

Description of attitudes belonging to the Research Pedagogy and the World Questioning in high school

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Summary

In the framework of Anthropological Theory of the Didactic (ATD) the attitudes that characterize the Paradigm of Questioning the World are described and analyzed in high school: problematization, herbartian, procognitive, exoteric and ordinary encyclopedic. These attitudes are defined by the ATD as necessary for the development of an RSP; within the paradigm of questioning, which teleology is the building of democratic and critics citizens. The study ¹was made with a group of students who studied mathematics during two years from an educational organization point of view focused on Research and Study Path (RSP). It was designed and implemented a RSP on the question "Which is the best savings plan to generate the higher amount of incomes at a low risk?"

The results allowed to identify in the students, after two years of experiencing the Paradigm of Questioning the World, gestures related to four of the five basic attitudes.

Keywords: Anthropological Theory of the Didactics, RSP, High School, Educational Research and questioning of the World; attitudes.

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1. Introduction

The time we spend in compulsory education is only a small part of our life, and our education cannot be reduced to this period. Much of our knowledge will be learned outside the school, and in order to happen, citizens must have attitudes to study and learn throughout life. The school may be a suitable place to promote such attitudes, but the paradigm of visiting works generated by the monumentality of traditional pedagogy does not allow it: in this pedagogy knowledge is from the school and to the school. The mathematical works are taught as completed and unquestionable objects visited as monuments in a museum. In contrast to this, Chevallard (2012a) proposes the Pedagogy Research of "Questioning the World". The Paradigm of questioning the world lies on five attitudes (Chevallard, 2012a, 2013a): problematization, herbartian, procognitive, exoteric and ordinary encyclopedic. These allow the formation of democratic and critical citizens. The ATD (Chevallard, 1999, 2012a, 2013a) has proposed a didactic device to face the monumentalization that appeal to the mentioned attitudes: the Study and Research Path (RSP). Its implementation requires a considerable change of the places that both the teacher and student occupy in the class (topogenesis). The place of the student, which was reduced to the application of previously taught techniques, needs to be modified in a direction that requires to take decisions, assume their own learning, etc. The teacher must occupy the role of director on this process of study and leaves place for students to assume their responsibilities, without occupying a privileged position. This new distribution of roles is very rare in high school.

In this paper we analyze what attitudes a group of students with two years of experience in the "paradigm of questioning the world" have, when developing a RSP. The RSP begins with the generatrix question "Which is the best savings plan to generate the higher amount of incomes at a low risk?"

2. The RSP in the Anthropological Theory of the Didactics

An RSP is a teaching device that organizes knowledge in a succession of pairs of questions and answers. This requires the class to build a teaching mean M , consisting of: existing answers, not necessarily relevant; new

questions from the generatrix question; mathematical works from mathematic or other disciplines, to be studied at a level of depth that requires the making process of M (Otero, Fanaro, Llanos, 2013; Otero, Llanos, 2012). The relevance to the questions is fundamental to overcome the classic paradigm of "visiting the knowledge", and introduces the new paradigm of "questioning the world". The latter, according to Chevallard (2012a, 2013a) lies on five attitudes:

Attitude Problem Identification: to formulate open questions which answers requires the acquisition of new praxeological equipment, gather information, or explore new fields of knowledge. A question will not be problematic if it is closed, dichotomous or if can be only answered by previous knowledge.

Herbartian: asks for the mathematical aspects of a phenomenon, and tries to answer (eg, questions an algebraic expression, ask for the existence of any formula, etc.). Instead one pre-Herbartian accepts formulas, without questioning them.

Procognitive: finds and studies works which will allow to answer questions for which a knowledge is not entirely available. A procognitive citizen must be prepared to study and learn, from the very beginning, new knowledge fields for himself. Instead, someone retro-cognitive, addresses only questions that supposed the acknowledge of the answer.

Exoteric: recognizes the lack of mastery of a field of knowledge and therefore studies. The opposite attitude is the esoteric. An esoteric has the illusion of mastering some area of knowledge and therefore he or she does not study.

Ordinary Encyclopaedist: the decision of learn knowledge fields in which the person is not specialized. Is to be open to new knowledge, without requiring knowing everything, or knowing much to get venture into the new. This combines well with procognitive and the exoteric (Otero, Fanaro, Llanos, 2013).

3. Research Questions

3.1. What attitudes of the “paradigm of questioning the world” can be identified during the development of a RSP related to the question about saving plans, on two “paradigm of questioning the world” experienced courses?

3.2. In which ways did the attitudes identified RSP influences?

4. Methodology

RSP was implemented in two fifth year courses (16-17 years) of a secondary school. The study involves 58 students. Students were grouped into teams of five or six members each. All students had been trained from primary level to a quaternary organization modeling explanation - exercise - test, from the use of a book in which the student completes the blanks. In the last two years, these students only studied mathematics from RSP and the principles of the “paradigm of questioning the world”.

Students integrate an association that raises funds for senior trip and prom. To this end the students held various events but did they could not get the expected gain. The students were disappointed with this form of savings, as there are factors that they cannot control, such as customers, competition, demand, etc. This problem, allowed to organize an RSP around the generatrix question Q_0 : What is the best savings plan for the group to generate a higher amount of secure income?

The RSP was implemented during the last three months of the school year. Classes were audio recorded and the students' written responses were collected every lesson. The teacher- researcher kept a journal class.

5. Data analysis and results

Given the question “Which is the best savings plan to generate the higher amount of incomes at a low risk?”, the students were asked to formulate new questions to help understand this problem. Some of the questions made by the groups were: Which are the current fixed-interests? How long does a fixed-interest last? Is there any mathematical formula that calculates the procedure? Which one? What is a fixed-

interest? How do you pay a fixed-interest? How do you calculate a fixed-interest? What is the minimum amount of money if you want to make a deposit? What is the benefit for the bank? Are there any other benefits? Is it advisable to deposit in dollars? How much is gained according to the amount deposited? How much is gained depending on the time in which the deposit was made? Which bank pays more interest? What is a savings plan?

To answer the questions proposed by the students, the research was made through two ways. First, the praxeologies related to "bank and contextual issues" as time deposits, simple and compound capitalization, nominal rates and effective exchange rates (all mediated by internet) were investigated. In the second one, the mathematical aspects of fixed-interest that led to the study of function and exponential equation were studied.

5.1. Problematization Attitude

The question settled, help to identify problematization attitude gestures. For example: What is a fixed-interest? How is calculated a fixed-interest? What is a savings plan? are open questions. These, in correspondence with the problematization attitude, claiming investigate new fields of knowledge, such as simple and compound capitalization, savings schemes, etc.

5.2. Procognitive Attitude

As students progressed in the RSP, they asked and answered new questions. For instance, the study of the term requires meeting the nominal annual rate (NAR) and the effective interest monthly rate, among others; the students looked for the different meanings on the Internet, and the class was devoted to study the equivalence of rates. This kind of attitude in the students is not limited to what they already know: they search, study and try to understand new fields of knowledge, which are procognitive attitudes gestures.

5.3. Herbartian Attitude

Having already studied the mathematical aspects of fixed-interest and rate changes, the students set out to explore options to capitalize the \$ 3,877.65 they had saved. The group, had a monthly fixed-interest that added month to a month \$660 (\$ 5 per person per week). However, none of the members knew how much money would be raised with this plan, so they calculate it. Most of the groups made recursive calculations, but one group search for the generalization. They proposed to change the algebraic expression of compound capitalization $M_f = (M_i) \cdot (1 + i)^t$ for $M_f = (M_i + 660 \cdot t) \cdot (1 + i)^t$. But as this expression did not modelate the proposed savings system, the study introduced a new problem "how to model a fixed-interest that had a periodic insertion of money?" This new issue shows gestures of a herbartian attitude, as this led to the study of the organization of financial mathematics and mathematical organization Revenue and sequences of geometric series.

5.4. Exoteric Attitude

While most of the groups calculated the savings plan they had, a group studied another alternative. They found that the greater the compounding period, the higher was the interest rate. With this information the group designed a savings plan consisting of twelve sub - plans. They used monthly, the best combination fixed-interest (Table 1).

Months	Fixed-interest and kinds of capitalization	Final amounts
0	Fixed-interest set to one year with an initial capital of \$3877,65	\$4.449,60
1	\$660 set to 9 months capitalized quaternary and then once bimonthly.	\$741,90
2	\$660 set to 9 months capitalized quaternary and then once monthly	\$734,03
3	\$660 set to 9 months quaternary capitalized	\$726,46
4	\$660 set to 6 months capitalized quaternary and then once bimonthly.	\$718,55
5	\$660 set to 6 months capitalized quaternary and then once monthly	\$710,93
6	\$660 set to 6 months quaternary capitalized	\$703,60
7	\$660 set once in a quaternary capitalization and the nonce bimonthly	\$695,93
8	\$660 set once in a quaternary capitalization and the nonce monthly	\$688,55
9	\$660 set once in a quaternary capitalization	\$681,45
10	\$660 set once in a bimonthly capitalization	\$674,03
11	\$660 set once in a monthly capitalization	\$666,88
12	The last fee contributed by the group.	\$660,00
TOTAL		\$12.851,90

Table 1

The table shows that for the month zero, they invested all their capital annually fixed; for month one, they started a new one with quarterly compounding during three periods and then they capitalized that money in a fixed-interest every two months, and so on. This attitude, of studying something they thought they knew when they had a savings plan that worked effectively, belongs to what Chevallard calls exoteric and its allowed the students to improve the current plan at \$200 per year.

This data analysis did not allow identification to the attitude encyclopedic ordinary.

5.5. Organizations encountered during the RSP

RSP development organizations transited mathematics and mathematical financial as shown in Figure 1. The diagram shows how, from the students generating question, they were able to generate a new sub-issues. These sub-issues identified RSP development, can only be made by the students who have basic attitudes of “paradigm of questioning the world”. The corollary of this statement helps us to infer that without these attitudes, the development of an RSP would be truncated.

As shown in Figure 1, the RSP allowed three financial mathematics organizations, address (OMF1 : Capitalization, OMF2 : Fees, OMF3 : financial income), one of them related to the study of functions (OM3 : Exponential Function), and other related to the study of sequences and series (OM6).

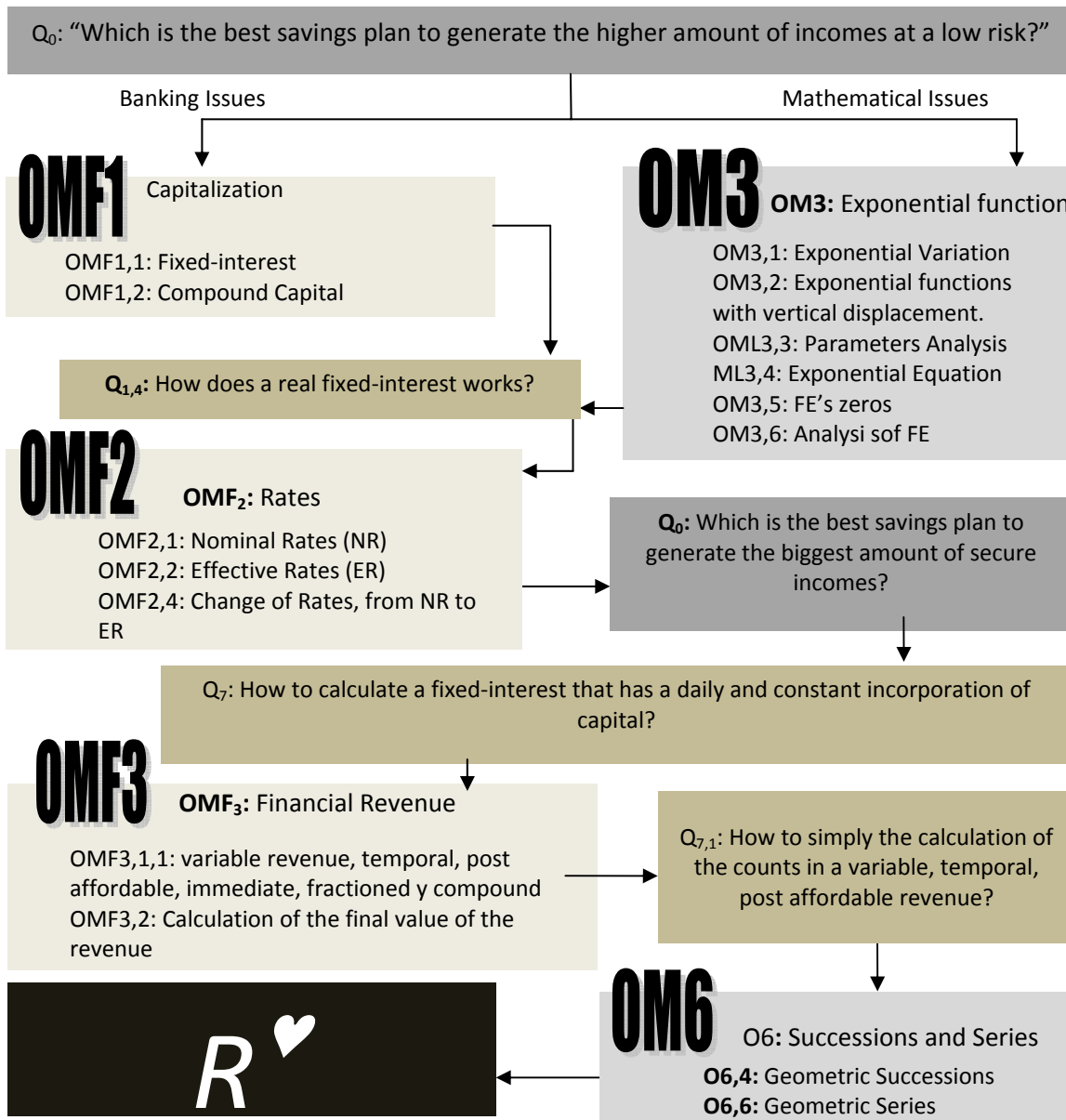


Figure 1: Diagram of RSP

6. Conclusions

RSP was developed with students who had two years of experience in the “paradigm of questioning the world”. The generatrix question of the RSP is: “Which is the best savings plan to generate the higher amount of incomes at a low risk?” Four out of the five attitudes described by Chevallard as favorable to the education of democratic citizens and critics were identified: problematization, Herbartian, procognitive and exoteric. These attitudes, uncommon in high school, are attributed to their experience of the “paradigm of

questioning the world” and were fundamental when developing the RSP. In this way, the problematization attitude led to new and relevant sub-issues to investigate. The Herbartian attitude, led the path of new mathematical works as exponential and geometric series. The Procognitive attitude, took the students to new knowledge that was needed to answer the questions. And the exoteric attitude led students to study in some depth the savings plans, going further, because they had a savings plan, which they considered effective. These four attitudes allowed the development of RSP. While ordinary encyclopedic approach could benefit the development of RSP, the methodology used in this investigation could not identify it.

First, the results shown that it is possible to revive some “paradigm of questioning the world” attitudes in high school, and meet the curriculum design at the same time. Moreover, this research showed that students with long training in pedagogy to visit works, can develop in a relatively large period (two years), attitudes belonging to the “paradigm of questioning the world”. These attitudes are desirable as they favor to the critical citizenship and lifelong learning (Otero, 2013).

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