The Programme for International Student Assessment (PISA) in Mexico and Other Latin American Countries: Sociological/cognitive Approach on Operations Used in Science Answers

Jorge Bartolucci¹ & Ernesto Bartolucci²

¹Instituto de Investigaciones Sobre la Universidad y la Educación, Universidad Nacional Autónoma de México, México
²Centro de Estudios Superiores en Turismo Secretaría de Turismo, México

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Abstract

The way to test that PISA applies is unusual in Mexico's education system. Instead of asking the student to identify the correct answer to a series of items that commonly are equal, confronts him with questions that measure the ability to perform one or more mental operations, such as memorizing a simple knowledge, applying that knowledge to problem solving, managing multiple sources of information or using other references not considered in the original context of the question before giving an answer. This article focuses on this discrepancy, because it shows what our students are accustomed to do in school or not, as a result of the way that the majority of institutions, both public and private, validate routines of teaching and learning considered acceptable and desirable to the length and breadth of the education system.

Keywords: PISA, scientific expertise, high school, learning assessment

Introduction

The Programme for International Student Assessment (PISA) is a standardized diagnostic evaluation exercise for pupils aged fifteen integrated in the education system, which was developed jointly by all countries participating in the OECD to assess reading literacy, mathematics and science. The place in which Mexico and other Latin American countries were located in this international ranking was widely publicized in the mass media and in the political arena. Scholars have also shown a growing concern about the impact and relevance of benchmarking exercises such as PISA. In this context, it should be mentioned the book coordinated by Angel Diaz Barriga (2011) of the Instituto de Investigaciones sobre la Universidad y la Educación, (ISSUE) of the UNAM, which deals with a critical analysis of the validity, scope and relevance of these tests, specifically in its 2006 edition.

In general, objections on PISA emphasize the fact that it does not take into account what is actually taught in Mexico, as well as in Latin American schools. This is indisputable, since for PISA, the term "competence" includes both, knowledge and intellectual capacity of students to apply them in solving the problems of everyday life (PISA 2006, pp. 7 and 9). In other words, PISA considers the acquisition of specific academic knowledge as a basic requirement, but is not limited to it. The kind of questions included in PISA test, seek to identify the level of complexity of cognitive operations that students are able to make, from the mere retention and reproduction of the information available, to its re-processing and analysis. Instead, in the Latin American Region the assessments are not designed with this intention. It is rare that the questions asked in class, assignments and examinations seek to distinguish the degree of mastery of such operations. Usually, the tests measure the student’s ability to answer the question with the required information prearranged by the teacher. So there is an alignment between what the student must answer and the instruction given by the teacher. Therefore, the space between the question and the answer is narrow, because it only requires finding the answer on the Internet, an encyclopedia, a book or class notes.

In this context, the logic underlying the PISA test is unusual in Latin America. One thing is to ask the student to identify the correct answer to a series of items rated equally, and other is to face him to other tasks to reveal whether he is capable of a) only memorize knowledge, b) apply that knowledge to solve a problem by one or more mental operations, and c) use other references not considered in the original context of the question. From our point of view such discrepancy is precisely what is important, since it demonstrates what students are accustomed to do or not in school, as a result of the way institutions, both public and private, validate teaching and learning routines considered acceptable and even desirable, in the whole educational system.

The aim of this paper is therefore to analyze the PISA as a program whose design, both theoretically and instrumentally, opens a window that provides a perspective from which it is possible to assess from other point of reference what is taught and learned in our schools. Under this analytical perspective, what calls our attention is not the international ranking resulting from its implementation in Latin American countries. For us, PISA scores reveal the maximum level of complexity of mental operations that our students, on average, are capable of performing, indicator that refers directly to the systemic weaknesses of high school.

We assume that the school is the social institution that contributes most to the intellectual formation of the young.
On one hand, this training provides access to a wide range of knowledge, ideas and concepts concerning nature and society. On the other hand, it shapes the way of using the mind, known as intellectual skills. The ability to observe, conceptualize, describe, argue, classify, compare, analyze, seriate, infer, synthesize or generalize, are intellectual skills that are acquired at an early age, but that the school has the responsibility to develop and promote to a higher level.

The full implementation of this social responsibility requires conceiving learning as a process of intellectual development that should be estimated in a continuous sequence that has a lower and an upper limit of performance. PISA tests have been generated under optimal conditions. The program includes an amount of knowledge and experience on high school education that no society has by itself, regardless of its development, and is grounded in one of the largest educational databases worldwide. The selected items seek to identify the type of skills that students have, challenging them with problems drawn from everyday life. The idea is to confront the students with a hypothetical scenario and get the answers that they are able to give. The steps required by students to reach a solution to the problem, let us know the level of complexity of mental operations underlying the responses. In other words, if whether or not students are able to retain certain notions and concepts, to apply mental operations requiring one or more steps, to manage one or more sources of information, to distinguish general trends or pay attention to internal dissent, or to introduce extra references (not included in the question), that can significantly alter the course of the argument to follow.

In conclusion, the design and structure of the PISA test is a benchmark from which we can infer the type and level of mental abilities that underlie most of the answers given by our students. It is, therefore, to give credit to a tool that has the advantage of estimating the school learning of Latin American youth, in terms of the extent to which they are able to perform intellectual operations ranging from the simplest to the most complex, such as memorization and repetition of information about an issue or a problem, at the lower end of the scale, and the ability to question the validity of certain information as a premise to support a conclusion, at the upper end.

Theoretical framework

These cognitive and intellectual abilities have been described by PISA through the notion of "competence", a term which refers to studies of Noam Chomsky (1989, 1992) on the "linguistic competence", applicable to the ownership of the productivity of languages and any other form of knowledge. The speaker’s linguistic competence consists, according to Chomsky, in the knowledge he has about the linguistic system under which is capable of producing an indefinitely large set of sentences that constitute language. Productivity is a cognitive property, which is the ability to understand and build an unlimited number of statements that have never occurred before in the experience of individuals.

This kind of ability has been taken up by Karmiloff-Smith (1994) as "re-representation", with the intention of emphasizing that learning does not stop at a mere reproduction or storage of the information generated in a given context. Rather, learning begins with these initial operations to generate an infinite number of propositions and considerations increasingly distant from their original context. The British author describes cognitive development as a process in which "the processing of inputs and outputs of information gains independence" (Karmiloff-Smith, 1994: 34). The mind is not prestructured "with finished performances", but channeled to the progressive development of representations "in interaction with both the external and the internal environment" (Karmiloff-Smith, 1994: 28). Hence, the cognitive processes include "representational redescription," through which "increases the flexibility of the knowledge stored in the mind." (Karmiloff-Smith, 1994: 33).

Learning takes place, then, from two complementary ways of processing that the mind exerts over the information. First, a "gradual process proceduralization" (Karmiloff-Smith, 1994: 36), ie, inflexible representations that the mind plays mechanically anchored to specific domains. Second, a number of subsequent operations that obtain new knowledge through internal exploitation of the information that is stored in the mind (Karmiloff-Smith, 1994: 34). In short, cognitive development is to make explicit what is implicit. This theoretical concept takes into account the importance of plasticity, flexibility of mind, whose architecture facilitates the operation of dynamic and creative processes of interaction between society and the environment. (Karmiloff-Smith, 1994: 27).

The same position on the powers of the mind is present in PISA, whose idea of proficiency aims to develop in students cognitive skills to be able not only to reproduce knowledge already given, but also to recreate it. Consequently, the concept of proficiency refers to the degree of control and autonomy that students are capable to achieve for managing the information in their minds. In other words, refers to the degree of control over the acquired knowledge and mental processes. From this perspective the PISA test results are important because they indicate the level of intellectual abilities that students achieve at the time of processing the information to respond to specific situations presented in the test.

This way of thinking is different from those that define PISA as a project that serves the interests of a world economic order that reflects the cultural hegemony that exert the most developed countries in a globalized world. Popkewitz et al (2003), Chartier & Hebrard (2002), Torres & Schugurensky (2000), Bombini (2008), among others, have been pointing out that under this hegemony, current educational policies are aimed at imposing a specific type of skills related to labor market demands. According to the reasoning here, if students are competent in the area of natural sciences, has to do with their ability not only to remember and to manage some information about the phenomena or scientific laws, but also be prepared to use this knowledge to identify problems of their daily lives and respond with arguments that follow the way that science validates their claims, so that they can recognize the scientific value of the available information and its potential as a basis for drawing conclusions and making decisions that are imposed from the experience in real life environment. In particular, the identification of scientific competence in PISA involves assessing the student’s ability to:

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Memorize in isolation simple scientific knowledge.

- Find the solution to problems that require a single step, using a basic scientific knowledge in response to a question.

- Identify and apply scientific concepts that require more than one operation.

- Interpret and problematize the data provided and confront them with two or more explanations about the same event.

- Generate explanations of a fact based on observations that lead to a precise and rigorous interpretation of the data.

- Compare the details of two or more sets of data and provide a review of a given conclusion.

- Relate different information sources and explanations assessing the relevance and significance of each one before giving a definitive answer.

To get a complete picture of the effectiveness of the education system in the task of infusing some of these cognitive abilities in our youth, it is advisable to pay attention to the distribution of these intellectual attributes in the six levels of scientific expertise that distinguishes PISA.

The score recorded by the student in this scale represents the degree of learning and mastering the science competencies that PISA considers necessary for its performance in the knowledge society.

The score achieved by the students in this scale serves as an indicator of the level of learning achieved. That is, it gives an idea of where they are in relation to the ideal to be achieved. To this end, we turn to analyze some questions released by PISA, to describe in detail the different levels of cognitive operations linked to the responses of the test in the area of science.

Content analysis and results

PISA identifies the level 2 as the basic skill level in science. (OECD, 2006: 48) Here are located the students that scored 409.5 points to 484.1, who were able to present scientific explanations derived explicitly from given evidence.

This means they can find the solution to problems that require a single step, such as making literal interpretations of the results of scientific research; remember certain isolated scientific notions and use the results of a scientific experiment represented in a data table and reach a conclusion. Question 3, ACID RAIN, unit dedicated to treating the case of deterioration of the caryatids statues, provides a good example of this level of performance. (OECD, 2006: 110-111)

Figure 1. Acid Rain

Above is a photo of statues called Caryatids that were built on the Acropolis in Athens more than 2500 years ago. The statues are made of a type of rock called marble. Marble is composed of calcium carbonate.

In 1980, the original statues were transferred inside the museum of the Acropolis and were replaced by replicas. The original statues were being eaten away by acid rain.

Question 3: ACID RAIN (S485Q03)

The effect of acid rain on marble can be modeled by placing chips of marble in vinegar overnight. Vinegar and acid rain have about the same acidity level. When a marble chip is placed in vinegar, bubbles of gas form. The mass of the dry marble chip can be found before and after the experiment.

A marble chip has a mass of 2.0 grams before being immersed in vinegar overnight. The chip is removed and dried the next day. What will the mass of the dried marble chip be?

A Less than 2.0 grams

B Exactly 2.0 grams

C Between 2.0 and 2.4 grams

D More than 2.4 grams Full Credit: Code 1: A. Less than 2.0 grams

The information that students should consider is explicitly said in the example. This tells the student that marble is composed of calcium carbonate, and further that the statues are being corroded by acid rain and the vinegar and acid rain have the same level of acidity. In turn, the text makes clear that the effect of acid rain on marble can be displayed by placing chips of marble in vinegar overnight and that when a marble chip is placed in vinegar, bubbles form. Whereas a marble chip has a mass of about 2.0 grams before being immersed in vinegar overnight, the question is: What is the mass of dry marble chip next day after drying?

The solution to this question requires a fairly complex intellectual operation. The students have to know that bubbles are indicating that a chemical reaction is acting on the chip, and as a result of that reaction gas is formed, which
implies mass loss. Students with strong notions of the chemical processes involved in the example, will not doubt that the only possibility is mass loss. Those who have doubts, if their reading ability is sufficient, will recognize the clues that point the way to a logical conclusion. In that case, they can prioritize information and create a meaningful abstraction that enables them to recognize the keys that contain information. Identify the facts that Caryatids are being corroded by acid rain is a reference only circumstantial.

That what happens to the Caryatids can be observed experimentally by placing a marble chip in vinegar: So, since the effect of vinegar on marble is equivalent to the reaction that produces acid rain, bubbles gas form as a consequence of that. Only after that is when the chemical knowledge begins to matter. That is, gas bubbles involve mass loss.

According to the results obtained from PISA 2006 (OECD 2008b: 16), the third of our students made the mental operations required in this exercise correctly. The 30.8 percent of the sample examined in Mexico demonstrated reading ability and cognitive resources available to interpret the results of scientific research and solve a simple problem of low technological complexity. As we advance, this ability is considered by PISA as the level of basic scientific aptitude that a 15 year old should possess today. But what happens when students doubt their chemical knowledge and their reading comprehension is insufficient? Then give equal weight to all parts of the text.

The Caryatids are in Athens, are 2500 years, and were taken inside the Acropolis in 1980 and replaced with replicas; they are made of marble and are being corroded by acid rain; that vinegar and acid rain have the same level of acidity; bubbles are formed and its mass can be measured before and after putting the chip in vinegar all overnight. By giving the same value to information, they are unable to organize data and create a meaningful abstraction. As a consequence of the lack of organizing information, their minds become saturated and get confused; they lose track somewhere and disconnect, which leads them to not answer or if they do, is by guessing randomly.

In the best case, students affected by these training deficiencies will be able to answer questions whose answers involve only remember a very simple scientific knowledge. That leads us to analyze the performance of students who just reached level 1 within the PISA scale. Consider the following question on the exam for this purpose.

**Figure 2. Physical Exercise**

Regular but moderate physical exercise is good for our health.

**Question 3: PHYSICAL EXERCISE (S493Q03)**

What happens when muscles are exercised? Circle YES or NO to each statement.

Muscles get an increased flow of blood. Yes / No

Fats are formed in the muscles Yes / No

Full Credit: The correct answers are YES / NO in that order.

The question requires merely acknowledge facts that are independent of each other, such as, during exercise, the muscles receive or not, increased blood flow and, whether or not exercise promotes fat formation. Clearly, in this case the amount of information is much smaller than in the example of level 2. The solution of the problem is reduced to make a direct connection between knowledge and the question. The student does not need to take the steps required by the Level 2 questions. To be able to resolve that question was necessary to establish a relationship between a chemical fact and a general law. Moreover, it was imperative to know that what happens to the Caryatids could be observed experimentally by placing a marble chip in vinegar. The effect of vinegar on marble is equivalent to the reaction that produces acid rain; as a result gas bubbles are formed. It was only from that point where chemical knowledge that gas bubbles involve mass loss became important: that gas bubbles involve mass loss. However, to achieve location at Level 1, students should simply remember that by exercising, muscles receive improved blood flow and, that exercise reduces fat formation, knowledge applied separately, in isolation. This is what happened to 32.8% of our students who scored between 334.9 and 409.5 points.

Those who could not even remember it were in the lowest level of the test. Indeed, students who lacked such basic knowledge as to exercise the muscles receive more blood flow, or who believe that fat is formed as a result of exercise, scored below the 334.9 points (Level -1); 18.2 percent of the sample examined in Mexico was in this situation. To estimate the size of this deficit is worth mentioning that the OECD average is 5.2 percent, while in Finland, the percentage of
students in this condition reached only 0.5 percent and Hong Kong, 1.7 percent. Overall, the percentage of students with basic skills level in science (Level 2), and those with elementary scientific knowledge (Level 1), totaling just over 63.6 percent of the sample examined in our schools.

Students who did not have even basic notions (Level -1) represented 18.2 percent of respondents.

It is at level 3 (between 484.1 and 558.7 points), where are represented the students able to identify and apply scientific concepts that require more than one operation, such as interpret and use scientific concepts from different disciplines, and apply research models to explain simple phenomena.

An example of this degree of difficulty is the following question selected from the GREENHOUSE unit, in which students must interpret evidence presented graphically and deduce that the graphics sets support the conclusion that both, the average temperature and emissions carbon dioxide, are increasing.

Figure 3. the Greenhouse Effect: Fact or Fiction?

Living things need energy to survive. The energy that sustains life on the Earth comes from the Sun, which radiates energy into space because it is so hot. A tiny proportion of this energy reaches the Earth. The Earth's atmosphere acts like a protective blanket over the surface of our planet, preventing the variations in temperature that would exist in an airless world. Most of the radiated energy coming from the Sun passes through the Earth's atmosphere. The Earth absorbs some of this energy, and some is reflected back from the Earth's surface.

The atmosphere absorbs part of the energy reflected by the earth. As a result of this, the average temperature above the Earth's surface is higher than it would be if there were no atmospheres. The Earth's atmosphere reproduces the same effect as a greenhouse; hence the term greenhouse effect. It is a fact that the average temperature of the Earth's atmosphere has increased. Newspapers and magazines often mention that the increase in emissions Carbon dioxide is the principal source of increased temperature in the twentieth century.

A student named Andre is interested in the possible relationship between average temperature of Earth's atmosphere and carbon dioxide emissions. In a library he finds the two graphs above.

From these two graphs, André concludes that it is true that the increase in the average temperature of the Earth's atmosphere is due to the increase in carbon dioxide emissions.

Question 3: GREENHOUSE (S114Q) SCORING 3

What is it about the graphs that supports André's conclusion?

What is the difference with the previous levels? To begin, the title poses a dilemma: "Fact or Fiction." It refers to a controversial issue, a debate between two or more explanations about the same event. This presupposes the possibility of an exchange of point of views. That is not present in any of the lower levels. The problems inherent in the lower level questions do not concede different interpretations. This should be enough to warn the student, that he is facing a more complex problem. Second, to follow the argument in the text, the reading comprehension level must be far greater than that required to solve the questions of level 2. The starting point is that living things need energy to survive and that the source of energy that sustains life on earth comes from the sun. To get to the greenhouse concept, students should be able to understand the relationship between source of energy, land and atmosphere. The Earth's atmosphere acts as a protective blanket over the surface of our planet. Most of the radiated energy from the Sun passes through the atmosphere. The Earth absorbs some of this energy and part is reflected back from the surface of the Earth. Since the atmosphere absorbs some of this reflected energy, the average temperature on the surface of the Earth is higher than it would be without the atmosphere. In conclusion, the Earth's atmosphere has the same effect as a greenhouse.

In accordance with the canons of the PISA, the question provides all information that is relevant to the problem: the average temperature of the earth has increased, and according to versions circulating in the mass media, this is due to the increase in carbon dioxide emissions. Students do not have to memorize any of this, but must interpret the data represented in the graph and validate the completion of another. The degree of uncertainty that encloses this question is greater than the previous, since they must assess whether or not the increase in carbon dioxide emissions can be considered as the cause of the increase in temperature of the earth in the twentieth century. When the maximum ability of the student does not go further to recognize the existence of a general upward trend between temperature and carbon dioxide emissions, its capacity is sufficient to detect a simple pattern of two sets of graphical data and use
it to support a conclusion. Such would be the case for those who like André, merely observed the increase of both, temperature and carbon dioxide emission average, using one of the following expressions:

- Temperature increased, as emissions increased,
- Graphs are both increasing. o Graphs began to increase in 1910.
- Temperature is rising as CO2 is emitted. o Information lines on the graphs rise together.
- Everything is on the rise. o When CO2 emission rise, temperature increases

It was also given full credit to those students that refer (in general terms) to 'positive relationship', 'similar shape' or 'directly proportional' between temperature and carbon dioxide emission; although the mentioned sample responses are not strictly correct, it shows sufficient understanding to be given credit here. At this level of difficulty, Mexico registered a 14.8 percent of students, which is close to that achieved by Argentina (13.6 percent), Colombia (10.6 percent) and Brazil (11.3 percent). Chile and Uruguay, however, showed better yields, 20.1 percent and 19.7 percent, respectively. Countries like China - Hong Kong, 28.7 percent, Canada 28.8 percent, Finland, 29 percent, Spain 30.2 percent, and the U.S, 24 percent, reported percentages close to the OECD average, which is 27.4 percent.

To reach the subsequent level (4), between 558.7 and 633.3 points, students should be able to use their cognitive abilities to develop more detailed explanations on a particular physical phenomenon. A new question on the greenhouse effect is again the case to illustrate the type of skills required by students to qualify at this level. Unlike the question 3, which asked students to support the finding of André, question 4 puts the student facing the following situation:

**Question 4: GREENHOUSE (S114Q04) SCORING 4 Y 5**

Another student, Jeanne, disagrees with André’s conclusion. She compares the two graphs and says that some parts of the graphs do not support his conclusion. Give an example of a part of the graphs that does not support André’s conclusion. Explain your answer.

Since the correlation shown in the graphs is not directly proportional, there is a chance to disagree with the conclusion of André, as does our imaginary student, Jeanne. She compares the two graphs and claims that parts of the graphics do not support this conclusion. Therefore, question 4 further examines the same information already exposed, but puts the student in front of a different interpretation and asks to give an example of a section of the graphs in which curves do not descend or ascend simultaneously. The correct answers to the question were classified according to two levels of difficulty. One, considered partial achievement (Scoring 4), referred to cases which mentioned some correct period without explanation, for example, '1930-1933', 'before 1910', or cases that only mentioned a particular year (not a period of time), with an acceptable explanation. For example: 'In 1980 the emissions were down but the temperature still rose'. Other responses that refer to differences between the two curves without mentioning a specific period, were also considered for partial achievement: 'At some places the temperature rises even if the emission decreases'; 'Earlier there was little emission but nevertheless high temperature'; 'When there is a steady increase in graph 1, there isn't an increase in graph 2, it stays constant'; 'Because at the start the temperature is still high where the carbon dioxide was very low'.

Partial achievement was also given to students that do not support André's conclusion but make a mistake in mentioning the period. For example, 'Between 1950 and 1960 the temperature decreased and the carbon dioxide emissions increased'. Those who refer to an irregularity in one of the graphs such as: 'It is about 1910 when the temperature had dropped and went on for a certain period of time'. 'In the second graph there is a decrease in temperature of the Earth's atmosphere just before 1910'. And to others that indicate difference in the graphs, but with poor explanation. For instance, 'In the 1940's the heat was very high but the carbon dioxide very low'. The explanation is poor, but the difference that is indicated is clear. All these examples refer to students who understood the question and identified a difference between graphics, but were incapable to communicate their observations clearly and accurately. If so, it may be assumed that the vast majority of Mexican students are not used to making a thorough analysis of the information and are not competent to identify specific differences in a correlation that is not directly proportional. In this segment, there is a strong decrease in the percentages obtained by Mexico, 3.2 percent, lower than Argentina, Uruguay and Chile, which were 4.1 percent, 6.9 percent and 8.4 percent, respectively. USA scored 18.3 percent, and France, 20.9 percent, figures close to the OECD average (20.5), while Japan, Canada, Hong Kong and Finland ranged from 27 to 30 points.

Full credit was granted to students whose understanding and analytical skills allowed them to place a section where curves were not ascending or descending at a time, and also reported it with sufficient clarity and precision. Those who achieved this goal were located on level 5, (633.3 to 707.9 points). Rather than a general reference to observable differences in various segments of the graphics, they were asked to accompany the aforementioned period with a precise explanation of this difference. Such was the case that refers to one particular segment of the graphs in which the curves are not both descending or both climbing and gives the corresponding explanation.

'In 1900-1910 (about) CO2 was increasing, whilst the temperature was going down'. 'In 1980-1983 carbon dioxide went down and the temperature rose'. 'The temperature in the 1800's is much the same but the first graph keeps climbing'. 'Between 1950 and 1980 the temperature didn't increase but the CO2 did'. 'From 1940 until 1975 the temperature stays about the same but the carbon dioxide emission shows a sharp rise'. 'In 1940 the temperature is a lot higher than in 1920 and they have similar carbon dioxide emissions'. The percentage of Mexican students who have demonstrated ability to identify differences in the two data sets and provide well-grounded conclusion was only 0.3 percent. The Latin American countries with the highest percentage of students placed in this high level of scientific aptitude were Chile (1.8 percent) and Uruguay (1.3 percent).
USA, Ireland and France scored very close to the OECD average (8.5) and the highest rates were observed in Finland (17.0) and Hong-Kong (14.7).

Level 6 (from 707.9 points), expresses the optimal intellectual performance of students. Besides relating different sources of information and their views clearly and precisely, the skills and abilities acquired during their training allow them to apply the knowledge they have about science with greater proficiency.

Question 5: GREENHOUSE (S114Q05) SCORING 6

André persists in his conclusion that the average temperature rise of the Earth's atmosphere is caused by the increase in the carbon dioxide emission. But Jeanne thinks that his conclusion is premature. She says: "Before accepting this conclusion you must be sure that other factors that could influence the greenhouse effect are constant". Name one of the factors that Jeanne means.

The question requires students not only assess the whole positive trend between the data presented in the graphics, or recognize observable differences in a certain segment. It requires considering that to explain the phenomenon in question should be included other sources of information on factors that have so far not been taken into account. The requirement of focusing on what has not been explicitly given had not been submitted in any of the previous levels. In this case, students have demonstrated sufficient knowledge of "Earth systems" to identify at least one factor that could be affecting, just like: 'The energy/radiation coming from the Sun'; 'The sun heating and maybe the earth changing position'; 'Energy reflected back from Earth', (assuming that by "Earth" the student means the ground). Or some other factor relative to a natural component or potential pollutant, as 'water vapor in the air'; 'the things such as volcanic eruptions'; 'atmospheric pollution (gas, fuel)'; 'the amount of exhaust gas'; 'CFC's (chlorofluorocarbons)'; 'the number of cars'; 'ozone (as a component of air)'. Having recognized the limitations of the data available and taking into account other factors introduced that could affect the physical phenomenon under study, are indicative of greater critical capacity and proper understanding of the way it works in science. None of the Mexican students sampled exhibited these qualities, and among the Southern Cone countries are Uruguay with 0.2 percent, and Chile and Brazil with 0.1 percent. The average for the OECD countries at this level is 1.5 percent. The highest percentages were recorded by Finland (4.6), New Zealand (4.4) and the UK (3.7).

Conclusion

According to the argument in this article, PISA should not be conceived as a simply technical tool for standardized assessment. Rather, it represents an internationally agreed evaluation model, whose application in Mexican and Latin American schools confronts our educational system with rationality other than that it governs. First, it highlights the value of learning in terms of the domain that students can have on the notions and concepts learned, as well as on the information gathered and all the mental processes that they have incorporated. Second, it introduces a different way of conceiving the academic assessment of students that consistently attempts to estimate the degree of progress of their academic skills, in relation to their intellectual growth, from the most basic abilities and knowledge to the levels of highest complex performance.

Academic studies on the implementation of PISA in Mexico and Latin America, consider this kind of tests, either as an instrument that is unable to recognize the specific educational needs of each society, or as part of a strategy of cultural domination coming from hegemonic countries. Instead, according to the analytical approach applied in this study, the distribution of the figures in the six proficiency levels in PISA, refers to the distribution of intellectual abilities acquired by students of 15 years in the participating countries. As to our students corresponds, beyond the significant percentage of young people who seem to lack the basic knowledge, it is clear that most of them are used to memorize isolated notions and concepts or to perform mental operations of a single step. The number of students who have demonstrated the ability to perform complex mental operations is significant, but not enough to change the overall average.

It's not about lamenting the shortage of students with higher intellectual abilities or to justify this lack, but to seize the opportunity offered by this framework to review an educational system whose north is oriented mostly toward repetition and memorization of instructions given in class by the teacher. In such a context, where the only reference of school behavior invariably falls on the figure of the teacher, the young are accustomed to perform mental operations that make sense in relation to the authority which it embodies, not in terms of impersonal authority of reason and logic. This is where our system falters. We need to leave behind a system of teaching based on the transmission of accumulated knowledge, and teach our students to be critical to assess the information available, and build their own perspective to decide what is relevant, what is appropriate, what is true, to handle ambiguity and uncertainty, and to recognize a hypertext with several levels, of which, at first sight reaches only a small portion of them. We need to move beyond teaching routines by accumulating content and move to teach so that our students learn to evaluate information and build their own perspective to decide what is relevant, what is appropriate, what is true; and also, to handle ambiguity and uncertainty, and to recognize a hypertext with several levels, of which, at first sight reaches only a small portion of them. (Aunión, 2010).

Pisa clearly prescribes the course of cognitive development and describes accurately the various mental operations that 15 year olds are able to perform, from the simplest to the most complex. This detailed and accurate description does not exist in our education system nor the tools to recognize and evaluate, much less the design of activities and strategies that allow us to align the whole system in that direction. The image we have, by contrast, is a single space with a very poor articulation, and also without institutional strategies to validate school performance; and so the results are more dependent on each student's cultural capital, than on what the school is willing to offer.

Instances and assessment tools that operate regularly do carelessly to appraise learning different scales of cognitive development. At best, they set very indeterminate types of academic performance, such as: very good students, good students, regular students or bad students. The only
information provided to the learner is whether he approves or disapproves an activity, a subject, a program or a cycle. Almost never seeks to communicate the progress of skills and knowledge in a given direction, only serves to reflect on whether or not the duty entrusted was done. In this context, the resources that are typically used to motivate students lose effectiveness and meaning. Rewarding the student with extra points if he did his homework, when he attends and participates in class, working alone or as a team, and for participation in outside activities (theater, libraries, etc.), although stimulates interest and compliance of pupils, is not conducive to raising the cognitive faculties that we should get them to acquire.

PISA's critics have stressed that the universal dimension assumed by these tests is equivocal, because the items used are outside the social and cultural context in which they are applied and not taken into account the contents of each curriculum. Therefore, its results do not reflect the actual level of knowledge of students tested. We agree that this is largely true, but the approach taken in this paper reverses the terms of the problem, drawing a line of thinking in a way that allows assessing the role that school education should play in transmitting scientific rationality, whose universality is unquestionable. One of the most common teaching resources in Mexico to facilitate learning is that the curricula are close to the reality of the child or young person. In view of this, it would be inappropriate to ask about something so far removed from their daily lives as the Caryatids, Acropolis and Athens. However, what is not, or should not be something far are, for example, the chemical reactions affecting the material as a result of exposure to climatic and environmental pollution. Neither should be unfamiliar, knowledge accumulated by mankind to observe, analyze and explain these phenomena. The point is the degree of familiarity of the students with the mental processes that require scientific reasoning to examine the available information, prioritize their importance, identify the relevance of knowledge and information, represent various logical possibilities and articulate a compelling argument to support a particular conclusion.

It is in that mirror that is necessary reflect ourselves, as a point of critical reflection, painful but necessary, and set a long-term strategic direction, allowing us to ensure that students acquire increasingly more complex levels of competition on a clearly defined scale recognized and institutionally supported and recognized by the educational community in the country. With a critical path of this type, it is inevitable "that education systems function as a funnel, on top of which are placed shiny new reform ideas every time a new government comes to power, in the middle there are ten or fifteen years of reforms layers unfinished and incoherent crowded, and in the background are the students and teachers face a bewildering burden of rules and regulations that nobody understands and nobody feels responsible." (Perez de Pablos, 2005)

At first glance it seems unattainable. Certainly, it is very difficult to change a system that has been very focused on the reproduction of the content of some subjects, to go to another that teaches students to think creatively and apply what they know. But, for now, we should stop telling teachers what to do and what they have to teach, to focus on what students should be able to achieve and that teachers decide what to teach and how to get to it. This implies that public and governmental concern for the mere control over the resources and content of education decreases, and reinforces interest in intellectual skills. In that sense, it is extremely important to have appropriate diagnostic to determine the level of competence of students, and deploy multiple simultaneous pedagogies to elevate them as much as possible. Education has always been a very important place on the political agenda, and there are compelling reasons in favor of using the political momentum for reforms to establish a firm consensus on the future of education. But it is also a fact that they do not produce dividends in the short term and that require long-term strategies. Otherwise, it's inevitable "that education systems function as a funnel, on top of which are placed shiny new reform ideas every time a new government comes to power, in the middle there are ten or fifteen years of reforms layers unfinished and incoherent crowded, and in the background are the students and teachers face a bewildering burden of rules and regulations that nobody understands and nobody feels responsible." (Perez de Pablos, 2005)

References


