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BOOK

# Students' conceptions on sugar production: A comparative and collaborative study between french west indies and Canada\*

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## Theoretical background:

Situated conceptions, as defined by Clément (2003), refer to the idea that learners' expressed conceptions are neither consistent nor uniform. Drawing on a classic example from the realm of biology education, namely the anatomy of the digestive system, the author illustrates that students' expressed conceptions often arise from situation-specific interpretations and may contradict their knowledge within a matter of minutes. The concept of "situated conceptions" was further expanded upon in its interactions with students' conceptions and social representations and its application within the framework of collaborative educational games (Delomier, 2013). The digital transformation has given individuals the opportunity to strengthen the social and collaborative aspects of their learning, enabling them to establish relationships and interact online (Baker & Détienne, 2019).

The contextuality of biology concepts is particularly significant, especially in the context of knowledge related to biodiversity and the environment. Authentic approaches and context-based approaches have demonstrated the importance of considering environmental contexts in science education, particularly for engaging students in their learning. The term "didactic contextualization" was specifically introduced in the context of field investigations (Giamellaro, 2014).

## Key objectives:

The objective of this study is to highlight that, similar to students' engagement, their "situated conceptions" are strongly linked to their everyday life and learning contexts. More specifically, in this work, we describe and discuss learners' conceptions on the subject of sugar production. Additionally, we will study whether, in the context of collaborative interactions among students from different socio-cultural backgrounds, these conceptions undergo transformation and enrichment, shaped by the contextual dynamics in play.

## Research design and methodology:

The presented results stem from the "*Anonyme*" project (funding by the ANR-FRQSC program) which aims to implement and evaluate a pedagogical innovation rooted in remote contextual comparisons across various scientific study topics, involving students from Guadeloupe and Quebec. Over several months, students engage in collaborative research on a shared scientific subject, utilizing both synchronous and asynchronous methods to present and exchange their findings. Data are collected through recordings of their interactions and the administration of pre- and post-questionnaires.

In this study, we focus on one question from a *Anonyme* experimentation about sugar production. We asked primary students to draw the sugar-producing plant, expecting Guadeloupe students to choose sugarcane and Canadian students to select maple trees. After collecting their drawings, we categorized the students' conceptions of sugar production *aposteriori* by examining the context they chose for graphical representation and considering other observed elements in their drawings.

## Findings:

The following section relies on the analysis of 94 drawings obtained from both the pre- and post-questionnaire phases. These are drawings for which we could interpret the content without any ambiguity.

### Finding 1: Contextual conceptions

As expected, the majority of the respondents represent the plant from their respective contexts (sugarcane in Guadeloupe, maple tree in Quebec). As shown in the Table 1, in post-questionnaire phase some students (3 in Guadeloupe, 12 in Quebec) chose to represent both plants as examples of vegetation which produces sugar.

Table 1 : Summary of the selected drawings for analysis

	Drawings kept for analysis	N drawings of sugarcane	N drawings of maple tree
Pre-test (Guadeloupe)	21	21	0
Post-test (Guadeloupe)	23	23	3
Pre-test (Quebec)	25	4	25
Post-test (Quebec)	25	12	24
<b>N in total</b>	<b>94</b>	<b>60</b>	<b>52</b>

By closely examining the drawings, we identify elements related to plant biology and agricultural aspects, such as cultivation tools, sugar collection, and field workers. Consequently, here are two more findings.

Finding 2: The overrepresentations of sugarcane stalks and maple tree trunks

As illustrated in Figure 1, a significant number of students prioritize represent graphically the fibrous stems of the sugarcane plant and the central trunks of maple trees in their drawings. We believe that reducing drawings primarily to the storage organ in sugar plants responsible for sugar production or the harvesting site can be viewed either as an utilitarian approach to illustrating plants or as an intention to provide an explanatory diagram showcasing the utility of these plants.

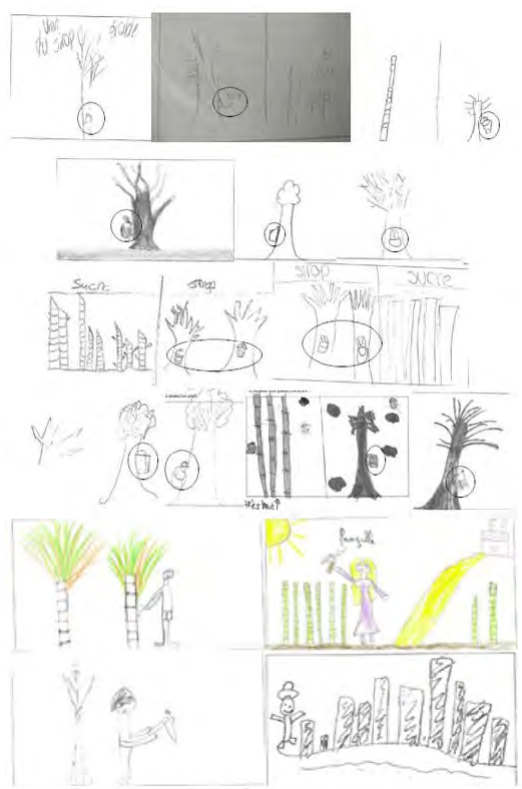

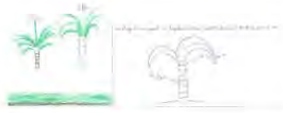

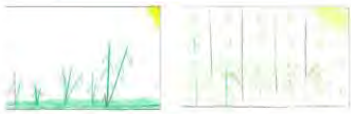



Figure 1 : Examples of reductive drawings collected

Finding 3: Multiple representations of sugarcane plants and prototypical leaves

The following table (Table 2) shows the various categories identified when students in Guadeloupe chose to represent their local plant, the sugarcane.

Table 2 : The sugarcane leaf representation as drawn by learners in Guadeloupe

	Representations	Examples	N in pre-tests (Guadeloupe)	N in post-tests (Guadeloupe)
A. Leaf shape	Rounds		3	2
	Serrated		17	20
B. Leaf extension	Extending		13	19
	In the middle		5	3
	Both		2	2

Most students in Guadeloupe drew sugarcane leaves that looked like coconut tree leaves, with serrated edges or extending from the sugarcane stalks. A notable finding from the data is that some students from Guadeloupe drew sugarcane plants with round leaves, as if they represented a basic leaf concept.

### Conclusions:

In the pre-test phase, students primarily represented the plant from their own context. However, in the post-test phase, a significant number of them also illustrated the plant responsible for sugar production from the other context.

It seems that after the implementation of this collaborative experience organized within the framework of *Anonyme* project, these multiple conceptions, presented in this article, appear to be more diverse and receptive to the biodiversity of various environments. They are not only "situated" but also deeply contextual in several ways, as they represent a plant in one context, another, or even in both contexts. These conceptions are influenced by the situation (situated conception) and are profoundly connected to the students' cultural and biological context. It is in this sense that we propose the term "contextual conception."

Finally, we are aware of two limitations in our research. The first limitation is that our study primarily focuses on qualitative aspects and is not designed to represent a larger population beyond the students in this specific project. The second limitation is related to categorization based on context, as it can be challenging to apply identical categories to drawings created by learners from different contexts. For example, in our case, it would not be suitable to use the exact same categories for drawings depicting sugarcane and a maple tree. The second is that when categorizing based on context, it can be challenging to use exactly the same categories for items drawn by learners from different contexts.

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