

# Projecto DIANOIA

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## Introduction

The Dianoia Project has been developing several lines of educational research pertaining to the area of teaching and Learning to think since 1986. This contribution seeks to outline the theoretical foundations of these Lines of research, describe them briefly, point out some results and products of the project, and take stock of some issues raised by the research done. Within the conceptual framework of theories of intelligence developed in cognitive psychology, the Dianoia Project focuses on action-research whose main objective is the creation of models of pedagogic intervention in the various curriculum areas, aiming specifically at the improvement of learners' cognitive skills. The research carried out by Dianoia is distinguished both by its options of research and intervention inside the curriculum and by its focus on the development of metacognition.

The early phase of theoretical and experimental research work was developed between 1986 and 1990 (Valente et al. 1987; 1989a). In its early stage the project issued a number of publications which were intended to diffuse not only the results obtained so far, but also data pertaining to this specific area of research (Valente et al., 1989b; 1991b). The second phase, currently under way, was started in 1989 and has developed according to several lines of research, namely:

- in-depth study and assessment of the results obtained in the early phase, in the field of compensatory education, involving a direct intervention in Portuguese language learning from a cross-curricular perspective;

- expansion of the research to curricular areas not involved before, such as mathematics in pre-service teacher training;

- exploration of another line of research, not specifically addressing any curricular subject area, aimed at developing teachers' general communication skills intended to promote

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learners' reflective thinking. Such a line of research has emerged as a project related to Dianoia, despite its specific characteristics (Valente et al., 1991a; 1991b; 1991c).

The research carried out so far seems to confirm the potentialities of these interventions, while it raises some issues concerning other, non-cognitive, dimensions associated with the development of thinking.

### **Theoretical foundations of Dianoia**

The Dianoia Project starts from the recognition that schools today fail to meet the demands of the modern world and that the intellectual skills demanded by the school do not correspond to those demands. In view of the fast pace at which existing knowledge becomes outdated and new knowledge is created, modern society requires individuals to own a repertoire of thinking skills enabling them to rethink situations, solve problems, search for innovative context-appropriate solutions and develop new solutions. Individuals are thus required to possess a range of skills related to such activities as analysing, organising, planning, synthesising, evaluating and controlling processes and products. Schools have not been able to keep in step with the fast pace of change, neither by selecting the most important knowledge to be learnt nor by structuring methodologies to promote thinking (Valente et al., 1989a).

Dianoia is in essence an intervention project; the research conducted so far has been founded on a broad conceptualisation of intelligence which is not subsidiary to a single theory, but which rather gathers suggestions from various currents of research. The work is thus based upon, among others, Howard Gardner's Multiple Intelligences, Sternberg's Triarchic Theory of Human Intelligence and Perkins' theoretical contributions, which emphasise the role played of tactics in intelligent behaviour. The project is structured as an intervention directed towards the teaching of thinking; it offers suggestions for strategies and mechanisms that are considered to be able to promote a certain modifiability for the productivity of thinking.

In Dianoia the action research is conducted at the curriculum level. This is in line with the latest research - both theories and data provided by the latest work in the field - which advocates that learners learn about the use and control of their cognitive processes more effectively if they are taught directly within the various curriculum subject areas. Specific consideration is given to the following: (a) the act of thinking is closely related to specific areas of knowledge, the teaching and learning of which should not take place outside the curriculum; (b) whenever confronted with unknown situations, learners generally try to interpret them from what they already know, which seems to account for the teaching of thinking skills in specific and familiar contexts; (c) recent studies on problem solving in

specific content knowledge areas have shown the existence of strong interactions between knowledge structures and cognitive processes. Besides this option directed to interventions in curriculum subject areas, Dianoia takes into account that thinking skills are acquired through the improvement of metacognition and therefore it has explored the possibility of promoting students' success through the convergence of teaching to think and teaching to think about thinking - metacognition.

As a matter of fact, Dianoia considers that the interest raised by interventions which develop metacognition follows from the recognition of its decisive role in efficient intelligent behaviour. On the one hand it has been observed that intellectually handicapped young people often behave as if they are unaware of the strategic requirements of the problems they are facing or the ways in which their own behaviour can be monitored and regulated in order to carry out tasks successfully. On the other hand, subjects that are efficient at performing tasks possess well-developed metacognitive skills: they realise the task objective, plan its execution, apply and modify problem solving strategies consciously and evaluate their own problem solving processes (Valente et al., 1989c).

The development of metacognition has proved effective in text study, in reading comprehension, in knowledge retention and retrieval, in writing comprehension and in problem solving. Beyond the acquisitions of skills, the learner learns how to control his learning, becomes better informed, more independent and pursues a goal in his learning and also focuses more on tasks by controlling his attention. Metacognition may thus be regarded as the key ability. All learning depends on the ability to learn how to think, the one thing that schools have neglected most often (Valente et al., 1989c).

As metacognitive thinking does not develop naturally, instructions have been designed to train metacognitive thinking directly and explicitly, by:

- encouraging learners to verbalise their difficulties and cognitive processes used in tasks; evaluating the efforts made; explaining the reasons underlying difficulties and achievements. Such procedures enable learners to become aware of their learning activities;

- using teaching strategies where, for example, the teacher explains his own mental processes when introducing contents. Such strategies enable the learner to gain insight into the other's intellectual behaviour and to confront it with his own, thus providing the possibility to check the relevance of his cognitive processes to the task requirements;

- using such teaching strategies where, for example, the teacher explains the cognition underlying the acquisition of contents; developing procedures concerned with comprehension rather than correction; analysing and evaluating the learning process rather than its products, thereby encouraging learners to detect their own errors themselves (Valente

et al., 1989c).

### **Research today**

Two investigations are now under way, one in the area of compensatory education in Portuguese, another in mathematics. The former investigation starts from the acknowledgement that (1) there is a high rate of school failure, (2) there is a lack of teaching methodologies for compensatory education in the Portuguese education system, and (3) it exerts pressure on the current process of curriculum reform. As far as low achievers are concerned, educational research has recommended the construction of effective methodologies that emphasise not only the identification of cognitive and metacognitive processes, but also the development of teaching strategies aiming at the conscious acquisition of intellectual processes. Research also indicates that learning to think is closely linked to motivational factors.

The investigation involves 2nd cycle Basic Education students and intends to (a) assess the effects of these teaching methods explicitly directed to the promotion of low achievers' thinking skills on text comprehension and production; (b) assess the effects of such methods on students' learning in the various curriculum subject areas; (c) assess the role of motivational factors in the performance and use of intellectual processes; (d) develop ways of training and intervention; (e) design instruments for observing and evaluating cognitive and metacognitive skills and motivational factors; (f) examine the effects on teachers' professional development.

The research currently under way is intended to develop (a) instruments for identifying and evaluating learning difficulties; (b) instruments for evaluating text comprehension and production skills; (c) training and intervention modules; (d) teacher training modules for compensatory education. Thus, the research seeks to enhance the success of learners.

The second investigation involves 4th grade students on the Basic Education Teacher Training Course - Mathematics/Natural Sciences branch, at the Escola Superior de Educação (Higher School of Education) in Viseu. This investigation, which has already been presented at a congress, starts from the acknowledgement that achieving the goals of the current curriculum reform - whose main aim is to make individuals into thinking, autonomous beings - depends to a large extent on suitable teacher training.

Institutions and teacher trainers should assume the responsibility for their part in the success of the reform, by directing research to the design of a teacher's profile that responds to the requirements of mathematics education recommended at the target level. Therefore, it is necessary to adapt teacher training to that new view of teaching and, among other aspects, to

introduce into training a component explicitly directed to the development of thinking and reaching thinking.

That is why one of the main priorities for research in this field is to determine what skills someone must acquire to become a good teacher of thinking. Neither research nor literature in this field is conclusive as to how best to concretise this component of teacher training. The research under way examines what should be included in a teacher training programme directed towards teaching thinking skills. One of the training components, the thinking skills, is tested in two distinct situations with prospective mathematics teachers in Basic Education, 2nd cycle. The study, then, compares the effects of two intervention models directed to the teaching of thinking skills, with a special emphasis on the use of metacognitive strategies in teachers' pre-service training.

One model aims directly at enhancing the quality of student teachers' thinking and indirectly at fostering behaviour that may induce improvements in the quality of teaching when these students go on teaching practice. The model is implicitly integrated into the teaching of mathematics V. It is present in the training of the student teachers, inserted in the very learning of mathematics, and it uses its contents and activities as its vehicles. The training of focused skills is aimed at new situations and a variety of contexts, a spontaneous transfer to practice being intended. Especially selected supporting texts guide the mathematics V teacher's performance, but they are neither mentioned nor handed out to trainees. Trainees only receive a small introductory text on the ideas underlying the experimental treatment, as an appendix to the mathematics V syllabus.

The other model aims directly at inspiring behaviours that promote pupils' thinking during student teachers' teaching practice. It constitutes a module entitled 'Didactics of Thinking', inserted explicitly as part of the content of mathematics didactics. It is linked to the student teacher's subject education, included as it is in the framework of learning to teach mathematics. The training of these skills in essence focuses on teaching during teaching practice. The supporting texts are handed out to the trainees, so they are systematically provided with information on the topics under study.

It is intended, then, to determine which is the better model in terms of

- promoting the trainees' quality of thinking
- changing the trainees' implicit theories on mathematics education, taking the concept of intelligence, the function of school and the teaching of mathematics as references.

### **A close line of research—the DIALOGOS Project**

As mentioned earlier, the Dianoia Project explored a new area of research between 1989 and

1991 - the development of teachers' communication skills that promote learners' reflective thinking - which inspired a closely related project, the Dialogos Project. However, this research has different characteristics.

Whereas Dianoia has been established to improve the teaching of thinking within curricular areas, Dialogos, though embedded within the curriculum, does not imply any specific interventions. In other words, the Dianoia Project has required a thorough reflection on teachers' subject matter knowledge and contains specific didactic options in constructing learning. Project Dialogos, on the other hand, by focusing on communication skills, fosters non-specific reflective thinking on the subject matter knowledge to be conveyed; moreover, being more or less independent of any subject-matter content, it is not intentionally directed to the learning object (Valente et al., 1991c; 1991d).

In line with this, the basic purpose of this project has been to examine whether learners' reflective thinking can be developed through intervention in the teacher's communication skills. It must be stressed, however, that the project does not aim at the development of specific reflective thinking on the subject matter knowledge to be communicated. It must also be emphasised that both the contents and its specific didactics have been disregarded.

It has been assumed from the start that there is a set of communication skills in which the teacher can be 'trained' and which have a decisive role in the development of the learners' reflective thinking. To that effect, teacher training strategies have been developed around a constellation of ten communication skills to be fostered in a progressively and methodically:

- extracting points of view and opinions
- self-clarifying and self-reshaping
- explaining their one's own ideas and interpreting those of others
- explaining arguments
- identifying inconsistencies
- searching for implicit presuppositions
- producing evidence of implicit presuppositions
- reviewing short- and long-term consequences
- developing alternatives, hypotheses and estimates.

The study has also examined the effects of such training on teachers' perceptions of their professional development. In addition, it has examined the collateral effects of promoting learners' reflective thinking, namely their perceptions of the learning environment and their self-concept.

During the research it was noted that in some situations the agreed solutions as regards the

communication skills, hardly gave an opening for practical operationalisation, causing unforeseen difficulties. As a result, some presuppositions made at the start were gradually dropped. Proposals were made for the operationalisation of the communication skills, which then were structured in a variety of situations within the specific subject matter context and referring to more concrete needs and issues.

The research concluded that the communication skills which the teachers implemented more easily and with better results, were: (a) extracting points of view and opinions; (b) self-clarifying and self-reshaping; (c) explaining one's own ideas and interpreting those of others; (d) explaining arguments; (e) identifying inconsistencies; (f) searching for implicit presuppositions; (g) producing evidence of implicit presuppositions; (h) reviewing short-, middle- and long-term consequences. As for the last communication skills on the list, (i) developing alternatives, hypotheses and estimates, teachers claimed they could implement them, but only partly.

The teachers showed evidence of the following results achieved in training which the researchers could witness themselves: (a) improved awareness of the failures registered in their communication with the learners; (b) greater self-confidence and assurance; (c) more attention to poor aspects of pre-service training plus a stronger will to overcome them; (d) greater sensitivity to learning processes aimed at improving the quality of the 'products'; (e) acquisition of the habit of using some of the trained communications skills; (f) enthusiasm and empathy regarding the training process followed - intervention-research model - as a process of professional development; (g) use of the trained communication skills in other contexts outside school.

As far as the learners in experimental classes were concerned, the following results were observed by both the teachers and the researchers: (a) improved self-confidence; (b) greater self-control; (c) more effective communicability; (d) critical thinking; (e) growth of vocabulary; (f) improved comprehension and production of texts; (g) more rigour when expressing ideas; (h) transfer of behaviours to situations outside school, more specifically familiar environments and the community in general; (i) enthusiasm and pleasure in the search for new ideas; (j) ability to listen to others; (k) improved approach to problem-solving.

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