

Original Contributions - Originalbeiträge

Lucia Lumbelli

Productive Thinking in Place of Problem-Solving?**Suggestions for Associating Productive Thinking with Text Comprehension Fostering****Introduction**

In educational research, the term *problem-solving* is still ubiquitous, with crucial functions being attributed to it. Unfortunately, however, these functions are often defined in a rather vague, ambiguous manner, in both theoretical and empirical contributions. The basic experimental research on problem-solving is not always accurately applied to the instructional proposals. Problem-solving is often considered synonymous with much more general terms such as active learning, discovery or inquiry learning, or even minimally guided learning, as opposed to maximally guided learning, or indirect instruction as opposed to direct instruction.

Here, firstly, the definitions of problem-solving in the educational field are summarised, referring mainly to the suggestions provided in the debate on constructivism, characterised by the importance attributed to problem-solving in instruction; secondly, those educational perspectives that render Gestalt psychologists' definition of problem-solving more interesting than the other definitions are highlighted, chiefly in relation to learners' motivation or interest in learning; finally, a description is given of the application of this definition of problem-solving to an educational approach *centred on thinking-aloud readers as problem-solvers* and aimed at fostering text comprehension ability.

Problem-Solving in the Debate on Constructivism

In the contemporary debate on the constructivism applied to education, the lack of clarity in the definitions of problem-solving can be imputed both to constructivists, who claim that learning based on problem-solving is important and effective (Jonassen, 2004, 2009; Schwartz, Lindgren & Lewis, 2009; Spiro, 2006; Spiro & DeSchryver, 2009), as well as to those who claim that the effectiveness of learning based on problem-solving has not been experimentally proven, while direct, maximally guided, instruction has been clearly and repeatedly demonstrated to be an effective kind of instruction (Clark, 2009; Kirschner, Sweller, & Clark, 2006; Mayer, 2004, 2009; Sweller, 2009).

A more accurate definition of the specific features of problem-solving processes seems to be required, since problem-solving is closely connected to the

fundamental theme of the relationship between cognitive processes as well as the quality and quantity of motivation necessary to support these processes in instruction. In fact, rigorously identifying the possible specific features of problem-solving also implies defining an important component of a kind of instruction that ensures effective learning by guaranteeing learners' *interest* (Hidi, 2006), *intrinsic motivation* (Deci, 1975) or *self-determination* (Deci & Ryan, 1985) in the learning situation.

One main distinction in this debate is drawn from psycho-cognitive research on problem-solving, namely, the distinction between *ill-defined*, or *ill-structured*, *problems* and *well-defined*, or *well-structured*, *problems* (Kellogg, 2012, p. 244). Well-defined problems are characterised by a clearly defined problem space consisting of a clearly defined initial state, goal state and path to reach the goal. Ill-defined problems are characterised by the lack of a clear definition of the problem space, which consists of various paths and also various possible solutions.

Examples of well-defined problems are those analysed by Newell and Simon (1972) in terms of information processing, such as the so-called Tower of Hanoi, whereas the problems analysed by Gestalt psychologists are judged as ill-defined precisely because they require *productive thinking* where "insight and creativity" coexist, since "the thinker must see a new way of organizing the problem, i.e. a new way of structuring the elements of thought and perception" (Kellogg, p. 247).

This summary should suffice to allow us to compare the distinction between the definitions of problem-solving made in basic experimental cognitive psychology and educational research, where these definitions are being attributed a meaning that is much broader and vaguer than in basic cognitive research.

Constructivists make assertions such as "all learning is problem-solving", inspired by the title of Carl Popper's book (1999) "All life is problem-solving". This tendency points to their emphasis on ill-structured problems, which are "interdisciplinary" inasmuch as they concern what it means to be a citizen or a professional or even regarding how to construct meaningful models of the world (Jonassen, 2009). Choosing ill-defined problems as the most important and general ones leads them to consider well-defined problems as being related to just a few specific domains such as mathematics and physics, chiefly characterised by one single correct solution.

This shift from the distinction between two categories of problems to the distinction between two categories of knowledge domains occurs frequently in the debate between constructivists and those scholars who base instruction on the *cognitive load theory* (Kirschner et al., 2006).

According to constructivists, ill-defined problems are the main feature of the teaching of subjects such as history, music and art, since these are ill-structured

domains. Problem-solving reduced to ill-defined problem-solving is considered an instruction method suited to domains such as the social sciences but not to well-structured domains, such as mathematics and physics, where constructivists, too, consider direct instruction feasible and acceptable (Spiro & DeSchryver, 2009).

The opponents of constructivism (Sweller, 2009) claim that the distinction between ill- and well-defined problems is unacceptable, firstly, because well-defined problems too may offer multiple paths to the solution, and secondly, because in every kind of problem, certain solutions may be considered superior to other ones. Their instructional proposals, which are well founded both theoretically and experimentally, are presented as an alternative to learning by problem-solving; any reference to the importance of fostering learner motivation as an important condition for effective learning is lacking.

They completely ignore the relationship between problem-solving and learner motivation, and even the educational value of intrinsic motivation, in learning.

Mayer (2009) argues that instruction based on problem-solving or “discovery methods” coincides with “behavioural activity or hands-on activity” during learning. Discovering the solution to a problem is equated with engaging in behavioural activity. Paradoxically, this reduction of problem-solving to mere behavioural activity is considered an alternative to “cognitive activity”. The latter, instead, is recognised as the basic feature of direct instruction: Mayer refers mainly to “presentations” structured so as to engage learners in “appropriate cognitive processing during learning”, a phrase he uses repeatedly to define optimal instruction, although the definition of the criteria for judging this appropriateness is missing in his own numerous contributions. In his papers, the features of presentations function as independent variables, and the various kinds of learning outcomes function as dependent variables, whereas no data that refer to learners’ cognitive processes and that would be useful to identify the author’s criteria of their appropriateness are provided.

Those “appropriate cognitive processes” to which the instructional presentations should be addressed are, instead, simply listed as follows: attending to relevant information, organising it into a coherent cognitive structure and linking it with relevant prior knowledge from long-term memory. This concise general description of learning processes does not seem to provide criteria for evaluating the processes occurring during the process of learning from the different versions of presentations compared and explaining their different learning outcome.

The “cognitive activity” that Mayer (2009) describes in these vague terms is assumed as the optimal alternative to the “behavioural activity” to which he reduces learning based on problem-solving. Mayer’s work does provide

well-defined criteria for evaluating and defining the independent variables of his experimental investigations consisting of various types of presentations, by identifying the principles that must govern the presentations and serve as conditions for effective learning, as follows: segmenting, pre-training, modality, multimedia, personalisation and voice. They are all clearly defined and accurately manipulated in the experimental design of his experimental investigations. The unique weakness consists of the contraposition between cognitive and behavioural processes, which bring about his debatable consideration of learning by problem-solving.

The Educational Perspectives of Problem-Solving as Productive Thinking

This short discussion about the scientific status of problem-solving in educational research provides the premises of the argumentation in favour of Gestalt psychologists' definition of problem-solving as productive thinking and, consequently, in favour of an educational intervention based on that definition, inasmuch as it can guarantee learners' motivation to engage in learning activities.

The problems defined and instanced by Wertheimer (1945) and Duncker (1935) concern every kind of domain, since all these problems involve a kind of thinking called *productive thinking*, which can be found in every domain and is clearly distinguished from the more usual *reproductive thinking* based on rote memory (which is compatible with an optimal use of both working memory and long-term memory and which *cognitive load* theorists [Kirschner et al., 2006] consider to be the main components of the cognitive processing involved in learning). This more-usual kind of thinking too obviously belongs to every domain.

The goal of the Gestalt psychologists was to identify the features of productive thinking that make it quite different from the more usual reproductive thinking: it consists of a special cognitive processing that gives rise to the discovery (often experienced suddenly) of a new organisation or restructuring of the elements constituting the problem situation and, consequently, to its solution. This sudden discovery has been described as specific to the experience lived by a productive thinker, and it is this immediacy that has been criticised for its alleged irrationality and inexplicableness. What Gestalt psychologists wanted to do was capture those qualities of thinking that sometimes do bring about discoveries endowed with historical value but are not necessarily bound to such rare events. Productive thinking consists of any cognitive processing that involves a restructuring of the problem elements. The influence of long-term memory was not denied but simply considered as less important in productive thinking than in reproductive thinking. Both types may be involved in problem-solving, but problem-solving only becomes an effective cognitive challenge when a restructuring is required, which productive thinking alone can perform.

Dunker (1935) has chosen *thinking aloud* as the most suitable method to make the discovery process less mysterious and to capture the quality of cognitive processing involved in problem-solving as directly as possible. By analysing the *thinking aloud* protocols of participants, he also makes a distinction that is still of interest today: good versus senseless errors in problem-solving. These *good errors* are of no use in finding the solution, but they do reveal the quality of productive thinking, i.e. of an exploration – of the problem situation – that reveals new aspects and relations, thereby restructuring them in some way.

The advantage of the definition of problem-solving provided by Gestalt psychology is that it is based on an accurate, phenomenological analysis of thinking as a cognitive effort to solve problems, effective in bringing about original scientific outcomes, probably precisely due to this phenomenological approach.

Choosing to define a specific kind of problem-solving in terms of productive thinking is also advantageous for instructional research, since it gives us the opportunity to transform *any* learning task, belonging to *any* field of knowledge or domain, into a problem situation requiring productive thinking.

In fact, Gestalt psychologists' definition of problem-solving has been applied (Lumbelli, 2009) to a kind of educational intervention aimed at improving text comprehension and enhancing motivation in disadvantaged learners with both low reading comprehension ability and low motivation to learn. This dual goal has been attained because of the unique characteristics of problem-solving requiring productive thinking, since it is most likely to be effective in encouraging learners' active research, thereby making learning less difficult.

Here are the main points drawn from Gestalt psychology's definition of problem-solving, which we applied to the educational approach, 1) The problem must be clearly formulated and must require only one definite solution, and thus no ambiguity has to be present in the piece of text relevant to the problem situation; the coherence gaps chosen can be unambiguously filled in by *bridging inference* (Clark, 1977; Kintsch, 1998); 2) the goal and the path have to be similarly well defined, namely, the goal must be adequate to be pursued by an exploration focussed mainly on the text (and not merely carried out in the long-term memory), so that the instructor can share with the learners their gradual steps towards the solution and the obstacles encountered; thus, the instructor is also able to provide relevant, effective feedback; 3) the piece of text relevant to the solving process must be rigorously delimited, so that the learners/readers are able to explore it repeatedly, thereby eventually succeeding in discovering both the items relevant to the solution as well as the relationship between them.

A specific criterion has been drawn from these premises to evaluate the occasions of comprehension difficulty in a text, i.e. passages likely to bring about

comprehension errors in those poor readers targeted by our educational project. This criterion can be also considered as the right answer to the following question: which comprehension errors can give rise to both the formulation of a problem requiring productive thinking as well as an educational situation suited to foster text comprehension ability by inviting learners to engage in a learning task presenting the motivational advantages of problem-solving?

Emphasis is placed on *inference demands* that can be satisfied at the *text-base level* only and, consequently, be suited to being unambiguously identified and transformed into a problem situation to be solved by productive thinking. No problem can be posed to readers who automatically comprehend text passages requiring well-determined integration. Consequently, the inference demands chosen must be hard enough to be likely to give rise to comprehension error and thus to a problem situation in the targeted learners.

Problem-Solving and Text Comprehension Processes

Choosing the text passages by the criterion stated earlier makes educational intervention aimed at fostering text comprehension compatible with learning based on problem-solving. This compatibility is denied by Kintsch (1998), who adopts the definition of problem-solving proposed by Newell and Simon (1972). Here, his theoretical and experimental research about text comprehension is assumed as a fundament, but it is applied together with the Gestalt psychologists' definition of problem-solving, because of the specific educational implications derivable from the latter.

Regarding Kintsch's educational suggestions, they can chiefly be recognised in the criteria adopted by McNamara, Kintsch, Songer, and Kintsch (1996) for identifying the probable comprehension difficulties in a text and for reducing these in order to make the same text easier to understand. These criteria chiefly refer to technical words without any explanation of their meaning (the only kind of difficulty related to local coherence) and to insufficient clues to macro-organisation (difficulties related to global coherence). Two versions of the same text are compared: the original difficult version is qualified as the less coherent, while the version made easier is qualified as the more coherent. In the experiment of McNamara et al, analyses and modifications never consisted of integrating the text by making explicit those bridging inferences required by gaps in explicit text information. Text manipulations always consist of increasing text redundancy. Neither easy inferences, nor difficult ones, were taken into account and applied to the text transformations. Thus, the main outcome of this investigation seems to be unavoidably influenced by the definition of those criteria used for defining the independent variable, i.e. criteria for distinguishing difficult/incoherent text versions from easy/coherent ones: less-coherent texts

are comprehended better by expert readers since the obstacles to be tackled require more mental effort.

The educational implication and application of this outcome are made less significant and promising by the fact that inference demands have not been considered as indicators of difficulty of comprehension related to text coherence.

The instructional perspectives linked to text-base-level local coherence, on the other hand, are almost completely ignored by Kintsch (2009). According to him, the domain of text comprehension is not well structured, similar to that of mathematics and physics, but is ill structured overall. This statement appears to derive from his emphasis on the *situation model construction* phase, rather than the *text-base construction* phase. He claims that the latter mainly involves automatically performed processes, which constitute the superficial component of comprehension processing and are not suitable to becoming a conscious problem-solving activity, whereas the most important component of text comprehension, i.e. situation model construction, requires inferences from prior knowledge not rigorously and uniquely predictable and, thus, makes the domain overall ill-structured and thereby makes ill-defined the problem-solving processes that can be found there.

Kintsch (2009) recognises that text-base construction is likely to require inferences that may be consciously performed with the goal of providing or restoring local coherence, but this statement does not bring him to use it in order to define the interesting concept of “problematism” of text comprehension in instruction.

In fact, in the research by McNamara et al. (1996), the term “problematism” was applied to the definition of the text version characterised as difficult; however, there the coherence gaps requiring bridging inferences are not taken into account and the text occasions of difficulty identified do not seem to be suitable to being transformed into occasions of problem-posing.

Finally, Kintsch (2009) recognises the importance of motivation in learning and agrees that problem-based learning can be effective in encouraging students’ motivation but fails to consider transforming comprehension difficulties into a well-defined problem situation as a source of comprehenders’ motivation.

The educational project suggested here, which has proved to be both feasible and effective (Lumbelli, 1996; Cavazzini, 1999), can be considered as deriving from Kintsch’s work since his basic research on text comprehension is accepted, but it is combined with Gestalt psychology’s definition of problem-solving in terms of productive thinking. This combination is made possible by a greater importance attributed to the text-base level and by a different meaning attributed to the term problem-solving (Dunker and Wertheimer’s *versus* Newell & Simon’s definition). The text comprehension task is transformed into a problem-solving process

starting from a well-defined problem. The gaps in text-base coherence, which can be filled in by well-determinable *bridging inferences*, are considered as a uniquely significant textual occasion for discovering problem situations similar to those analysed by Gestalt psychologists.

Why is the text-base level alone considered as being suitable to being transformed into problem-solving? Precisely because local coherence problems lend themselves to being transformed into *well-defined problems* with one single unambiguously definable solution and a path that can be rigorously reconstructed, which would be impossible if this transformation attempt regarded the situation model construction phase, which, according to Kintsch (2009), can only bring about ill-defined problems.

Both solution and path have to be reconstructed by accurately analysing the text section containing those relevant elements that a reader/learner who initially has not understood the passage correctly has to *reorganise* in order to move towards the problem solution involving the correct text integration and, consequently, the correct text comprehension.

Discovering Problem Situations in a Text as a Premise for Fostering Text Comprehension

Our text analysis is aimed at identifying those passages that a poor reader is unlikely to elaborate on by making the bridging inferences required and is thus likely to need educational help. The kind of help defined here and applied in the *thinking-aloud-reader-centred approach* (Lumbelli, 2009) is illustrated by analysing an example taken from Calvino's collection of short stories entitled *Marcovaldo*, where it is easy to find a suitable text passage precisely because of the frequent occurrences of the virtue of *quickness*, theorised by Calvino (1988). This textual virtue occurs when the reader is asked for a text integration that can be provided by *bridging inferences*, i.e. inferences that bridge different elements of text, giving it coherence, and involve text information items relatively nearby and, in any case, constituting a well-delimited text space.

Our example of crucial passage in the sense defined thus is taken from the story entitled "The Forest Beside the Motorway" (Calvino, 1963, pp. 46–40).

In the cited text piece, we are informed that the main character Marcovaldo worries about his home being cold and tells his children that he intends to go out looking for firewood to make the home warmer. Both Marcovaldo and his children are described as naïve, with the difference that before coming to the big city where they now live, he lived in the countryside and had the chance to get to know and appreciate nature, whereas his own children were born in the city and know nothing about nature. They have never seen a forest and have only read

in their schoolbook that firewood can be found there and thus decide to go out looking for firewood just like their father in order to help him. When they get to where the city streets become a motorway with billboards on either side, they see the billboards and think that they have found the forest. Calvino writes “the children saw the forest” and immediately following this sentence, describes what they were actually seeing, describing the billboards from the children’s point of view:

Along the sides of the motorway, the children saw the forest: a dense covering of strange trees hiding the plains from view. Their trunks were very narrow, whether straight or bent; their tops were flat and extended, with the strangest shapes and the strangest colours, and when a car went past, they were lit up in its headlights. Branches shaped like toothpaste, like faces, like cheese, like hands, like razors, like bottles, like cows, like tyres, covered with leaves like letters of the alphabet.

The word “billboard” is never used in this description and does not appear in the following text piece either: “And so they felled a little tree shaped like a yellow primula, cut it up into bits and carried it home.”

Marcovaldo comes home after his children, finds the stove lit and exclaims “Where did you get *it*?” pointing to the remainders of the billboard that had burned quickly since it was made of plywood. This is considered a crucial passage because the identification of the co-reference of the anaphora *it* is a necessary step on the path to the solution, which consists of making this meaning coherent with the meaning of the previous text pieces quoted above. This solution is also the only way to correctly comprehend the text read so far.

Since the billboards are not referred to explicitly, the poor reader who is the addressee of the educational intervention may fail to reconstruct the co-reference of *it*, thus posing (or being helped to pose) the problem: how can we explain, on the one hand, that Marcovaldo is pointing at the remainders of a billboard in the stove and asking how that billboard got to their home, and, on the other, that his children have brought home pieces of firewood found in a forest, and not pieces of billboard?

The only correct solution can be reached by noticing the children’s error of thinking that the billboards are trees from a forest, an error that can be explained on the basis of the textual information that they had never seen a forest, or acquired any explicit knowledge of one. To be precise, this information must be put in relation with the items provided in the description of the forest, such as the repeated use of the adjective “strange” to describe the branches of the trees, and their leaves being “like letters of the alphabet”.

Both these information items are premises of the inferences necessary to solve the problem: *if* Marcovaldo’s children have never seen a forest and have no formal

knowledge of one, they are likely to confuse it with a lot of billboards made of wood; *if* the children are described as seeing shapes that are not the usual shapes of trees, but look like objects from the everyday life of people in general (and of Marcovaldo's children in particular), *then* we can infer that the description is actually referring to what they think they see and not to objects that are really beside the motorway.

If poor readers get to the crucial passage where the anaphora is easy enough to be elaborated on to conclude that Marcovaldo's children had brought home a billboard, without having understood that the forest previously described was not a real forest, they are in the condition to pose (or be helped to pose) the coherence problem formulated above. They are therefore able to draw in this problem the motivation to search the previous text piece for relevant information and can be successfully invited to read the text again, this time keeping the problem in mind.

The second reading of the previously read text is a partially new processing since the new activity of the reader consists not merely of decoding successive words and sentences (like during the first reading) but also of evaluating the decoding outcome, putting it in relation with the problem. During the second reading, then, information items that might previously have been missed may be noticed. This new reading is therefore likely to trigger a sort of *reorganisation* of the problem elements: this restructuring of the readers' text base may derive both from the discovery that Marcovaldo's children were born and brought up in the city and had never seen a forest as well as from a more careful decoding of phrases and words referring to the branches of the trees described from the children's viewpoint.

This conscious re-exploration and reviewing of both text and text base (with the outcome of partially transforming the latter) enables the initial non-comprehenders to experience real *insight*, either when they re-encounter the crucial passage or when simply processing the previous relevant information items.

This statement is founded not only on the text analysis described above but also on the empirical data gathered by inviting our poor readers to *think aloud*, both immediately after the first reading of each successive text piece and during the text re-exploration. The methodology was used by Duncker (1935) as an alternative to introspection and allows us to avoid the well-known drawbacks of introspection data, pointed out also by those scholars who support the use of thinking-out-loud (TOL) protocols as reliable information regarding cognitive processes, especially reasoning and text comprehension (Ericsson & Simon, 1984; Olson, Duffy, & Mack, 1984).

However, the use of TOL protocols seems unable to capture the full richness of concurrent cognitive processes. TOL data do not go beyond the spontaneous utterances of thinkers and comprehenders. The unavoidable omissions and

ambiguities of participants' spontaneous utterances remain in the verbal protocols permanently as data regarding cognitive processes.

Integrating TOL with Rogers' Reflection-Response

Until now, no methodological resources that might at least make the drawbacks of TOL less bothersome and easier to overcome have been identified. Here, this difficulty has been tackled by using a special kind of feedback that seems to minimise those drawbacks. This feedback, called *reflection-response*, consists of faithfully reformulating (or partly repeating) the addressees' utterances so as to encourage them to go on, thereby making integration and clarification more likely without, however, interfering with their thinking flow.

The effect of encouraging the addressees to go on speaking has been proved repeatedly, first in psychotherapy (Rogers, 1951) and in the research interview (Kahn & Cannel, 1957), and then in educational communication with disadvantaged learners whose intrinsic motivation needs to be encouraged and enhanced more than any other kind of thinker (Lumbelli, 1996, 2009). This feedback facilitates completion of spontaneous thinking-aloud protocols without influencing them, just like direct invitations and questions do. In fact, reflection-response simply *mirrors* their spontaneous utterances without adding anything, thus making it likely that addressees repair these utterances spontaneously. Direct influence is rigorously avoided, thus ensuring the reliability of TOL protocols as data.

This communication act, which in psychotherapy has been shown to encourage addressees to face their own troubles and express them as autonomously as possible and tackle the demanding activity of modifying their own experience, has also been shown to encourage thinking-aloud participants to overcome those difficulties that are intrinsically and naturally connected with their task, namely, to encourage them to go on with paraphrases and completions of their own utterances. While this function of reflection-response is relevant to all categories of addressees invited to think aloud, it is even more important when the addressees are those disadvantaged poor readers targeted by our educational intervention. In fact, this feedback encourages the reader/learner to engage in the problem-solving situation with as much mental effort as possible. This statement is acceptable if we consider that poor comprehenders are also characterised by low motivation to engage in any learning task and, consequently, by low tolerance of the frustration likely to be encountered while learning.

When applied to instruction, both the transformation of the learning task into the problem situation defined by Gestalt psychologists and the adoption of the reflection-response are suitable when learners are most in need of reassurance and support in their efforts to search a text to solve a problem and simultaneously think aloud.

Here is an example of the information about text comprehension processes that can be obtained by adopting the method discussed above applied to the passage of Calvino's text analysed in the previous section. Poor readers were invited to think aloud, both after the first reading of the text passage and during their re-exploration of the text read so far, aimed at solving the problem posed immediately after the crucial passage with the anaphora *it*.

Below is the TOL protocol produced by a socially disadvantaged 13-year-old reader immediately after reading the section of the story preceding the crucial passage and being invited to report what she had understood in the text preceding the crucial passage, followed by the interview centred on the thinking-aloud reader, which starts from this initial protocol.

Learner: Michelino goes with his brothers and sisters to cut some wood in the forest but having always lived in town he doesn't know where the wood is and makes his with his wet branches he finds the stove lit with the wood that his children have found. The children who had gone to the forest by the motorway had taken this wood and so Marcovaldo too decides to go and get this wood.... the wood from a forest by the motorway.

Instructor 1: from a forest by the motorway... before you said that the trees had strange shapes like cheese and toothpaste.

Learner: near the forest there was a billboard as well.

Instructor 2: near the forest there was a billboard.

Learner: yes near the motorway there was a forest and also a billboard. The children got branches and the billboard too....I think this forest is all the pollution...for example the cheeses and the toothpastes are the people who pollute the environment...the children because they have never seen a forest think that they are branches.

Instructor 3: the children who have never seen a forest think that it is wood and instead you say that it's pollution.

Learner: basically the people who pass by throw things away.

Instructor 4: Marcovaldo's children find things that people have thrown beside the motorway.

Learner: I think the children believe this is a real forest because they had never seen a forest but it is actually a kind of tip.

The reader's initial report shows that a lot of details have been processed, but no reference is made to the billboard appearing in the last crucial passage read: the reader might have not questioned the children's idea of having found a real forest. However, no conclusion can be drawn from this first report because it may be only temporarily incomplete; i.e. the reader may have given up referring to that

idea because of doubts and uncertainties. This hypothesis can be checked by the instructor/interviewer, due to the function attributable to the reflection-response without the risk of influencing the addressee's thought.

In response number 1, the instructor simply repeats the reader's last words, and after a short pause, reformulates a few of her previous utterances with the intention of eliciting further information about the cognitive processes actually carried out, though not yet expressed. In fact, this intervention is effective in obtaining a significant clue to the actual processing: the billboard had not initially been reported, but had been elaborated on; its existence is now recognised, but as something in addition to the existence of the forest.

In response number 2, this co-existence is mirrored with the goal of giving the reader a chance of making her mental representation clearer. This clarification is obtained as a result of the fairly long verbal protocol that follows. Firstly, the co-existence is confirmed, but then immediately after, the hypothesis does indeed emerge that it was not a real forest, although in this discovery, no function is attributed to the billboard. The trees do not have real branches, but the description of the "strange" forest seems to have led the reader to refer to the objects that can be found in a "tip". Although here the reader talks about "pollution", her reaction to the subsequent feedbacks shows that this is only a wrong lexical choice, and that both of the words refer to pieces of prior knowledge associated in her long-term memory with a subject labelled as ecological matters.

Response number 3, consisting of a careful reformulation, obtains clear confirmation of the hypothesis reported above since the reader even paraphrases the meaning of the word "tip".

In response number 4, the instructor in turn paraphrases the reader's further integration and obtains a succinct description of what the reader thinks about the whole text section read so far: the children's lack of knowledge about forests is well borne in mind and elaborated on so as to explain their mistaken idea. However, the element of the problem situation in the crucial passage referring to the billboard is not sufficiently elaborated on; its relation with the other elements is not noticed and the solution is consequently not found.

The conditions therefore exist in which the instructor can pose the problem defined above and invite the reader to reread the same text section read before in order to identify elements as yet unnoticed, or insufficiently processed, which might serve to arrive at the goal/solution.

Here is the transcription of the dialogue that takes place during the re-exploration of the description of the "strange" forest, which shows clearly how a real experience of *Insight* or *Aha Erlebniss* may occur when (as in this case) firstly, the reader

has failed to reach an automatically correct text comprehension and, secondly, the instructor had clearly defined the text coherence problem and invited the reader to read through the relevant text piece in order to solve it.

Learner: Ah! Now I understand...basically the billboards consisted of those toothpastes...they were advertising tyres they were advertising cheeses razors all those things they listed and here when he says (reading out) covered with leaves like letters of the alphabet, it means the words written on them.

Instructor: the billboards consist of toothpaste of tyres.

Learner: it's not a tip! The billboards show cheeses razors bottles...and there were words written on them that the children thought were leaves.... basically it was just the billboards along the motorway.

The reader's initial words reveal that when she re-encounters the description of the forest from the children's point of view, she frees herself of all uncertainty and any overlapping of prior knowledge. The sentences that follow confirm that her discovery coincides with the correct solution of the problem posed: it emerges that the reference to leaves being like letters of the alphabet now enables her to understand that the description she is rereading does not refer to a real forest but to what the children think a forest is, whereas it is really a row of billboards. In any case, the last words uttered show that by now, the relationship between the forest and the billboards has become quite clear. The insertion of the word "just" seems to indicate this without any shadow of doubt.

Conclusion

The example given above highlights the following aspects that make feasible the application of the Gestalt theory definition of problem-solving to an educational project that is aimed at fostering text comprehension ability in socially disadvantaged poor comprehenders and is centred on thinking-aloud readers:

1. One specific category of text comprehension difficulty must be focussed on, i.e. a source of difficulty that appears to be particularly suitable to be transformed into a problem situation that can be faced without the risk that any prior lack of knowledge or lexical competence might interfere with thinking about the text elements making up the problem situation. A special kind of text analysis is needed, based mainly upon the search for text occasions likely to give rise to this category of difficulty.
2. We have confirmed that thinking-aloud protocols do indeed inform about the cognitive processes involved in readers' comprehension, but these are at the same time likely to be negatively affected by those omissions and

ambiguities repeatedly emphasised by cognitive psychologists from Duncker (1935) on, whether they accept this method or not.

3. Integration of TOL protocols with the systematic use of the feedback defined by Rogers (1951) is shown to be feasible and effective in enabling thinking-aloud readers to complete their verbal protocols in every case in which the gaps in discourse were not also gaps in thinking. The reliability of these verbal protocols is ensured by the careful, systematic use of reflection-response. This special feedback has the important advantage of combining rigorous methodology with a warm respect for participants.

This respect is of the utmost importance in educational research involving participants who are also disadvantaged learners, such as those poor comprehenders who are the participants in investigations on projects aimed at fostering text comprehension ability, such as *reciprocal teaching* (Palincsar & Brown, 1984). Although such projects do recognise that disadvantaged comprehenders need to be reassured and helped to tolerate the inevitable frustration, they fail to take into account the educational requirement that motivation to learn should be enhanced from the very starting point of the learning process. Instead, in the first phase of *reciprocal teaching*, the teacher has to *model* the right processes, which the disadvantaged comprehenders are unable to carry out autonomously; only in the second phase, when the learners' ability improves, is their self-determination encouraged and the teacher's modelling gradually reduced.

Similarly, in the definition of *scaffolding* (Wood, Bruner, & Ross, 1976), learners' intrinsic motivation is not considered at the very beginning of the learning process, which is precisely when the poor comprehenders (who also have low motivation to learn) are most in need of encouragement to engage actively in the task of text comprehension.

In our approach, centred on the thinking-aloud reader, the instructor's task is to deal with poor comprehenders' difficulties by transforming the most likely comprehension difficulties into problem situations and by guaranteeing that the effect of increasing motivation triggered by the problem situation itself is maintained due to the use of reflection responses. We are able to start from the problem position and invite learners to search autonomously for the solution because the reflection-response allows us to provide systematic help to learners when they most need it.

Summary

Why and how is the Gestalt theorists' concept of *productive thinking* particularly suitable for being applied to the educational question of how student motivation can be encouraged, thus providing an important condition for self-regulated, intrinsically motivated learning?

An answer to this question has been sought using an approach to the fostering of text comprehension ability, based upon the features specific to productive thinking, originally identified by Wertheimer (1945) and Duncker (1935).

Firstly, these specific features are dealt with and their educational implications compared with those deriving from the definitions of *problem-solving* used most frequently in educational research. Secondly, an analysis is made of the process by which the features specific to productive thinking are turned into the conditions for a kind of text analysis suitable for designing an instructional project aimed at enhancing text comprehension ability and, at the same time, encouraging intrinsic motivation and self-regulation on the part of the learner. Thirdly, an educational project centred on the thinking-aloud poor reader is described, where *thinking aloud* and *reflection-response* are combined in order to guarantee the maximum level of intrinsic motivation. In the concluding section, the most important features of the project are discussed in relation to *reciprocal teaching* and *scaffolding*.

Keywords: Text Comprehension, Problem Solving, Intrinsic Motivation, Student-Centred Instruction, Self-Regulation, Aloud Thinking, Reflection-Response.

Produktives Denken Anstelle von Problem-Lösen?

Anregungen zur Verbindung von Produktivem Denken mit Text-Verständnis-Förderung

Zusammenfassung

Wie und warum ist das gestalttheoretische Konzept des "Produktiven Denken" besonders in Bezug auf die erzieherische Frage der Stärkung der Motivation von Schülern geeignet, wichtige Voraussetzungen für selbstreguliertes, innen-motiviertes Lernen anzuregen?

Zur Beantwortung dieser Frage wurde ein Ansatz zur Förderung der Text-Verständnis-Fähigkeit verwendet, der auf spezifischen Merkmalen des Produktiven Denkens, wie sie ursprünglich von Wertheimer (1945) und Duncker (1935) beschrieben wurden, beruht.

Diese spezifischen Merkmale werden zunächst besprochen und ihre erzieherischen Konsequenzen mit denjenigen verglichen, die sich von den Definitionen des *Problem-Lösens*, wie in jüngster Zeit in der Erziehungs-Forschung verwendet, ableiten. Zweitens folgt die Analyse eines Prozesses, in dem die für produktives Denken spezifischen Merkmale in Bedingungen für eine Gattung der Textanalyse umgewandelt werden. Ziel ist die Erstellung eines Unterricht-Projektes, in dem gleichzeitig die Text-Verständnis-Fähigkeit erhöht und die Innen-Motivierung und Selbstregulierung des Lernenden unterstützt wird. Drittens wird ein Unterrichtsprojekt beschrieben, in dem das Laut-Denken eines schwachen Lesers im Mittelpunkt steht. Laut-Denken (*thinking-aloud*) und Ausdruck-Antwort (*reflection-response*) werden kombiniert, um ein maximales Ausmaß an innerer Motivation zu garantieren. Im letzten Teil werden die wichtigsten Charakteristika des Projektes mit Bezug zu *reciprocal teaching* und *scaffolding* diskutiert.

Schlüsselwörter: Text-Verständnis, Problem-Lösen, Innere Motivation, Studenten-zentrierte Anweisung, Selbstregulierung, lautes Denken, Ausdruck-Antwort.

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Lucia Lumbelli is Professor Emeritus of Department of Life Sciences, University of Trieste, Italy. Her research programme started by using the Carl Rogers approach as a possible relevant "source" in the sense of Dewey (1929) in order to face significant problems of educational relationship, and it continued by analogously using psychological research on the text comprehension cognitive processes (Kintsch, 1998) to define instruction projects aimed at fostering reading comprehension ability while encouraging intrinsic motivation. A few results of this psychological research field were also applied in her studies about audiovisual communication *versus* reading (Lumbelli, 2008) and about the fostering of the significant component of writing that consists of an effective revision activity (Lumbelli, 2012; Lumbelli & Paoletti, 2005). The contributions herein mentioned are the most recent of those written in English.

Address: Department of Life Sciences, Psychology Unit "Gaetano Kanizsa", University of Trieste, Via Weiss, 2, I-34128 Trieste, Italy.

E-mail: lumbelli@units.it