Cognitive Processes in the Development of Competencies in Technical Agricultural Middle Schools: A Correlational Study

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Abstract

This correlational study seeks to determine which cognitive processes teachers perceive to more efficiently contribute in the development of competencies in Mexico's national curriculum. It analyzes and evaluates the degree of association between cognitive processes and development of competencies among teachers in Mexico City's Agricultural Technical Junior High School System. The Conceptual Framework describes the hierarchy of cognitive processes in Bloom's Taxonomy and their evaluation in the Programme for International Student Assessment (PISA).The population surveyed was 50 teachers in Technical Junior High Schools in Mexico City. The Discussion and Conclusions report the correlations the survey found between the types of cognitive process and their usefulness for development of the generic competencies stipulated by Mexico's Secretariat of Education in the current curriculum for mandatory education.

Keywords: cognitive processes, competencies, PISA, junior high school

1. Introduction

The skills required for success in the labor market have changed. Abundant, easily accessed information available today, in large part thanks to internet, requires citizens be prepared to interpret it(Secretariat of Interior 2013).Increasingly frequent evaluations of quality in education evidence students' serious inability to perform competently both in their transit through educational levels and in their future careers. This places the priority on developing competencies for continuous learning, or learning to learn, as stipulated by the Delors Commission's four pillars of education of increasing importance to societies of knowledge (Delors, 1996: 31).

Mexican documents and institutions referred to in this article were translated by the authors.

2. Conceptual Framework

2.1 Cognitive Processes and Bloom's Taxonomy

Also known as the Taxonomy of Educational Objectives, Bloom's Taxonomy is a classification of a learner's mental tasks and skills. It has six levels, as follows (Bloom& Broder 1958).

2.1.1Knowledge: Knowledge is the level of remembering information; it merges the cognitive process of remembering with the various types of knowledge recalled in the same form it had been presented.

2.1.2 Comprehension: Comprehension represents the broadest class of intellectual skills and abilities involved in taking new information via verbal, written, symbolic, or experiential communication and giving significance to it. Significance is created by processes such as translation, interpretation, and extrapolation.

2.1.3 Application: Application is described in relation to a specific type of abstraction, defined principally in terms that contrast it against the other five levels in the taxonomy. It involves implementing the correct abstraction of a problem in a concrete situation by transferring learning for effective problem-solving.

2.1.4 Analysis: Analysis is defined relative the levels of Application and Comprehension, emphasizing the ability to detect relationships among parts and their manner of integration. Recognition of constituent parts includes recognition of tacit suppositions, distinguishing fact from opinion, and differentiation between conclusions and the fact upon which they are based. Analysis of relationships implies identification of conceptual relations, awareness of cause and effect, and inferring the organizing principles, purpose, points of view, prejudices, and persuasion techniques an author has.

2.1.5 Synthesis: Synthesis involves generating new structures of knowledge by unifying parts or elements to conformanovel unity different from previously existing patterns and structures. This process generally implies a recombination of portions of experiences with new materials, so as to form a product that is new to the student.

2.1.6Evaluation: Evaluation is the most complex of all cognitive processes, the ability to consciously judge the value of knowledge for a given end, based on a clearly defined set of criteria. It involves decision taking in the light of essential characteristics.

The next section conceptualizes the variables of cognitive processes and development of competencies applied in the exams by the Programme for International Student Assessment (PISA).

2.2Cognitive Processes Imply Conscious Direction of the Flow of Thought

These cognitive processes, or conscious direction of the flow of ideas, are what PISA is designed to test via problem solving that utilizes the processes of observation, comprehension, representation, and execution in accordance with the competencies in the national curriculum (Secretariat of Public Education 2011).

The following are the cognitive processes included in PISA's 2013report.

2.2.1 Observe and Comprehend: Explore the situation surrounding the problem, by observing, interacting to search for information, limitations, or obstacles for the purpose of demonstrating comprehension of the information given and discovered.

2.2.2 Represent and Formulate: Use tables, charts, symbols, or words to represent aspects of the problem and formulate hypotheses on relevant factors and the relationships among them to construct a coherent mental representation of the problem's situation.

2.2.3 Plan and Execute: Elaborate a plan or strategy for solving a problem, and carrying that plan out.

2.2.4 Monitor and Reflect: Monitoring progress in response to feedback, and reflecting on the solution, information given, or strategy adopted.

The ability to reason is implicit in each and every problem-solving process. For students to achieve comprehension of a problem's situation, they must distinguish fact from opinion, which may include identifying relationships among variables when choosing a strategy, considering cause and effect, and critically evaluating suppositions and alternative solutions to achieve a favorable result. PISA gives junior high school students tasks that test their skills at deduction, induction, analysis, or combining types of reasoning. Crucial to the selection of items in the battery is that these are the skills that can be taught and perfected in daily classroom interaction (for instance: Adey et al., 2007; Klauer & Phye, 2008).

2.3 Development of Competencies

In modern societies, each moment of life means solving problems. Social change, the environment, and technology signify that the content of applicable knowledge evolves rapidly. Adaptation, learning, daring to try new options, and constantly being prepared to learn from mistakes are some of the keys to the capacity to overcome and be successful in an unpredictable world (PISA 2013).

Such competencies for life are contained in the most recent reform of the national curriculum for junior high school in 2011 in its profile for graduation, curricular standards, and expected learning outcomes. The curriculum describes "competency" as the ability to respond to different situations, and implies procedural knowledge (skills), linked with facts (declarative knowledge),and the judging of their consequences of the act (values and attitudes, knowing how to be).

Lifelong competencies mobilize and direct all of these components — knowledge, skills, attitudes, and values — toward fulfillment of concrete objectives. They are more than knowing, knowing how, or knowing to be because they are manifest in holistic daily action. The following are the generic competencies stated in the Secretariat of Education's 2011 curriculum for all subjects.

2.3.1 Competencies for ongoing learning: Lifelong learning requires reading comprehension and skills, integrating oneself into written culture, communicating with others of the same language, digital skills, and learning to learn.

2.3.2 Competencies for handling information to identify what is needed to learn: Learn to search, identify, evaluate, select, organize, and systematize data, to appropriate data critically, to use and share information ethically.

2.3.3 Competencies for handling risk situations: Learn to manage uncertainty, propose procedures and carry them to fruition, manage time, foment change and confront those that arise, take decisions and assume the consequences, succeed over failure, frustration, and disappointment, act autonomously and develop life plans.

2.3.4 Competencies for coexistence: Learn empathy, relate harmoniously with others and nature, be assertive, work collaboratively, make agreements and negotiate, grow with others, recognize and value social, cultural, and linguistic diversity.

2.3.5 Competencies for living in society: Learn to decide and act critically within values and social and cultural norms, act to favor democracy, freedom, and peace, respect the legality of human rights.

3. Contextual Framework

More than 90% of 15 year old students are in traditional classrooms in 32 of the 34 countries in the Organization of Economic Cooperation and Development (OECD).Mexico ranks third lowest in this standard, with school attendance of about 70%of this population according to PISA 2012(OECD 2014).

Of every 100 Mexican children who enter primary school, only 76 finish high school. This dropout rate also prevails in the Technical Junior High School System (DGEST); the majority of its 119 schools are in low income neighbourhoods and its classes are very large, usually with 50 students.

The DGEST curriculum includes the core subjects prescribed by the national curriculum, complemented with holistic technological studies applied in specialized areas such as Industrial Design, Computing, Fishing, and Agriculture.

The majority of teachers in the DGESTsystem hold bachelor's degrees or some studies in higher education in a broad diversity of fields, few of which are related to education or related social sciences.

4. Justification

The fact that only about 70% of children who enter elementary school will complete high school has severely limited coverage of mandatory education in secondary and tertiary studies per the General Law on Education.

Therein derives the necessity of exploring cognitive processes that promote the development of competencies, since Volume V of the 2013PISA Report specifies that the skills to solve problems of daily life by observation, comprehension, representation, formulation, planning, execution, monitoring, and reflection is what PISA truly tests and will do so again in 2015 in the next round.

5. Objective and Purpose

Analyze the correlation between cognitive processes and development of competencies in the 2011 national curriculum.

Explain how cognitive processes contribute effectively to the development of competencies within the 2011 national curriculum.

6. Hypothesis

Some cognitive processes are perceived to contribute more effectively than others to the development of competencies within the 2011 national curriculum.

7. Research Question

What are the perceptions among teaching staff on cognitive processes that favor the development of competencies?

8. Variables

The variables under study are cognitive processes and generic disciplinary competencies specified by the 2011 national curriculum.

9. Method and Population

The population interviewed is 50 teachers from all the subjects and agricultural activities: Agriculture, Apiculture, Cattle Husbandry, and Food Preservation and Industrialization from the three Technical Junior Highs within Mexico City.

10. Instrument

The research instrument was a questionnaire on perceptions of utility of teaching strategies, (Appendix 1).

11. Procedure

A description of the possible correlation among the variables was achievedvia a survey in which questionnaires on perceptions of utility of teaching strategies were applied to 50 teachers from the three Technical Junior Highs within Mexico City.

The descriptors were adapted from the Cognitive Levels and Evaluation, Taxonomies of Cognitive Processes published by the Teacher Training Department of the National University's College of Chemistry (2009).

12.Results from Survey

This section presents the perceptions 50 teachers reported of the values they assigned to teaching strategies that promote cognitive strategies derivative from the taxonomic levels classified by Bloom. The instrument offered diverse teaching strategies accompanied by the cognitive strategies implied by each. Interviewees were asked to indicate, on a scale from 1 for "never" to 5 for "always", the perceived classroom utility or use of the activities with students.

12.1Memorization Skills

The largest number of the teaching strategies presented cognitive loads of recall and recognition, where students demonstrate the capacity to remember facts, concepts, and procedures at the moment of evoking, repeating, and identifying them.

Sixty percent, or 30, of the teachers surveyed responded to these questions with scores of 4 and 5, signifying they nearly always or always perceive this type of activity to be highly useful.

12.2Comprehension Skills

Several of the questions teaching strategies presented degrees of cognitive demand at the level of comprehension and organization of concepts, ones where students display development of concepts and organization of specific knowledge, such as comprehending school contents, characterization, expressing functions, deduction, inference, generalization, discrimination, predict tendencies, explain, transfer to similar situations, and translate symbolic languages.

Only 10%, or five, of the teachers surveyed perceived the usefulness of teaching this class of strategies.

12.3Higher Order Skills

About one fifth of the teaching strategy examples were from the highest levels in Bloom's Taxonomy, ones in which students demonstrate the ability to perform activities that imply analyzing data, results, graphics, and patterns, drawing up work plans to test a hypothesis, present conclusions, propose improvements, analyze and organize results, distinguish hypothesis from theory, resolve problems, and analyze critically.

Only two teachers, representing 5%of those surveyed, perceived this type of activity as useful.

12.4 Surveys Invalidated

Although there were no correct nor incorrect responses, only options that indicated frequency of use for the teaching strategies, the researchers found that fully 25% of the questionnaires had been answered at random. This was determined by examining the counterbalanced responses, a technique that involves detecting contradictory responses by comparing a low score on one question against a high score given for a contrary strategy, which should have been assigned a low score so as to coincide in significance.

13. Discussion and Conclusions

The correlation found between the variables was in inverse proportion, which is to say that all of the respondents indicated that the lower cognitive processes are those they perceive to be useful, while very few teachers surveyed report as useful the strategies that imply elaboration, organization, and synthesis. These items that deploy higher order cognitive skills were not perceived as useful, the ones which require describing relationships among time, natural space, multicausality, and simultaneity were.

One of the causes of such a perception may be that this type of activity and the evaluation by performance of competencies is quite different from what they lived in their own learning.

Given that the majority of Technical Junior High teachers have little or no professional training in education, another possible reason is that they lack the pedagogical insight to appreciate the utility of higher mental processes.

It is clear to the researchers that they must continue this line of investigation. For future use the survey would need to be refined to give a more even treatment of the various academic disciplines.

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Appendix 1

Survey on Perception of Usefulness of Cognitive Processes

The questions are counterbalanced; that is,they may contradict the meaning of another question, such that in one your score may be high in one and low in another so that their meanings match. There are no right or wrong answers, only different styles of teaching and learning. **It is anonymous since it is indispensable that you reflect before answering and you be sincere. Thank you for your time!**

Male____ Female__ Years of study in your discipline: _____
Years of teaching in agricultural junior high:_____ School (number) _____

Score by 1, 2, 3, 4, 5 according to your opinion.

(1 = NEVER, 2 = OCCASIONALLY, 3 = SOMETIMES,4 = OFTEN,5 = ALWAYS

Correct memorization and repetition is more important than the context in my classes.	1 2 3 4 5
The time to answer tests is very short and causes stress in my students.	1 2 3 4 5
My students locate the main idea.	1 2 3 4 5
My students repeat and copy a variety of information.	1 2 3 4 5
My students locate key words in oral and written text.	1 2 3 4 5
My students use various meanings of a new word.	1 2 3 4 5
Students explain differences and similarities of distinct information.	1 2 3 4 5
Students paraphrase oral and written information.	1 2 3 4 5
Students perform personages with their own words.	1 2 3 4 5
Students use body movements to express vocabulary.	1 2 3 4 5
Students complement story and sentence endings.	1 2 3 4 5
Students express family or professional relationships in oral or written text.	1 2 3 4 5
Students deduce the location of a given action or situation in oral or written text.	1 2 3 4 5
Students write synonyms to replace key or other words in oral or written text.	1 2 3 4 5
Students write prefixes or suffixes to words.	1 2 3 4 5
Students locate the missing word in a sentence.	1 2 3 4 5
Students express an idea, story, or sentence in various manners.	1 2 3 4 5
Students locate the error in a sentence.	1 2 3 4 5
Students express the missing word in a paragraph.	1 2 3 4 5
Students deducewords by their context.	1 2 3 4 5
Students use drawings or sentences to express the development of stories or routines.	1 2 3 4 5
Students predict information that follows a paragraph without reading it.	1 2 3 4 5
Students predict a title.	1 2 3 4 5
Students explain why an idea is the main one in oral or written text.	1 2 3 4 5
Students translate word-by-word in English class.	1 2 3 4 5
Students find similarities or differences in grammatical structures in English.	1 2 3 4 5
Students explain what a text is about before reading it in science classes.	1 2 3 4 5
Students use words they know in various manners.	1 2 3 4 5
Students express the information in their own words.	1 2 3 4 5
I ask mystudents their opinion of an oral or written text.	1 2 3 4 5
Students read or write new words several times.	1 2 3 4 5
Students deduce missing words in a textor sentence.	1 2 3 4 5
I ask mystudents about relevant or extra information in oral or written text.	1 2 3 4 5
Students order ideas before writing.	1 2 3 4 5
Students listen many times to comprehend well in English.	1 2 3 4 5
Students explain their own errors in solving a math problem.	1 2 3 4 5
I assume beforehand that my students are capable.	1 2 3 4 5
I assume beforehand that my students can research efficiently.	1 2 3 4 5
Students can express information that comes before a paragraph without having read it.	1 2 3 4 5
Students write without giving importance to the hierarchical organization of my ideas.	1 2 3 4 5
Students clearly locate the author's purpose.	1 2 3 4 5
Students use transitions or conjunctions to speak or write correctly in Spanish.	1 2 3 4 5
Mystudents question about the differences or similarities of an oral or written text in Civics.	1 2 3 4 5
Students explain the spatialand natural relations in Geography.	1 2 3 4 5
Students express an alternative solution and performance in a game in Physical Education.	1 2 3 4 5
Students express relations of multicausality and simultaneity of the events in History.	1 2 3 4 5
Students write with a variety of structures and vocabulary in Spanish.	1 2 3 4 5
Students write without thinking much about the main idea, as it occurs to me.	1 2 3 4 5
I ask my students about the key words in a text.	1 2 3 4 5
Students explain the relationshipbetween natural phenomena and daily life processes in Sciences.	1 2 3 4 5
Students order their words or ideas before speaking at the front of the room.	1 2 3 4 5
Students repeat to learn the sounds of English without regard to the context.	1 2 3 4 5
I motivate and ask my students to research additional information.	1 2 3 4 5
Students listen many times to better locate specific information from a recording in any subject.	1 2 3 4 5
With mystudents it is better to pay attention to all the information in a text than to the main idea.	1 2 3 4 5
Mystudents clearly locate references or relations of meaning in a written text.	1 2 3 4 5
I ask mystudents explanations on their opinions about an oral or written text.	1 2 3 4 5
Mystudents describeobjects or stories in their own words.	1 2 3 4 5
I ask mystudents about the time, places, and persons in an oral or written text.	1 2 3 4 5