

BRIDGING TWO THEORIES

THE THEORY OF DIDACTICAL SITUATIONS

Elena Polotskaia, Université du Québec en Outaouais, Canada; Helena Boubllil-Ekimova, Université Laval, Canada

THE THEORY OF DEVELOPMENTAL INSTRUCTION

The *theory of didactical situations*, developed in France by Brousseau (1988) between 1970-90 has become central to the study of didactics of mathematics in French-speaking countries. The theory of didactical situation operates the concepts such as didactical situation, learning obstacle, didactic contract, fundamental situations.

Brousseau insists on the special design of fundamental situations *guided by a didactical goal*. The process of knowledge development by students, according to TDS, includes several consecutive steps (types of situations) such as action situation, communication situation, validation situation, and institutionalization situation.

For Brousseau, *abstraction* appeals to the idea of structure, which governs the situations. The structure is seen as a set of properties.

In TDS, a *concept* is represented by a collection of situations that comprise knowledge that, in turn, is used as a mental tool to deal with (understand, solve) these situations supposedly having some common characteristics. Brousseau explicitly states that the *notion* can appear for the learner from her interactions with situations for which the notion can be a solution.

In *action situation*, the learner should first construct a tool (read conception) to solve one or more problems that are concrete and specially designed to represent the new knowledge.

In *communication situation*, the learner should recognize this tool as something worthy to formulate explicitly and to communicate to others.

Validation situation allows the learner to confirm the validity (generalisability) of the formulated conception or strategy explicitly and logically (read mathematically).

In *institutionalization situation*, the learner should modify the conception to adapt it to a culturally established form (read concept) and to connect it to other existing concepts.

In my opinion the existence of the *didactical contract* is what assures the functioning of the process, and not an arbitrary law of the genesis of knowledge (Brousseau, 2002, p. 141)

TDS proposes that students should interact with a *milieu*—specially designed environment in order to realize that some strategies do not work and to find working one.

[P]roblems posed by a situation at the time of putting a pre-existing model (implicit or explicit) to work, or by a theory at the time of making of a decision provoke the *evolution*, the modification or the rejection and the formulation of theories (Brousseau, 2002, p. 221).

In Russia, Davydov (2008) and his colleagues built a theory of developmental instruction. Based on the Vygotskian idea of the cultural-historical nature of teaching and learning, Davydov's theory has informed research and practice in Russia and other countries worldwide. The *theory of developmental instruction* speaks about empirical thinking and theoretical thinking, learning activity, and learning tasks.

Concept as a form of mental reflection is, for Davydov, a mental instrument the thinker uses to understand and to operate upon the object.

Concept as a form of human activity allows Davydov to connect the notion of concept of knowledge to the idea of knowledge as created through culturally and historically structured human activities. Once created, a piece of knowledge becomes part of the culture, begins to determine some new human activities, shapes existing activities, and becomes their form.

For Davydov, *empirical thinking* focuses on observable attributes, which can be similar to or different from attributes of other objects. Empirical thinking does not seek to identify the internal and external relationships existing between attributes, properties of objects, and their components because such relationships are not directly observable.

Theoretical thinking seeks to identify relationships between an object's components, the essence of the object's structure, as well as the relationships between the object of study and other objects. We can say that theoretical thinking aims at representing the internal and external *raison d'être* of the object; at explaining why the object exists as such and how it relates to and interacts with the world around it.

...a *concept* is a form of thinking activity that reproduces an idealized object together with its system of links. [...] The concept is simultaneously both a form of reflection of the material object and a means for mentally reproducing or constructing it (Davydov, 2008, pp. 90-91).

The *learning task*, which is presented to the school children by the teacher, requires that they: 1) analyze factual material with the goal of discovering some general relation having a natural connection with the various manifestations of that material, i.e. construct a contentful abstraction and a contentful generalization; 2) derive, based on the abstraction and generalization, particular relations in the given material and unify (synthesize) them into some holistic object, i.e. construct the 'cell' of that material and the mental concrete object; 3) master, by this process of analysis-synthesis, the general method for constructing the object of study (Davydov, 2008, p. 124).

The children first discover the initial general relation in some field of study. Then they use it to construct a contentful generalization, and then they use that to determine the content of the 'cell' of the subject, converting it into a means for deriving other, more particular relations—i.e. into a concept (Davydov, 2008, p. 122).

Playing with two little bears Additive relationship: comparison

There is no action situation in this scenario. Additive relationship is not a solution to a problem, thus such action situation cannot be constructed. Students have some general knowledge of comparison, still not precise and insufficient to solve problems.

1. Listen and discuss the story about two little bears arguing about two pieces of cheese. They don't know how to compare the two pieces, therefore the old fox eat almost all cheese.

2. Formulate a rigorous procedure of comparison of two strings by length. Children try to formulate and the teacher, by executing exactly the proposed action, demonstrate the incompleteness of the formulation. Until the procedure is fully formulated. Notate the procedure as a schematic drawing. Test the procedure by comparing two strings with closed eyes.

The teacher can play the role of the milieu by interpreting students' suggestions of strategies

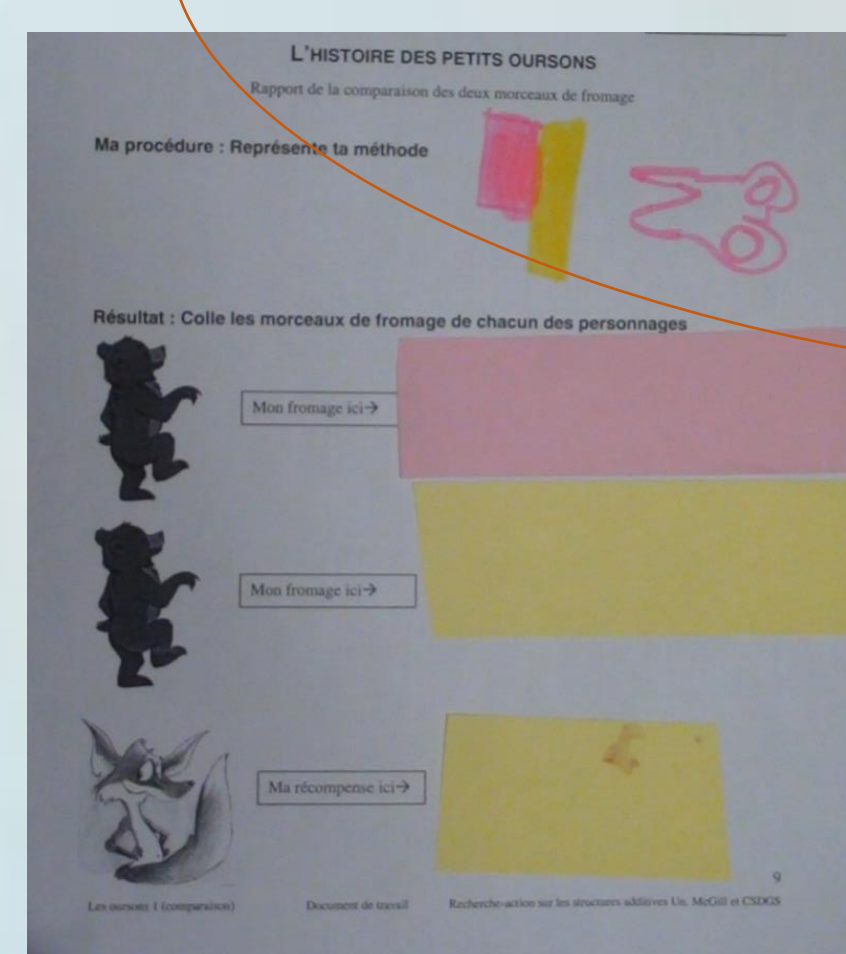
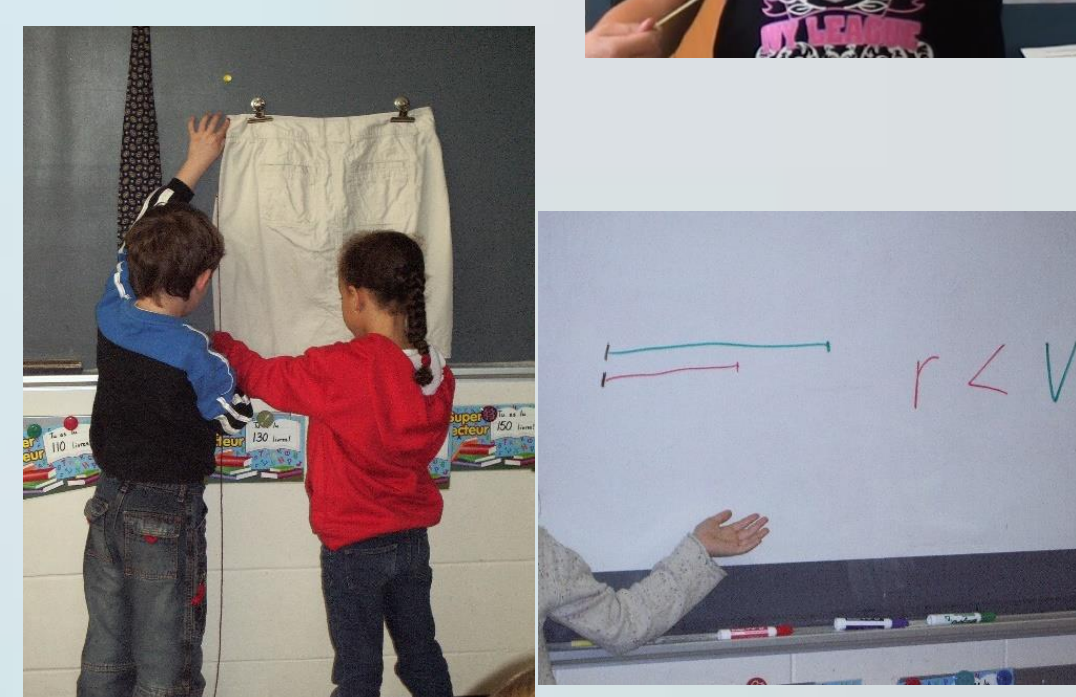
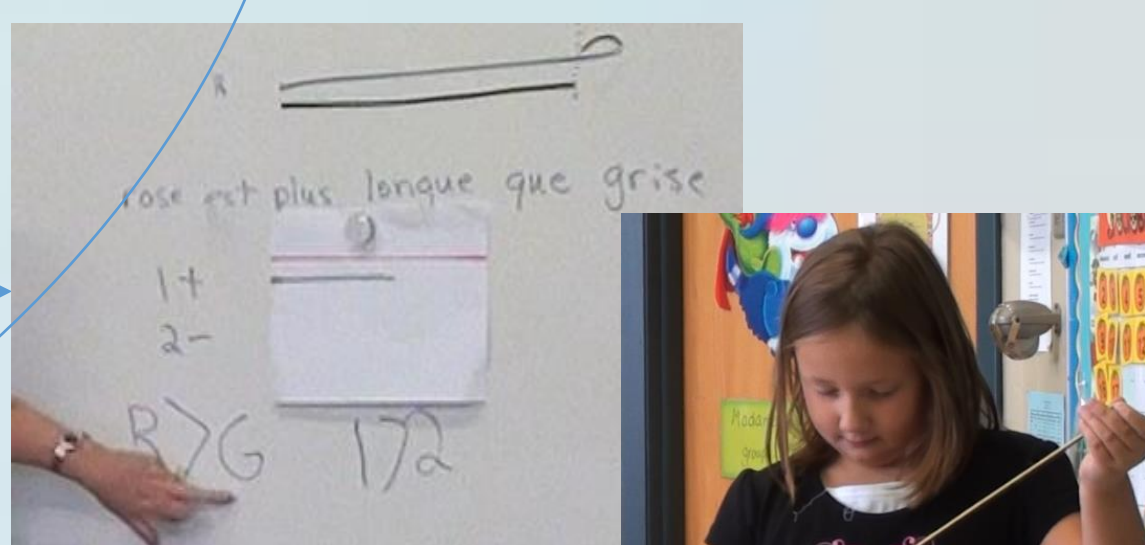
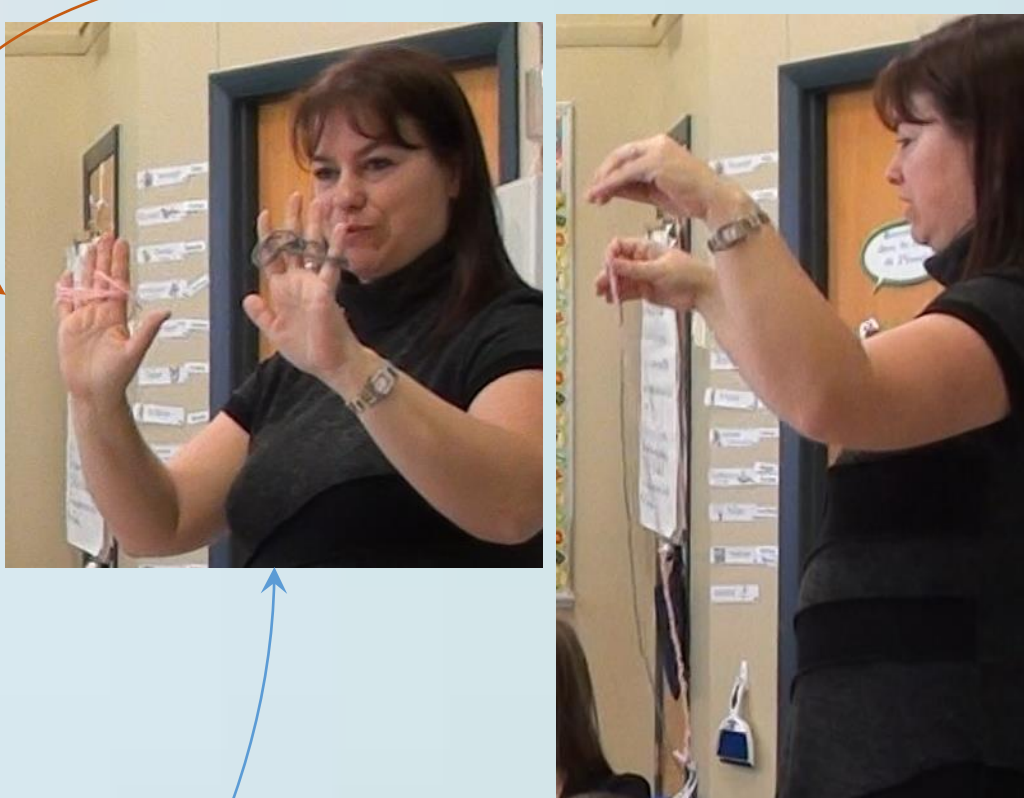
3. Compare the lengths of physical objects by using the developed procedure and an intermediate object (string). Notate the result as a schema and as a formula.

4. Equalize "fairly" two pieces of cheese (paper strips) by using the developed knowledge. Explain by drawing a schema.

The comparison by "looking" at pieces is a kind of empirical thinking in this situation



Students need to identify the SYSTEM of key characteristics of the comparison procedure.



Conclusion

Both theories offer a set of theoretical constructs that are rich, often coherent and sometimes complementary. According to the two theories, the internal form of the activity or the rules governing the milieu are precisely what allows students to grasp new knowledge. Therefore, the epistemological and systemic analysis of the concepts to be taught in the long term and in the short term is a key to development of a curriculum as well as other teaching sequences. The requirement of such a study should be a standard in the field of education.

The visions of the development of mathematical knowledge in students (in the classroom) are distinct in TDS and TD1 as well as their practical recommendations. Nevertheless, we were able to identify almost all listed theoretical constructs from both theories within the proposed teaching sequence. While the TID states that learning a concept should explicitly require theoretical thinking from the earliest practical experience, TSD postulates that practical solutions to concrete cases form the basis for generalizing more of a concept. We think that the amount of "practical solutions" before theorization depends on the nature of the knowledge to learn and on the level of familiarization of students with the context and the general idea behind the knowledge.