THE MATHEMATICS IN MOROCCAN UNIVERSITIES

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Abstract:
This works deals with the teaching and learning of mathematics in Moroccan universities. Our Goal is to better understand difficulties encountered by students, with math, and to study in which measure the integration of new technologies of information and communication may help them overcome these difficulties, by favoring interactions between representation by ICT and classical representation of the concerned course. On the basis of the instrumental approach of computers in teaching, we start from the hypothesis that succeeding to this type of mathematical tasks requires, beyond knowing adequate commands and their syntax, learning specific instrumented techniques, in a context taken in charge by the institution. In our thesis, a technique to represent called 3D technology occupies a central part, as a means to reduce the distance between the knowledge teachable and the knowledge to be taught.
The works includes an institutional analysis (ecological analysis of university curriculum) about the teaching of mathematics and the use of 3D technology, as well as two experiments, without and with the other.

Key Words: Mathematics, Information Technology and Communication ICT, 3D technology

Introduction

Our interest in this work is part of our experience as a student at the “University Abdelmalek Essaadi, Faculty of Tetouan” Morocco. Indeed, in our discussions with both teachers and students, we have made the empirical observation of many difficulties of teaching and learning mathematics. These difficulties affect first the students, who are struggling to capture mathematical concepts given to them and especially to visualize it in space. In addition, teachers are often helpless Faced with these difficulties and obstacles of their students and do not see too how to act. The intention to solve these problems is the idea of integrating the new technologies of information and communication in education.

Here, for example, an excerpt from an interview we had with Mr. Benslimane, professor of mathematics at the Faculty of Tetouan, which pretty much sums up, in our view, the difficulties encountered:

“Even if the student knows the theory, how can he manipulate it to solve more complex problems. He needs to know how the base past the abstract to the concrete. Much will depend on the viewing space of mathematical objects. This passage is very complicated, either the student has a visualization of the problem, or is very difficult to do. In general, the student should have this ability. But unfortunately it did not, because currently teaching mathematics does not follow a certain pedagogy. So there is this difficulty”

It seems that many points mentioned in this quotation require clarification or comments. For example, when the teacher talks about the transition from the abstract to the concrete, this phase of work is based primarily on a "view space", he stresses that this is the point that raises the most difficulties for students. What is "viewing space"? Does it appeal only theoretical tools? If yes, which ones?

In fact, the teacher speaks of "visualization of the problem" and "vision in space." The two expressions do they cover all the same (or more) didactic reality (s)? Which one? Putting themselves in the mathematical corpus commonly called Analytic Geometry of Space (AGS) is it the ability to relate reality (the theory) and imagination? And more generally it is constantly able to make interpretations in the space of mathematical objects involved? This "ability" is it just a gift to "see" in space? Or correspond to knowledge and know-how to identify it is better to control it?

Answering these questions requires of course looking further into the study of mathematics degree program to better identify mathematics gaps involved and the roles of theory and interpretation in space.

At another point in the interview we had with Mr. Benslimane, he attributed that using the new technologies of information and communication can facilitated the transition from the abstract to the concrete in mathematics. This point deserves our attention. What ICT can bring to the teaching of mathematics, how can we integrate them effectively in this teaching, teaching in what way?

According to Y. Chevallard:

"An object (eg, a mathematical object) is an emerging system of practices which are handled material objects that are cut in different semiotic registers: register oral, spoken words or phrases, register sign language field scription of, what is written or drawn (graphics, formalisms, calculation, etc..), that is to say, register writes. (1991, page 110)."

Our own teaching experience has led us to hypothesize that technological tools, including ICT, may be denied assistance in mathematics education, reducing the distance between the knowledge teachable and the knowledge to be taught.

In addition, several education institutions today introduced software to try to better manage mathematical objects that pose difficulties for students. For example, the Maple software, which helps calculate multiple integrals.

In the light of the first questions we already tightened our object of study by focusing on:

The transition from the abstract to the concrete in mathematics using new information technologies and communication. More specifically, the 3D technology.

This study motivated by the acknowledged difficulties of students and teachers is also justified by the need to assess the various initiatives implemented in recent years in Morocco and supported by the Ministry of National Education of Morocco.

Theoretical framework

We will build on approaches to the representation of mathematical objects. We will thus refer to the concept of registers of semiotic representation introduced by Duval in teaching (1993). This approach seems interesting because it will allow us to decontextualized and contextualized mathematical object. However, this approach alone is not sufficient to effectively study the issues that arise in the context of our research, since the institutional dimension is essential. We find, in this regard, support in the anthropological approach to teaching (TAD) developed by Chevallard (1999). Based on the use of ICT, our theoretical foundations will finally allow us to take into account the instrumental dimension of learning media environments. In this way, we build on the work of researchers in cognitive ergonomics, learning about the use of technological tools and in particular, the theory proposed by Verillon instrumentation & Rabardel (1995). We conclude with the presentation of the research questions we ask in the context of these frameworks and methodological and theoretical choices that we made.

The theory of instrumentation

To better understand the role of ICT in the teaching of mathematics, we use the theory of instrumentation. This theory, following the work in cognitive ergonomics concerns the use of learning technologies. We refer in particular to the theoretical framework developed by Rabardel (1995).

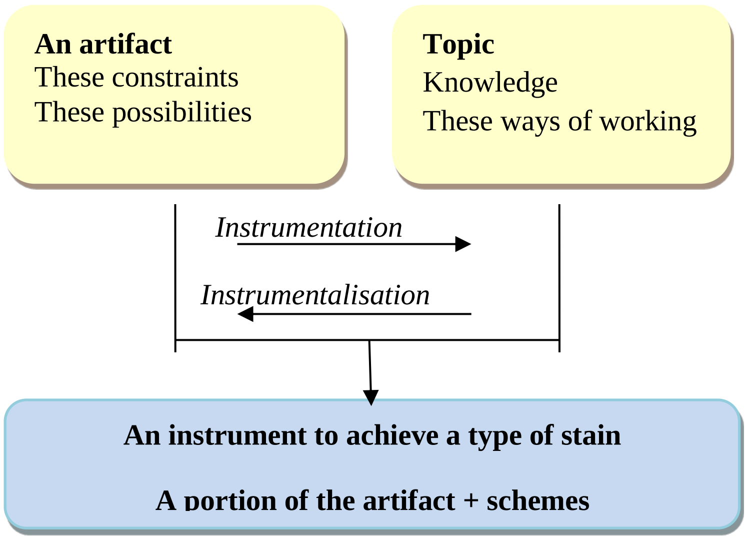
In recent years, many educational researchers have focused their attention on this theoretical perspective: Guin & Trouche (1999), Artigue (1997), Artigue (2002), Lagrange (2000), Guin & Trouche & Ruthven (2005) Haspekian (2005), BuenoRavel & Gueudet (2009), Drijvers (2000), Trouche (2000) ... etc

This emphasizes that:

"Recent works in cognitive ergonomics provide theoretical tools for understanding the process of ownership calculator's complex. Rabardel (1995), with regard to education in general and education in particular, offers a new approach, which essentially distinguishes technical tool (artifact), which is given to the subject, and instrument, which is constructed by the subject. The construction or instrumental genesis is a complex process due to the characteristics of the artifact (its potential and its limitations), and the activity of the subject, knowledge and work habits earlier (Op. cit. 195)."

The instrument is not "given", it was built by the subject during a process of instrumental genesis. In this sense, Drijvers emphasizes that:

"The starting point of the theory is the idea that instrumentation tool is not automatically an effective and practical. A hammer, for example, an object is meaningless, except that when you have something to pound, it is transformed into a useful tool. This idea also applies to other objects, or computer software. The learning process in which an artifact is gradually becoming an instrument is called instrumental genesis. The user must develop skills to first recognize the tasks for which the instrument is suitable for and then perform in the environment of the instrument (Op. cit. 218)."



Instrumental genesis (Trouche, 2004)

The integration of technology in mathematical activity led to the construction of patterns of use, more responsive and less and less effective. According Rabardel schemata are multifunctional. Brought into play in specific situations, they help to:

- *Understanding them (their epistemic function)*
- *Acting, transform, solve (this is their pragmatic function)*
- *Organize and control the action (this is their heuristic function)*

It will be important for our work to characterize specific practices in mathematics education, and the use of 3D technology in the institution (University Abdelmalek Essaadi, Faculty of Sciences). We find support in the anthropological approach to teaching developed by Chevallard (1992) that we present below.

"The anthropological approach helps us think about the technical and instrumental dimension of mathematical work, which in didactic analyzes is often left in the background in favor of more conceptual analysis. (Ibid., p. 9)."

The anthropological didactic approach

The approach developed by Chevallard (1992) is an extension of the theory of didactic transposition. It considers mathematical objects, not as existing in itself, but as entities that emerge from practices in systems and institutions. These systems are praxeologies or described in terms of tasks in which the object is invested technologies can solve them, and through which discourse is used to explain and justify the technology. These can be viewed from the instrumental point of view (as explained Lagrange (2000, p. 169)).

According Chevallard, science education, like all teaching, is in the field of social anthropology, that is to say, the study of man. Similarly there exists a religious anthropology or political anthropology, whose objects of study are respectively the religious or political Chevallard (1992) proposes to develop a didactic anthropology whose object of study is the learning to study, for example, the student with the problem mathematically.

As emphasized Chevallard mathematical knowledge as a special form of knowledge is the result of human action institution: it is something that occurs, is used, taught, or more generally, transposes institutions.

Chevallard proposes the notion of organization or praxeological praxeology (as the key concept) to examine institutional practices relating to an object of knowledge and in particular social practices in mathematics. He proposes to distinguish praxeologies that can be built in a class where we study this subject, analyzing how can build the study of this object, and allow the description and study conditions achievement. The praxeologies are described in terms of:

1. (Type de) Tâches
2. (Type de) Techniques

3. Technologie
4. Théorie

The notion of semiotic register of representation

In mathematics, the objects are only accessible through their representations. By Duval (1993):

"There is a paradox cognitive mathematical thinking: on the one hand, the understanding of mathematical objects can only be a conceptual understanding and, secondly, it is only by means of a semiotic representations activity of mathematical objects is possible. This paradox can be a real learning circle. (Op. cit. 38)."

Semiotic representation is a representation constructed from the mobilization of a system of signs. Its meaning is determined partly by the form in the semiotic system, on the other hand, the reference to the object represented. Geometric figures, a statement in language, an algebraic formula, a graph, are semiotic representations that are different semiotic systems. Treatments mathematical objects depend therefore opportunities representations themselves.

Duval (1995) explains the concept of semiotic register of representation as follows:

"Semiotic systems are capable of performing the three cognitive activities inherent in any representation. First, create a trace or sets perceptible traces that are identifiable as a representation of something in a given system. Then transform representations only by rules specific to the system in order to obtain other representations may constitute a relationship of knowledge in relation to the initial representations. Finally, convert the representations produced in a system of representation of another system, so that they allow explaining other meanings for what is represented. All semiotic systems do not allow these three fundamental cognitive activities ... But natural languages, symbolic languages, graphs, geometric figures, etc. The permit. We speak then register semiotic representation. (Op. cit. 20)."

Duval thus distinguishes three cognitive activities related registers of semiotic representation:

 The formation of a semiotic representation - using a (several) sign (s) to update or replace the target object. It is based on the application of compliance rules [1] and the selection of a number of characters from the content preview. For example: composition of a text, drawing a geometric figure, drawing a diagram, writes a formula.

 Treatment of representation - is the transformation of the representation in the registry even when it was formed. Treatment is an internal transformation to a register. For example, the calculation is a form of symbolic writing specific processing (numerical, algebraic calculus, integral calculus ...).

 The conversion of representation - is the transformation of this representation to a representation of another register. For example: Translation is the conversion of a linguistic representation in a given language in a linguistic representation of another language.

The translation should not be confused with two activities, however, are nearby coding and interpretation. Interpretation requires a change of framework or context. This change does not involve a registry change but often mobilizes analogies.

"Coding" is the "transcription" of a representation in another semiotic system that it is given.

The conversion is therefore of particular importance. However, it is generally neglected in the teaching of mathematics, while, as noted Duval one of the essential conditions for the conceptual understanding of mathematical objects is available for the same purpose, several semiotic representations. The choice of an appropriate register of representation can facilitate processing (transformations of representations within a register).

Research Questions

As we already mentioned, our research focuses on the teaching and learning of mathematics in higher education and in particular to reduce the cognitive effort of mathematics. We will study the "object of knowledge", the tasks proposed to students, available technologies to solve their justifications and technological-theoretical depend on a set of data relating to the institution in which teaching takes place. In addition, analysis of the ecology of a mathematical object in an institution understands its meaning for this institution is to identify the organization mathematical object is in. Thus, we propose to study, in the context the TAD, the mathematical organization. This study should allow us to answer the first research question:

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[1]. Rules to be observed in the formation of a semiotic representation, such as grammar for natural language training rules in a formal system design constraints for the figures ... The formation of these rules is to ensure, first , the conditions of identification and recognition of the representation and, second, the possibility of their use for treatment. (Duval, 1993, p. 41).

Q1. What is the mathematical organization in Moroccan universities?

Praxeological concepts of organization and reporting institutional offer, from an ecological study of the academic program, the tools to find answers to such questions. This question must be supplemented by other, more in relation to ICT (and more specifically 3D technology). Indeed, the academic program introduces the use of ICT in teaching and contemporary in particular 3D technology. As Lagrange points (2000, p.41)

"For techniques [instrumented] are meaningful, it should build praxeologies in which these techniques could be inserted and take a mathematical meaning."

Take into account the role of ICTs, including 3D technology in the university raises the following questions:

Q2. What is the academic report instrument to 3D technology at this university?

Q3. What constraints they impose the university, what conditions do they provide to the teaching of mathematics with 3D?

Analysis of 3D technology will allow us to better understand how this tool can reduce the cognitive effort of mathematics. We will try to press the three frames with the ostensive aspects and non-ostensive mathematical objects, their semiotics, and the instrumental aspects around these objects play important roles. This study will allow us also to identify potentialities, constraints on the actions and changes desired by the user 3D mathematical objects. To the analysis of these constraints, we will take into account the type considered by Trouche (2000). The following questions arise in the context of cognitive instruments:

Q4. What tools are available in the environment publicized 3D technology on: analytic geometry in space (GAE) [2]?

Q5. How through the use of these tools are changed techniques solving certain tasks?

Conclusion

Our work is the first investigation in a virgin field of education research. Level of education, very specific mathematical content and the use of 3D technology are all factors that have asked us to be innovative. It is a first draft that can be used especially for teachers Moroccans. We hope to have shown to accurately and varied work needed on the development of technology to reduce the distance between scholarly knowledge and expertise teachable. Our experiments show the potential of this technology. it will also show that you cannot just rely on this technology and process instrumentation must include the issue of transition from the abstract to the concrete in a more global manner by using certainly more explicit knowledge students.

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[2]. Both on the analytical representation and graphics or by functions of two variables, either by parametric equations.