Multirepresentations in TI-Nspire and TI-Navigator environments

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Summary of the presentation

1. When working with calculators or computers, teachers and students are faced with two slightly different transpositive worlds. One is the ordinary transpositive world associated with paper and pencil environments and the other is the computer environment. Any research about learning processes in technological environments must be sensitive to the necessity of integrating the two aspects and to the related cognitive and didactic problems (Artigue, 1997).
From the one side, we need theoretical frameworks that allow us to approach the *institutional* and *cultural* dimensions of such teaching-learning processes. From the other side, it is necessary to recognise the fact that teaching-learning mathematics in computer environments introduces a strong *instrumental dimension* to the corresponding processes. Moreover it is necessary to deepen the systemic nature of the interactions between the *technological* and the *human* components of the environments where ICT are used.
All these have strong consequences on the *cognitive dimensions* of the didactic phenomena in the classroom of mathematics and these must be carefully considered.
Because of these reasons, we design our research within the following frames:

- the *anthropological approach,* developed by Chevallard (1999);
- the *instrumental approach,* coming from cognitive ergonomy of Rabardel and Verillon (1995);
- the *human-with-media approach*, defined by Borba and Villareal (2005);
- the *multimodal paradigm,* coming from cognitive science (Kress et al., 2001; Williamson, 2005).

In the presentation we will concentrate particularly on the last one and will see how such a lens can help us in analysing the nature of multi-representations within TI-Nspire and TI-Navigator environments and in focusing the consequent dynamics of students learning processes.

2. The notion of *multimodality* has evolved within the paradigm of *embodiment*, which has been developed in these last years (Wilson, 2002). It emphasizes the many ways and contexts in which people experience communication and come to develop understandings. The new stance emphasizes sensory and motor functions, as well as their importance for successful interaction with the environment.
Instrumented activity in technological settings is multimodal in an essential way. Many times it reflects the fact that action is not only directed towards objects but is also directed towards persons: teachers no longer simply speak at students, and students no longer simply read texts and write down responses. They simultaneously use a wide array of verbal, gestural, and graphic registers to communicate their thought. All such components or modalities (written signs, oral language, body enactments, artefacts use, etc) intervene in an intertwined way in learning and more in general in knowledge formation. A multimodal mode is typical of people using computer; but this is even

more intriguing in the case of TI-Nspire and TI-Navigator, because of their multifaceted environments, where different representations and forms of communication are simultaneously present. These amplify the multimodality of the semiotic resources that student are able to use while doing mathematics. While multimodality is not exclusively new, then, it is clearly important for us to accurately describe the altered landscape of communication that is produced in such environments.

3. During the presentation we will sketch some didactical phenomena that are peculiar of the multimodal approach triggered by TI-environments; to make more palpable our claims we will illustrate them through some video-clips of students who are using TI-Nspire and TI-Navigator devices.

Such phenomena can be categorized in two major typologies, according to the nature of the multiple representations in the different TI-environments. The former mainly concerns the interactions of the students with the multi-representations supported by the software itself (e.g. TI-Nspire): typically, the geometrical, the algebraic and the spreadsheet treatment of the same problem produced by a single student or by a small group of students using the same device (*within-multi-representations*). The latter concerns principally the interactions that the instrument (e.g. TI-Navigator) triggers and supports among the students in the classroom, because of the simultaneous access on the shared screen to the solutions produced by different students for the same task (*between-multi-representations*).

As major examples of the dynamics driven by the within-multiple-representations we will describe:

1. The *quasi-empirical* nature of many instrumented actions in TI-Nspire.
2. The *fluency* and *tempos* of thinking processes of students while using TI-Nspire.

As a main example of the dynamics driven by the between-multiple-representations we will describe:

3. The complex nature of the *social interactions* in TI-Navigator.

In the final part we will sketch a theoretical model apt to describe the multimodal features of all such dynamics and will use it to draw a critical comparison of students processes while working in TI-Nspire environments with and without handheld.

References

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