 

# An overview of Project Intelligence

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With this article, an overview is given of a Venezuelan project which aims at improving the ability of students to perform a wide variety of intellectually demanding tasks. This project acknowledges that there is no substitute for thought. Conventional subject matter is only taught in so far as it is helpful to realize the ultimate goal: that of enhancing thinking skills. But perhaps the most important aspect of the project is attitudes; particularly those that are most conducive to intellectual growth and achievement.

Met hierdie artikel word 'n oorsig gegee oor 'n projek wat in Venezuela ontstaan het en wat ten doel het om studente te help om 'n wye verskeidenheid intellektueel inspannende opdragte uit te voer. Die projek gee erkenning daaraan dat denkprosesse met niks vervang kan word nie. Konvensionele lesmateriaal word ook slegs gebruik in soverre dit kan bydra tot die bereiking van die uiteindelike doelwit, naamlik om die denkvermoë te stimuleer. Maar die grootste klem val waarskynlik op instelling: dié soort instelling wat die grootste bydrae kan lewer tot intellektuele groei en selfverwesenliking.

For the development of the intelligence of the Venezuelan population several programmes were initiated during the period 1979-1984, when Dr Luis Alberto Machado held the office of Minister of State for the Development of Human Intelligence. One of these programmes was designed by Harvard University and the consulting firm Bolt, Beranek and Newman, in conjunction with the Ministry of Education of Venezuela. The programme was named Project Intelligence. (This project has been published in English as *Odyssey: A Curriculum for Thinking,* by Mastery Education Corporation, Watertown, MA, 1985.)

The general purpose of the project is to produce materials and methods that would enhance thinking skills. In particular, the project aims at developing a course that could teach the kinds of thinking skills that would be useful in their own right, that would facilitate the acquisition of other skills, that would enhance intellectual performance in various conventional subject domains and that would be broadly applicable in a variety of different contexts.

The specific goals of the course are:

- To develop in the students a set of habits and organizational schemes that will support systematic and analytic observations;
- To introduce the students to certain basic modes of, and tools for interrelating information productively; and
- To exercise and elaborate these skills in a variety of different contexts, pointing out analogies and, thus, promoting transfer between them.

The course is composed of 99 lessons, each of which provides material and guidance for one 45-minute classroom session. The lessons are organized into 20 units of three or more lessons each, and the units, in turn, are organized into six series. Heavy emphasis is placed on student participation and the lessons are designed to engage the students actively in thinking and discussion.

Each series represents one of six major themes:

- Foundations of reasoning
- Understanding language
- Verbal reasoning
- Problem solving
- Decision making
- Inventive thinking.

The first series of lessons "Foundations of Reasoning" has been designed to introduce the students to the basic attitudes, concepts and processes, upon which the course as a whole has been structured. This series of lessons is divided into five lesson units.

The first of these units is entitled *Observation and Classification.* If we think of the lesson series as a whole as the foundation of the course, we might think of its first unit as the "cornerstone" of the course. The primary objective of the unit is one of introducing the students to the processes of gathering, organizing and interpreting information in a systematic, critical and productive way.

The first lesson of the unit, *Observation,* is directed toward increasing the students' awareness of the importance of observation. The students are led to the realization that all knowledge we have acquired or have yet to acquire must, in the final analysis, derive from some person's direct observation. It follows that our skills as careful, analytic observers are important. The lesson then turns to the concept of characteristics or the elementary aspects of objects, and the students are given several exercises designed to emphasize that astute observation and description depend on attending to the world at the level of individual characteristics.

In lessons 2 and 3, the students are engaged in observing and describing the similarities and differences between objects. Through the activities, the students are introduced to the principle that the interpretation of one's observations is often biased by both the context in which they are embedded and the purpose one has for making them. In addition, the students are exposed to exercises requiring inductive or creative thinking. The most important objective of these two lessons however, is that of familiarizing the students with the concept of dimension.

In lesson 4, the students are introduced to the fundamental epistemic operation of classification; in other words, to the grouping of objects on the basis of their similarities and differences. The students are engaged in comparing and contrasting sets of abstract designs in order to form classes of shared characteristics.

The formal definitions of classes and of the process of classification are presented in lesson 5. The students are exercised in the rudiments of identifying, creating and using classes for purposes of organizing information, thus clarifying their relationship to dimensions and characteristics.

In lesson 6, the concepts and processes introduced in the previous lessons culminate in the activities of hypothesis formulation and verification. These activities involve a critically balanced interplay between analyzing and synthesizing information.

In short, the lessons in this unit provide a very basic introduction to the concepts and processes that were considered to be fundamental to the course as a whole.

Unit 2 is entitled *Ordering.* It begins with an introduction to three different types of sequences: progressive, cyclical and alternating. The students are then led to discover the defining characteristics of orderable dimensions, as well as some of their interpretative advantages and perils.

The objective of lessons 7 and 8 is to equip the students with the basic concepts and processes that support the ability to recognize an entity across a change and, moreover, the ability to understand and project the change itself.

In lessons 9, 10 and 11, the emphasis shifts from the concept of order to the concept of orderability. In lesson 9, the students are introduced to the idea that the characteristics of some dimensions are intrinsically orderable. They are also provided with a simple test for distinguishing orderable from unorderable dimensions. Then, in lessons 10 and 11, they are exposed to some of the interpretative advantages and risks associated with orderable dimensions. The students are led to consider, for example, the advantages of being able to extrapolate and interpolate values by working with graphs, and the inherent relativity and consequent

ambiguity of orderable descriptors by examining misleading advertisements.

In the third unit of this series *Hierarchical Classification,* the students are brought back to the topic of classification. However, the focus here is not on simple classification as it was in Unit 1, but on hierarchical classification. In a classification hierarchy, classes are contained within classes. In this way, the hierarchy allows more precise definition of the similarities and differences between its members. Moreover, the structure of a classification hierarchy is such that the relationship between any two of its members is available at a glance. Because of these characteristics, the classification hierarchy is ubiquitously useful for purposes of analytic description, organization and research.

The activities of lesson 12 are designed to lead the students to discover the nature and the structure of the classification hierarchy.

The objective of lesson 13 is one of reinforcing the students' understanding of the hierarchy while extending their appreciation of its utility.

In lesson 14, the students are introduced to a little bit of information theory as they are shown that the classification hierarchy can be used to maximize the efficiency of deductive thinking.

Unit 4 is on the structure and logic of *Analogical Relations*. In lesson 15, the students are presented with a definition of analogies. They are then given a series of simple analogical problems and a strategy for solving them. The purpose of this strategy is to direct the students toward explicit and organized analysis and comparisons of the dimensions and characteristics upon which analogies pivot.

The objective of lesson 16 is to introduce the students to the bi-directional relationships that necessarily underlie well-structured analogies.

The primary objective of lesson 17 is to consolidate the students' appreciation of these bi-directional relationships. The analogies in this lesson consist of groups rather than pairs of figures and in order to organize and interpret them, the strategy of discovering and using the horizontal and vertical relationships becomes critical.

In lesson 18, the students are presented with analogies in the standard format. They are asked to complete each of these analogies, not by selecting the missing figure from a given set of alternatives, but by drawing it, thus providing a strong test of the students' understanding as it requires that they generate, rather than merely "recognize", the logical constraints underlying sound analogies.

Unit 5, the last one of series 1, is entitled *Spatial Reasoning and Strategies*. The vehicle for all the lessons in this unit is an ancient Chinese puzzle, the tangram. The principal motive for this unit is to extend two of the fundamental reasoning skills, analysis or decomposition and transformation, to the spatial domain. These lessons serve to reinforce the theme that, whatever the nature of the problem, the solution can be facilitated through a well reasoned and methodical approach.

In lesson 19, the students are introduced to the tangram through a series of relatively simple exercises and are given two strategies to facilitate their efforts.

In lesson 20, the students are faced with more complex puzzles so that their new concepts and skills are both exercised and extended. They are, in addition, given two new strategies for tackling the problems.

In the last lesson of this unit, the students are asked to employ a strategy of trying to project or imagine how a puzzle might be constructed from the seven pieces of the tangram before actually trying to do so. In this lesson, the strategies and skills must be exercised, not in the physical, but in the mental or imaginal domain.

In brief, each of the five units in series 1 is designed to develop an understanding of some specific set of basic terms, concepts and processes that will be required in later lessons in the course.

The second series is entitled *Understanding Language*. It has been designed to help students develop an explicit understanding of the composite nature of word meanings and the ways in which they are interrelated through language. This series consists of fifteen lessons divided into three units.

The first of these units is named *Word Relations*. Its objective is to extend students' analytical skills to the domain of vocabulary. The very process of understanding language is one of decomposing the meanings of words and thereby discovering ways in which their components can be sensibly interrelated.

The first two lessons in the unit are on synonyms. The intention is not to teach the students about the terms *noun, verb, adjective,* and so on. Rather, the lessons are intended to demonstrate that different words have different functions in a sentence and that a word's function is an important aspect of its total meaning. As a test of synonymity, the students have to substitute one word for another in a sentence. If they can succeed without changing the meaning or impairing the structure of the sentence, they may conclude that the two words are synonyms.

At this stage, an example of a lesson may be suitable. What follows, is an extract from the *Odyssey; Understanding Language,* lesson one:

**Objectives of the lesson**

1. To present the concept and definition of synonymity

2. To anchor the students' analyses of word meanings in the previously learned concepts of dimensions and characteristics

3. To help the students reflect upon the relative similarities of word meanings

4. To show the students how they can use relative semantic similarity to infer the meanings of unfamiliar words

**Target behaviors**

1. To order words describing a single semantic dimension in terms of intensity

2. To identify synonyms from these ordered lists on the basis of their similarity

3. To assess the relative similarities of the meanings of two words by substituting them in a sentence

Classroom Procedure

▲Introduction

➔ The lesson we are about to do involves *word relations.*

Write *Word Relations* on the board.

➔ In order for us to examine how our minds organize words, let's do an experiment.

➔ I will say a word and you should write down the first other word that comes to mind.

➔ There are no right or wrong answers because you can relate the word that I say to others in many different ways.

Ask the students to close their eyes. Then announce:

➔ The word I am thinking of is *small.*

Allow a few seconds for the students to form an association. Then ask two volunteers to write their classmates' answers on the board. The list may resemble the following:

| | |
|---|---|
| | little |
| | mouse |
| small | large |
| | young |
| | child |
| | tiny |

After each suggestion ask:

➔ How many of you thought of one of these words?

➔ Who thought of a different word? What word(s) did you think of? Do you know why you made that association?

Be sure to get both an antonymous pair (small-large) and a synonymous pair (small-little).

Pick a pair of synonyms given by the students and write the two words on the board. Point to the pair and ask:

➤ How do these two words relate to each other? *(They have similar meanings.)*

➤ Yes, they mean almost the same thing.

➤ Can anyone tell me to what more general category or dimension the word small belongs?

If the students need help in naming the dimension, write the following list on the board and ask them which of the terms they think is the dimension to which *small* belongs.

color
weight
texture
size
taste
shape
emotion
action

*(Size)*

➤ Very good. The dimension to which the word small belongs is size.

➤ We know *small* is one word in the dimension of size. Can you name more words that belong to this dimension?

Write the words on the board as the students say them. The list will resemble this:

small
tiny
big
tremendous
medium
huge
little
large
giant
middle-sized
gigantic

➤ Do you think we could put these words in order, starting with the very smallest and ending with the very largest? Let's try.

➤ Which of these words describes the very smallest? *(Tiny)*

➤ Good, then we'll put *tiny* first on the list. Which word should we put next? Which one describes the next smallest size?

Continue in this way, eliciting the ordered list from the students. Depending on the specific words that the students have suggested, there will occasionally be disagreements about which of two or more words should come next. Whenever you detect a hint of a disagreement, draw it out; then settle the debate by writing the words next to each other in the list to illustrate the closeness of their meanings.

Given the words in the example, the ordered list might look like this:

tiny
little, small
medium, middle-sized
large, big
huge, giant
tremendous, gigantic

➤ That's really good work. Then the answer to our question is yes, we can put these words from the general category of size into an order. That's because *size* is an *orderable dimension*. When a family of words can be arranged into a natural order from least of something to most of something, it means that they describe an orderable dimension.

➤ We wrote some of the words on our list right next to each other. Why did we do that? (*Because we couldn't agree on which one was bigger and which one was smaller.*)

➤ That's exactly right. The closer any two words are on our list, the closer the sizes they describe.

This is but part of the lesson on synonyms. As the subject is explored further, the students are constantly invited to participate. Emphasis is also placed on having students explore ideas and concepts and discover relationships, since they retain better what they discover than what they are told.

In lesson 2 the learners are given words that are almost synonyms, but not quite. The challenge is to single out that aspect of meaning that distin-

guishes one member of each pair from the other. Thus synonymity is used as a vehicle to help the students perceive the ranges and shades with which the meanings of words can differ from one another.

Whereas the lessons in Unit 1 concentrated on meaning conveyed by individual words, the lessons in Unit 2 focus on the aspects of meaning that depend on the *relationships between words*. The basic message of this unit is that the ideas in a well-written text form an organized structure and that there are definite logical principles that should be used both to construct and to interpret these structures.

The purpose of Unit 3, *Reading for Meaning,* is to help the students appreciate that although the content and structure of a text are important determinants of its meaning, the full meaning depends on other factors as well, such as the purpose of the author, the points of view he is trying to relate, and the familiarity of his topic to the reader.

The third series is entitled *Verbal Reasoning*. Effective reasoning means many things. It means, for example, being able to:

- Analyse and evaluate arguments including our own.
- Recognize contradictions and inconsistencies.
- Recognize what is implicit and/or explicit in an assertion.
- Form and test hypotheses.
- Modify one's beliefs when new evidence indicates they should be modified.

These abilities and many more are summarized by saying that the goal of reasoning is the establishment and maintenance of beliefs that are consistent, so far as possible, with reality or at least with such evidence as one has regarding reality. The use of evidence involves the constructing and evaluating of arguments. Thus, to be an effective reasoner requires that one be able to use language carefully and well. The lesson series is divided into two units. The first unit focuses on *Assertions*, and the second on *Arguments*.

The fourth series, *Problem Solving,* has been designed to teach students how to solve structural problems. A structured problem is a problem with an explicit and precise statement, one in which it is clear what the given information is and what has to be found. Moreover, the given information is always necessary and frequently sufficient to solve the problem. In brief, with structured problems you can be certain that all the information given has a specific purpose.

Although the characteristics of real-life problems are apparently very different from and even contrary to the ones in structured problems, there are three fundamental reasons for teaching structured problems. First of all, structured problems invoke a large subset of thinking skills. The second reason is that structured problems allow the learning of specific skills. And the third and most important reason is that behind every real-life problem, or in other words, behind every non-structured problem, there is always a structured problem.

The series is composed of eighteen lessons divided into five units.

The first unit *Linear Representation,* teaches a method for the resolution of problems that involve only one dimension. In lesson 1 the students are led to solve problems that require the construction of a one-dimensional figure in order to obtain a solution. In the following lessons difficulties are introduced; sometimes only in the sense that more sophisticated language is used to make the reading of the statement more intricate. At the end of the unit the students have verbally synthesized a problem situation and are able to describe it.

The second unit is entitled *Tabular Representation*. When more than one dimension is involved, the representation becomes more complicated. In this unit, the students are introduced to the idea of a table and are shown how to use it to solve problems that require representing several quantified dimensions at the same time.

Unit 3, *Representations by Simulations and Enactment*, has been designed to teach students how it is possible to easily visualize the dynamic situation

referred to in a problem through simulated execution of the actions described in its statements. Once visualized, the representation of the situation is a relatively simple matter.

In the previous units the students dealt with problems whose solution could be grasped once the representation was constructed. In unit 4, *Systematic Trial and Error,* the students are presented with problems where the representation leads not to a single answer but to several possibilities, and are taught a very powerful and general approach for dealing with such situations.

Unit 5 focuses on a strategy named *Thinking out the Implications*. When the answer to a given problem cannot simply be read out of a representation or its meaning, or when there are so many trial answers that the "systematic trial and error strategy" becomes impractical, it is necessary to turn to other methods in order to find a promising way to solve the problem.

The fifth lesson series is entitled *Decision Making,* a topic that has been the object of intensive study for at least the last twenty-five years. The series consist of ten lessons divided into three units.

The first unit *Introduction to Decision Making* has been designed to help students understand that many of the choices they make, apparently without thinking, are accessible to introspection and analysis and that, often, the effort required to exercise these skills is more than compensated for by the satisfaction obtained from the results their decisions produce.

Lesson 1 focuses on what decisions are, who makes them and when.

Lesson 2 approaches the question of why it is that some decisions are difficult to make. The lesson is directed to the exploration of the factors that raise difficulty, using simple representations of decision making situations.

Lesson 3 elaborates on the difficulty associated with making choices when the outcomes are unknown or are known imprecisely.

The second unit *Gathering and Evaluating Information to Reduce Uncertainty* has three major purposes:

- The first is to reinforce the awareness that in most real-life decision-making situations, the outcome associated with any given alternative cannot be known with certainty before the alternative is actually selected; but that despite this uncertainty, the general rule of maximizing the chance of a desirable outcome can still be applied if the relative likelihood of each of the outcomes can be ordered.

- The second major purpose of the unit is to teach the students that an important strategy for reducing the difficulty of making choices among alternatives with uncertain outcomes is that of gathering more information.

- The third purpose is to provide instruction and exercise in the classification of information along three important dimensions: relevance, consistency and credibility.

The third unit is entitled *Analyzing Complex Decision Situations*. The purpose of this unit is to acquaint students with a simple preference specification algorithm that can be applied in everyday choice situations where each of the possible outcomes has both attractive and unattractive characteristics.

In lesson 9, the students are presented with an approach that accords well with common sense: choices among complex outcomes can be facilitated by decomposing each outcome into its constituent dimensions, rank-ordering preferences among outcomes on each dimension independently, combining the ranks across all dimensions for each outcome and, finally, choosing the outcome with the highest combined score.

In the last lesson of the unit, this approach is modified to include an obvious and critical aspect of the choice process: the consideration of the relative "importance" of the component dimensions to guarantee the production of desired results.

The lessons in the sixth series, *Inventive Thinking,* introduce the concept of design as a way of teaching inventive thinking. Design is considered a bridge concept that provides a way of moving from the specific, concrete and simple to the general, abstract and complex. The series introduces

the students to inventive thinking by addressing the designs of specific, concrete and simple things. Later, they approach much more general, abstract and complex things, talking about them in the same vocabulary of design. One basic assumption behind this series of lessons is that effective inventive thinking requires students who understand and appreciate the creativity in their environment. The series consists of fifteen lessons divided into two units: *Design* and *Procedures as Designs*. As with the previous series, the first unit of the lesson series provides a foundation for the second to build upon.

The first four lessons introduce and provide practice in three strategies for understanding the designs of simple objects. The students come to recognize the inventiveness behind ordinary items, such as a pencil or a paperclip, items we rarely think about.

Besides understanding designs, another crucial prerequisite to inventive thinking is evaluating them. In lesson 5, the students learn a strategy for evaluating designs using a number of design standards. They not only identify positive and negative features of a design, but also judge their relative importance.

Building on this foundation, the last four lessons of the first unit challenge the students to improve existing designs and to invent new ones. The strategies taught for improving and inventing are almost identical. They each involve two main parts: defining the problem and solving the problem. The steps within each part are arranged so that a step in which the students think divergently and generate ideas is followed by one in which the students choose critically among the ideas.

The lessons in the second unit are about "procedures". Procedures are methods for doing something. They range from the everyday procedures involved in shopping or cooking to the complex procedures of scientific and technological enterprises. Procedures are central to these lessons on inventive thinking as well as all the other lessons in this course because what the lessons teach are procedures: better procedures for thinking. Accordingly, the understanding, appreciation and improvement of procedures is an especially appropriate theme for this unit.

In lessons 10 and 11, the students learn that one can analyze a procedure as a series of steps.

In lessons 12 and 13, the students learn how to evaluate a procedure through a strategy resembling the one for evaluating concrete objects.

In the last two lessons, 14 and 15, the students transfer the strategy they learned for improving the designs of concrete objects to improving procedures.

As we have just seen, the overall goal of the programme is to enhance the ability of students to perform a wide variety of intellectually demanding tasks; in other words, tasks that not only require a careful, systematic and analytic observation or gathering of information, but that also depend on the ability to interrelate or to build inferences on those observations so as to draw useful conclusions or insights from them.

All the lessons throughout the course have been designed to enable the student to become an independent and autonomous thinker, a person who is able to constantly improve not only his thinking, but also his own procedures for better thinking.

**Bibliography**

ADAMS, Marilyn Jager (curriculum coordinator) 1986. *Odyssey: a Curriculum for Thinking. Understanding Language. Teacher Manual.* Watertown, MA: Mastery Education.