights. (Much greater detail about the issues referred to here will be found in Wray, (1994)).

Metacognition and comprehension monitoring

Vygotsky suggested (1962) that there are two stages in the development of knowledge: firstly, its automatic unconscious acquisition (we learn things or how to do things, but do not know that we know these things), and secondly, a gradual increase in active conscious control over that knowledge (we begin to know what we know and that there is more that we do not know). This distinction is essentially the difference between the cognitive and metacognitive aspects of knowledge and thought. The term metacognition is used to refer to the deliberate conscious control of one's own cognitive actions (Brown, 1980), that is, cognition about cognition: thinking about thinking.

There is a hierarchical relationship between the terms • metacognition' and • comprehension monitoring' (Baker & Brown, 1984). • Metacognition' can be seen as the wider concept, applying to knowledge about cognition in general. • Comprehension monitoring' is seen as applying mainly to the comprehension of connected discourse, which may, of course, involve either reading or listening. In thinking about this topic the following kinds of questions tend to get asked (Wagoner, 1983): What do readers know about their own comprehension, that is, what they comprehend and how they comprehend? Are they aware of when they comprehend adequately and when they do not? How do readers decide when their comprehension is adequate? What kinds of strategies do readers use when they realise they are not comprehending what they read in order to compensate for this? Some fairly clear answers to these questions have emerged from research, and they are answers with important implications for teachers of reading.

Comprehension monitoring in reading

An analysis of the operation of comprehension monitoring during the reading process must begin with a description of what this process involves. Good reading has been described as follows: "A good reader proceeds smoothly and quickly as long as his understanding of the

material is complete. But as soon as he senses that he has missed an idea, that the track has been lost, he brings smooth progress to a blinding halt. Advancing more slowly, he seeks clarification in the subsequent material, examining it for the light it can throw on the earlier trouble spot. If still dissatisfied with his grasp, he returns to the point where the difficulty began and rereads the section more carefully. He probes and analyses phrases and sentences for their exact meaning; he tries to visualise abstruse descriptions; and through a series of approximations, deductions, and corrections he translates scientific and technical terms into concrete examples. (Whimbey, 1975, p. 91)

While it is, of course, true that all readers do not follow precisely this sequence of actions, most theories of reading have suggested similarly strategic models for the comprehension process. According to Brown (1980), some of the metacognitive activities involved in reading are:

a) clarifying one's purposes for reading, that is understanding the explicit and implicit demands of a particular reading task,
b) identifying the important aspects of a text,
c) focussing attention on these principal aspects rather than on relatively trivial aspects,
d) monitoring on-going activities to determine whether comprehension is taking place,
e) engaging in self-questioning to check whether the aims are being achieved,
f) taking corrective action if and when failures in comprehension are detected.

Reading for meaning therefore inevitably involves the metacognitive activity of comprehension monitoring, which entails keeping track of the success with which one's comprehension is proceeding, ensuring that the process continues smoothly and taking remedial action if necessary. It thus involves the use of what have been called 'debugging' skills (Brown, 1980).

Although mature readers typically engage in comprehension monitoring as they read for meaning, it is usually not a conscious experience. Brown (1980) distinguishes between an automatic and debugging state. Skilled readers, she argues, tend to proceed on automatic pilot until a 'triggering event' alerts them to a failure or problem in their comprehension. When alerted in this way they must slow down and devote extra effort in mental processing to the area which is causing the problem. They employ debugging devices and strategies, all of which demand extra time and mental effort. Anderson (1980) suggests that efficient readers need not devote constant attention to evaluating their own understanding and he suggests the existence of an 'automated monitoring mechanism' which 'renders the clicks of comprehension and clunks of comprehension failure'.

The events which trigger such action may vary widely. One common triggering event is the realisation that an expectation held about a text has not been confirmed by actual experience of the text. For example, in reading a sentence such as the following; "The old man the boats"; the fourth and fifth words will probably cause a revision of the reader's sense of understanding and therefore take longer to process. Another triggering event is the meeting of unfamiliar ideas at too rapid a frequency for the reader to maintain a tolerance for the subsequent lack of understanding. The usual reader reaction to this is to slow down the rate of processing, devoting time and effort to the task of sorting out the failure in comprehension. The reader enters a deliberate, 'aware' state quite distinct from the automatic pilot state and the smooth flow of reading abruptly changes. (Baker & Brown, 1984).

Realising that one has failed to understand is only part of comprehension monitoring; one must also know what to do when such failures occur. This involves the making of a number of strategic decisions. The first of these is simply to decide whether or not remedial action is required. This seems to depend largely upon the reader's purposes for reading (Alessi, Anderson & Goetz, 1979). For example, if a reader's purpose is to locate a specific piece of information, a lack of understanding of the surrounding text will not usually trigger any remedial action. On the other hand, if the purpose is to understand a detailed argument, then practically any uncertainty will spark off extra mental activity.

In the event of a decision to take action, there are a number of options available. The reader may simply store the confusion in memory as an unanswered question (Anderson, 1980) in the hope that the author will subsequently provide sufficient clarification to enable its resolution, or the reader may decide to take action immediately, which may involve rereading, jumping ahead in the text, consulting a dictionary or knowledgeable person, or a number of other strategies (Baker & Brown, 1984).

The occurrence of this range of strategies has been studied by Winser (1988) who asked readers of various ages to think aloud as they tried to understand difficult texts. The strategies they used when they encountered comprehension difficulties included the following:

- reading on: reading more of the text to see if more information could be gained,
- sounding out: examining letters and sounds carefully (this strategy was used most often by younger readers),
- making an inference: guessing a meaning on the basis of textual clues and previous knowledge,
- re-reading: reading the difficult section again,
- suspending judgement: waiting to see if the text provided more clues.

Research on comprehension monitoring in action

Two important studies of the comprehension monitoring of undergraduate students have given us insights into how this operates in mature, skilful readers. Baker (1979) gave students passages to read in which the middle paragraph had deliberately confusing features such as inconsistent information, an unclear reference, or an inappropriate connecting word. A large proportion of these confusions (62%) seemed not to be detected by the students even after they had been specifically asked to search for them. However, asking them afterwards about what they had been thinking while reading suggested that many of their failures to report confusions were due to their use of 'fix-up' strategies for resolving comprehension problems. They often, for example, made inferences from what they read in order to make up for the omission of information in the passage. With other text problems, they seemed to make a rapid assessment that the problem was unimportant and then ignored it.

Baker & Anderson (1982), also working with undergraduate students, used a computer terminal to present texts for evaluation. Passages containing inconsistencies were presented one sentence at a time on a computer, under the reader's control. Records were kept of the total time spent reading the passages, the time spent on each sentence and of the amount of looking back. The readers did seem to spend more time reading inconsistent paragraphs than consistent paragraphs and they also looked back at previous information more frequently when inconsistencies were present. A full third of the inconsistencies, however, seemed to go undetected but, of course, there are several possible explanations for this. They may really have been undetected, or they may have been detected and 'fixed', or detected and ignored.

It does seem, however, that in general mature readers evaluate their own understanding during the actual process of reading. If they encounter a confusion they give extra time to studying it and they reread previous sentences in an effort to clarify their understanding. They also seem to be prepared to make allowances for the fact that the problem might lie in the text rather than in them. This comprehension monitoring behaviour implies an active approach to gaining understanding from texts. How and when does this develop in younger and less experienced readers?

Numerous research studies have examined children's monitoring of their own comprehension and there has been a remarkable consistency in the findings of these studies. The two most replicated results have been that:
a) "younger and poorer readers have little awareness that they must attempt to make sense of text; they focus on reading as a decoding process, rather than as a meaning-getting process" (Baker & Brown, 1984, p.358)
b) "younger children and poorer readers are unlikely to demonstrate that they notice major blocks to text understanding. They seem not to realise when they do not understand" (Garner & Reis, 1981, p.571)

These findings have emerged from studies using a range of methodological approaches and it must be admitted that methodology has always been problematic. It is no easy matter to discover what is going on in the minds of highly articulate adults, let alone those of young children and children with reading problems. Studies have focussed on interviewing children (asking what they do when they read), measuring the eye movements of young readers for signs of their responses to lack of comprehension, asking readers to make a judgement about how certain they are that they understand a text and then to compare their judgements with their actual comprehension as measured by a test, examining children's self-corrections as they read, and the use of distorted texts, that is, texts containing inconsistencies of various kinds or other deliberate errors.

While there are problems with each of these research approaches and there also remain several unanswered questions about comprehension monitoring in reading, it is possible to draw some fairly firm conclusions from the extensive research in this area. Garner (1987) sums these up well: "The convergent findings from recent research can be summarised: Young children and poor readers are not nearly as adept as older children / adults and good readers, respectively, in engaging in planful activities either to make cognitive progress or to monitor it. Younger, less proficient learners are not nearly as 'resourceful' in completing a variety of reading and studying tasks important in academic settings" (p. 59). It appears that "planful, strategic behaviour" (Brown, 1978, p.457) in the face of the kind of reading tasks likely to be encountered in school learning does not develop until relatively late in children's school careers, and for some children, those who find reading difficult, this may be very late indeed. This is important because this kind of awareness is an essential ingredient in success in school. "Part of being a good student is learning to be aware of the state of one's mind and the degree of one's understanding. The good student may be one who often says that he does not understand, simply because he keeps a constant check on his understanding. The poor student, who does not, so to speak, watch himself trying to understand, does not know most of the time whether he understands or not. Thus the problem is not to get students to ask us what they don't know; the problem is to make them aware of the difference between what they know and what they don't." (Holt, 1969, p. 23).

This, of course, begs the question of how teachers might help children to develop the monitoring of their own understanding while reading and the next section of this article will examine some teaching approaches to this.

Teaching approaches to comprehension monitoring

Several teaching strategies have been suggested as beneficial in developing children's comprehension. Most, however, have not yet been subjected to objective research assessment and conclusions about them must remain tentative (See Wray (1994) for a more extensive discussion of teaching approaches). A major problem which has emerged in work on teaching awareness and strategy use has been that of transfer of learning. Children who demonstrate that they have learnt to act in a particular metacognitive way in the context of the training they have been given often seem not to maintain this way of acting in other situations or over the longer term. Brown, Armbruster & Baker (1986) suggest that, in order to overcome this problem, children need to learn strategies rather than particular techniques, strategic understanding involving a knowledge of not just what to do but of when, where, how and why to use particular techniques.

One relatively simple strategy with some history of success is that of teacher modelling. Tonjes (1988) discusses metacognitive modelling as a way of teachers demonstrating to children the monitoring strategies they use in their own reading and Duffy, Roehler & Herrmann (1988) similarly discuss the idea of the teacher modelling mental processes to children. They argue that teachers using this approach should concentrate upon transferring metacognitive control from themselves to their children and should model mental processes - what they think as they read or write - rather than simply procedures - what they do. Only in this way, they suggest, can children learn strategies which they can apply across a range of situations rather than which are limited to the context in which they were encountered.

Another apparently beneficial strategy is that of children being taught to ask themselves questions as they read. Miller (1985) reports on a study in which eight to ten year olds who were explicitly taught a self-questioning procedure to accompany their reading were better able to identify inconsistencies and errors in texts (that is, according to Miller, monitor their comprehension) than other children who were directly told to look for these inconsistencies. The self-questioning procedure these children were trained to apply consisted of the following questions which they had to ask themselves as they read:

1. First, I am going to decide if this story has any problems in it, like if one sentence says one thing and another sentence says something different or opposite.
2. Second, as I read I will ask myself, "Is there anything wrong with the story?"
3. Third, I will read two sentences and stop and ask if anything is wrong.
4. Fourth, so far, so good, I am doing a great job. Now I will read the whole story and decide if there are any problems in the whole story.
5. Did I find any problems in this story?

It should be noted that this study does not provide evidence that the effects of the training would transfer to other, more self-sponsored reading tasks. It is perhaps not so surprising that children trained to alert themselves to the presence of text inconsistencies should become fairly good at spotting them. This does not necessarily mean, however, that they will have improved their abilities to monitor their own comprehension when reading texts in which there are no deliberate errors or inconsistencies.

Tregaskes & Daines (1989) report on their research into the effectiveness of the direct teaching of strategies to monitor comprehension to twelve year olds. These children were taught the following metacognitive strategies:

1. Visual imagery (Stewart & Tei, 1984). The children were asked to visualise selected passages as the teacher read them, then to share their images by discussing and sketching them.
2. Summary sentences (Stewart & Tei, 1984). The children were taught to omit trivial and redundant information in order to identify the main ideas of a text.
3. Webbing (Clewell & Haidemos, 1983). The children were shown how to make concept maps of the ideas in a given passage.
4. Self-interrogation (Brown, 1978). The children were encouraged to ask themselves questions about what they already knew about a topic and what they expected to learn from the new passage.
5. 'Clunk Click' cards (Babbs, 1984). The children were introduced to a monitoring procedure outlined for them on a personal card. A copy of this card is shown in Figure 1.

Groups of children were directly instructed in these strategies over a twelve week period. After that time they were found to perform significantly better on the testing measures than children who had not been taught the strategies. Again, however, it needs to be pointed out that these testing measures were less than satisfactory, involving, firstly, cloze tests in which the children received a mark only for each word they got exactly right, and, secondly, an error detection test in which children had to underline words or sentences in passages which did not make sense to them. This seems a limited method of measuring improvements in comprehension and in comprehension monitoring. No attempt was made to assess whether the children's command of comprehension monitoring strategies extended to other contexts or indicated a lasting improvement.

Studies such as these give some hope, albeit tentative, that beneficial effects might arise from the direct teaching of metacognitive strategies. Approaches such as the modelling of mental processes by teachers, the encouragement of children to ask themselves questions about their own understandings and intentions and the setting of this kind of work into collaborative contexts may all be useful procedures for teachers to adopt.

Larger scale research has been carried out on one teaching approach which is currently receiving major worldwide attention and it will be useful to explore this in greater detail.

Palincsar & Brown (1984) begin by arguing that most training studies have produced rather discouraging outcomes, with little real impact on children's use of strategies and, particularly, on the transfer of these to activities outside those directly experienced during the training context. They attribute this failure to effect real change in learners' approaches to dealing with text to a model of learning which sees learners as simply responding, relatively passively, to instruction without really being made aware of just what they are learning and why. They claim that training, to be successful, needs to encourage learners to be active in their use of strategies and to understand why, and when, they should use the strategies to which they are introduced. The model of learning they propose as an alternative is based upon the twin ideas of 'expert scaffolding' and what they refer to as 'proleptic' teaching: that is, teaching in anticipation of competence. This model arises from the ideas of Vygotsky (1978), who put forward the notion that children first experience a particular cognitive activity in collaboration with expert practitioners. The child is firstly a spectator as the

majority of the cognitive work is done by the expert (parent or teacher), then a novice as he/she starts to take over some of the work under the close supervision of the expert. As the child grows in experience and capability of performing the task, the expert passes over greater and greater responsibility but still acts as a guide, assisting the child at problematic points. Eventually, the child assumes full responsibility for the task with the expert still present in the role of a supportive audience. Using this approach to teaching, children learn about the task at their own pace, joining in only at a level at which they are capable - or perhaps a little beyond this level so that the task continually provides sufficient challenge to be interesting. The approach is often referred to as an apprenticeship approach and many teachers will be familiar with its operation in the teaching of reading (Waterland, 1985). The distance between the level at which children can manage independently and which they can manage with the aid of an expert is termed by Vygotsky 'the zone of proximal development' and it is, according to the model, the area in which the most profitable instruction can proceed. Vygotsky claimed that "what children can do with the assistance of others might be in some sense even more indicative of their mental development than what they can do alone" (1978, p.85).

Palincsar & Brown (1984) designed their comprehension monitoring teaching procedures around this apprenticeship model of learning. Their approach used what they termed 'reciprocal teaching' to focus upon four activities:

a) summarising - asking children to summarise sections of text, thereby encouraging them to focus upon the main ideas in a passage and to check their own understanding of these,
b) questioning - getting children to ask questions about what they have read, which again encourages them to attend to the principal ideas and to think about their own comprehension of these,
c) clarifying - asking children to clarify potentially problematic sections of text, requiring them to critically evaluate the current state of their understanding,
d) predicting - getting them to go beyond what the text actually says to make inferences which they have to justify by reference to what they have read.

Each of these activities had a cognitive and a metacognitive dimension in that not only were the children working upon their comprehension of the texts (comprehension fostering) but they also having to reflect upon the extent of their comprehension (comprehension monitoring).

The reciprocal teaching procedure involved an interactive 'game' between the teacher and the learners in which each took it in turns to lead a dialogue about a particular section of text. The 'teacher' for each section firstly asked a question, then summarised, then clarified and predicted as appropriate. The real teacher modelled each of these activities and the role played by the children was gradually expanded as time went on from mostly pupil to mostly teacher.

This procedure was tested on a group of eleven year olds with reading difficulties. These children did initially experience some difficulties in taking over the role of teacher and needed a lot of help in verbalising during summarising, questioning, clarifying and predicting. They did eventually, however, become much more accomplished leaders of the comprehension dialogues and showed a very significant improvement on tests of reading comprehension, an improvement which seemed to generalise to other classroom activities and did not fade away after the completion of the research project. Palincsar & Brown attribute

the success of their training programme to the reciprocal teaching procedure, suggesting that it involved extensive modelling of comprehension fostering and monitoring strategies which are usually difficult to detect in expert readers, that it forced children to take part in dialogues about their understanding even if at a non-expert level and they learnt from this engagement.

Gilroy & Moore (1988) report on the results of their replication of the Palincsar & Brown reciprocal teaching procedure with 9 to 13 year olds in New Zealand. They found that positive gains in comprehension test scores were made by these children. In a review of research on the reciprocal teaching approach Moore (1988) agrees with the Palincsar & Brown analysis of the strengths of the approach and suggests that it has a great deal to offer, particularly to children with identifiable weaknesses in reading comprehension.

Conclusion

Although there are several caveats to be made about the quality of the research evidence, in particular about the methods typically used to ascertain children's comprehension monitoring performance, it does seem that there is reason to focus upon the development of this ability as one possible way forward in developing reading comprehension, particularly in poorer readers. It may be that the key to enhancing children's understanding in reading is to develop their abilities to be more 'aware' of their reading.

If this is the case, then teachers need to consider carefully how they will set about doing this. Although, again, the research evidence is as yet incomplete, there do seem to be several teaching strategies which might be beneficial in this area. Reciprocal teaching is certainly creating a great deal of interest, especially among teachers of children with reading problems (for example, McGowan & Bell, 1993), and this procedure currently seems to offer the greatest hope in terms of a well-founded, systematic approach to teaching. Its components, however, such as teacher modelling, encouraging self-questioning and explicit discussion of comprehension processes, are all beneficial teaching activities in their own rights. The teaching of reading comprehension would undoubtedly benefit from wider use of such approaches.

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