

“HAZARD'S TREATMENT” IN SECONDARY SCHOOL

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The research work that we present is framed in an investigation agenda whose aim is to study the teaching and learning process of probabilistic knowledge. The fundamental objective of this work is the analysis of the intervention models associated with the planning, development and assessment of the “Hazard’s treatment” in the teaching and learning process in Secondary School (ESO). To value and know the effects that the introduction of this topic can have in mathematics teaching and learning process, first, we propose to analyse the curriculum developed in the ESO textbooks. In this paper we present, the first results.

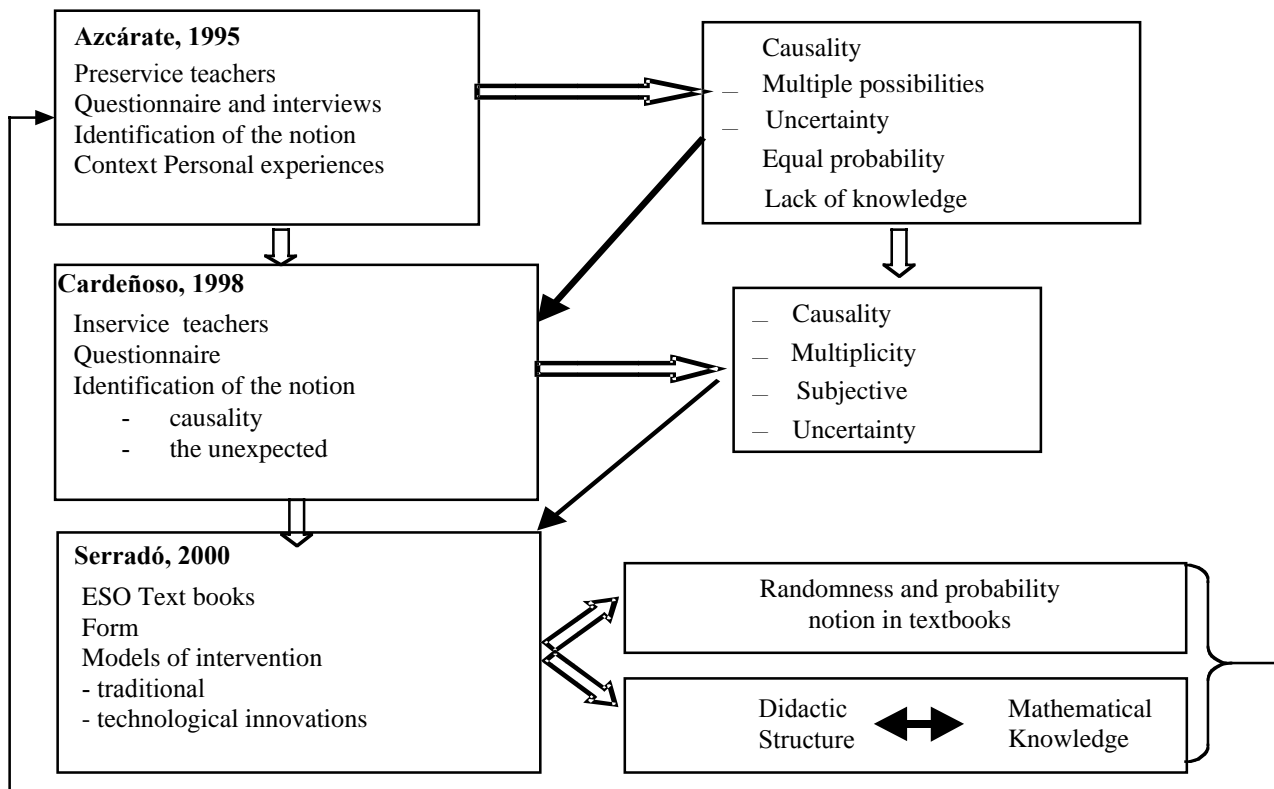
La investigación que presentamos, se enmarca en una agenda de investigación cuyo objetivo es el estudio de los procesos de enseñanza y aprendizaje del conocimiento probabilístico. El objetivo fundamental de este trabajo es el análisis de los modelos de intervención asociados a la planificación, desarrollo y evaluación del proceso de Enseñanza y Aprendizaje del "Tratamiento del Azar" en Educación Secundaria Obligatoria (ESO). Para valorar y conocer los efectos que la introducción de este tópico puede tener en el proceso de enseñanza y aprendizaje de las matemáticas, nos proponemos, en primer lugar, el análisis del currículum desarrollado en los libros de texto de la ESO. En esta comunicación presentamos los primeros resultados.

1 Presentation

The research work that we present is framed in an investigation agenda whose aim is to study the teaching and learning process of probabilistic knowledge, analysed from the perspective of the teacher; the ideas, knowledge, capacities and instruments that are used when planning and developing teaching skills in the field of mathematical knowledge.

The fundamental objective of this work is the analysis of the intervention models associated with the planning, development and assessment of the “Hazard’s treatment” in the teaching and learning process in Secondary School (ESO). “Hazard’s treatment” has been incorporated in the curricula after reflection about the substantial changes that society has experienced recently. Today’s citizens must face a world of continual change and their development must necessarily evolve in order to provide instruments and resources that enable them to face up to open and complex situations, common in today’s society. From an educational point of view, this necessity has provoked the introduction of “Hazard’s treatment” in our schools (Cardeñoso and Azcárate, 1995). To value and know the effects that the introduction of this topic can have in mathematics teaching and learning process, first, we propose to analyse the curriculum developed in the ESO textbooks. Secondly, we intend to analyse the use the teachers make of the textbooks in the process of planning, development and assessment of the “Hazard’s treatment” in the Secondary Schools classrooms.

Recently society has clearly demanded the use of textbooks. Educational researchers have considered this type of demand and carried out a great number of studies on school materials (Goodson 1995; Torres. 1991; Gimeno, 1995). Nowadays, curriculum development has become the focus of attention in relation to problems of quality in teaching. The analysis field has been enlarged from technical questions to more general questions related with the curricular material's determination, and how, in an explicit or implicit way, a great part of the schooling activity is determined.



Graph 1: Characterisation of the Research Agenda

Our previous works (graph 1) have focused on understanding tendencies of probabilistic thinking of the teachers, Azcarate (1996, 1996a) and Cardenoso (2001). These three works constitute the basis of the project that we are developing at present and form the research agenda pointed out by Cardenoso and Serradó (2001). From the ideas and tendencies detected in these two investigations, we can argue that mathematics teachers who must face the new Mathematics curriculum do not have adequate information/formation available to elaborate the didactic units related with probability.

In general, teachers will have difficulties in designing the didactic units and organising them to facilitate significant probabilistic learning. The lack of didactic formation and, in many cases, the dominion of the topic, will be an obstacle for its adequate elaboration, and teachers will turn to *textbooks* and didactic guides. In this sense, we believe that the textbooks that they use define the educational tendencies

that the ESO mathematics teachers develop when they are treating probabilistic knowledge in their classrooms. Therefore, the goal of our investigation is to determine how “Hazard’s treatment is developed in Secondary School textbooks, and how the teachers use textbooks when teaching this topic.

2 Investigation Problems

Torres (1991) was interested in what the text books that the students have access to, say, and what they omit; what their stereotypes are and how they distort from the reality they promote; what contexts are considered, etc. For this author it was necessary to know:

- What knowledge associated to the notion of randomness and probability do the textbooks introduce? What are the relationships among this knowledge?
- What procedures do the students develop to give meaning and calculate probability?
- What methodological strategies do the textbooks present? (Type of activities, resources used, grouping of students,...)
- To try to give some answer to these queries, we focus our first empirical study on the *Content Analysis* of the Didactic Units dedicated to “Hazard’s treatment” in some of our more used textbooks. The problems that direct the study are:

PROBLEM 1: In the first place, we are interested in characterising the elements that form the structure of the textbook and their possible relationship (Serradó, 2000):

What is the nature of the subjacent mathematical knowledge? How do books present the contents? How is the discussion that introduces the theoretical notions organised? What types of activities do they introduce? Which resources and methodological strategies do they suggest? How is the student assessed? Are there any models in common between the set of books and the text analysed?

PROBLEM 2: We are interested in characterising the knowledge that the textbooks develop about randomness.

Which definitions do the textbooks suggest about the notion of randomness? In what contexts do they introduce the notion of randomness? What do they propose the student should do with respect to the notion of randomness? What is the degree of formalization of the mathematical concept of randomness ?

PROBLEM 3: We are interested in analysing the arguments, interpretations or meanings that textbooks’ authors give to random phenomena in probabilistic terms.

What is the nature that authors assign to probability? Which are the contexts where the teachers introduce the probability concept? What definitions do the textbooks suggest? What calculation strategies are introduced? What must students do in relation with this notion?

In the last phase of the investigation, we will approach a fourth problem related to how a group of teachers act and we can formulate it as:

PROBLEM 4: Characterising the use the teachers make of the textbook during the planning of the intervention in the Secondary Schools' classrooms.

What source do the teachers use when planning the class? Do they consider different sources of knowledge? Do they consider situations of context? What type of activities do they propose? How do they design the follow-up of the teaching and learning process?

To approach the formulated problems it is necessary to have a conceptual reference that will orient the research process available; that is, a system of adequate categories. This research builds upon the study of the intervention models and the hazard's notion developed in previous studies. The study of the intervention models includes the analysis of all the elements that form the design of a textbook, besides the elaboration of some progression hypotheses about the intervention models associated with the teacher's performances in the classroom, adapted to the models of intervention in the textbooks. The study of the notion of randomness includes the study of the mathematical notions of randomness and probability, besides the knowledge progression hypothesis about the hazard notion.

3 Investigation design

Four Spanish publishing houses, Bruño, Santillana, McGraw Hill and Guadiel, constitute the sample considered for the textbooks' study. Five books, which compose the curricular project of the ESO (first year, second year, third year and fourth year option A and B) from each of the publishing houses, were analysed. With respect to the selection of the group of teachers, we choose five teachers, from a group of secondary school teachers, who were willing to participate in the study. We chose these five for their contextual and professional criteria.

The research methodology used differs according to whether we are analysing textbooks or teachers. The methodological strategy used in the analysis of the textbooks will be content analysis (Bardin, 1986). Content analysis refers to two levels of analysis: the manifesto or what appears and what is latent or underlying or what can be read between lines, where the researcher tries to codify the meaning of the answer or the underlying motivation of the behaviour described. The conclusions of this first part of the research will allow us to establish the categories necessary for the later analysis of the planning of the classroom teacher's intervention. For this second study, the basic strategy will be the case method; this implies an inquiry process that is characterised by the detailed, comprehensive and systematic examination of the topic or problem of interest.

In a first place, the data collection's technique will be an open questionnaire, and later a half-structured interview with the teachers, that will enable us to go deeper into their ideas. We will adopt the general procedure of qualitative analysis for the qualitative data obtained from the half-structured interviews.

4 First results

Table 1 shows the tendency that each publishing house promotes in its texts, from the perspective of the models of intervention characterised.

Indicators	Ed. Bruño	Ed. Santillana	Ed. Guadiel	Mc Graw Hill
Programming	Systematic Objectives	Systematic Objectives	Systematic Objectives	Systematic Objectives
Content	Conceptual & procedimental Predominance	Conceptual & procedimental Predominance	Conceptual & procedimental Predominance	Conceptual & procedimental Predominance
Presentation of Knowledge	Fragmented accumulative, lineal organisation	Fragmented accumulative, lineal organisation	Staggered and rigid organisation; emulating constructivist sequence	Staggered and rigid organisation; emulating constructivist sequence
Discussion Structure	Deductive Model	Deductive Model	Inductive Model	Inductive Model
Methodological Strategies	Explanation.	Explanation.	Closed sequence of activities	Closed sequence of activities
Sources of Knowledge	Text book Teacher	Different sources, Closed Use	Different sources, Closed Use	Different sources, Closed Use
Work	Individual	Mainly Individual work. Group work also included	Mainly Individual work. Group work also included	Mainly Individual work. Group work also included
Interaction	Not considered	Sporadic and directed contrast	Sporadic and directed contrast	Sporadic and directed contrast
Sequencing	Very rigid temporal	Very rigid temporal	Very rigid temporal	Very rigid temporal
Motivation	Not considered	Not considered	Not considered	Not considered

Activities	Application or support	Application and Validation of Knowledge	Emulation constructivist sequence	Emulation constructivist sequence
When assess?	At end	At end	Beginning and end	Beginning and end
What assess?	Conceptual k. and application activities	Conceptual k. and application activities	Obtaining programmed objectives	Obtaining programmed objectives
How assess?	Exams	Exams	Pre-test post-test	Pre-test post-test

Table 1. - Intervention models of the publishing houses.

Firstly, we consider that the publishing house Bruño presents a traditional model of intervention that has not suffered any type of innovation, the publishing house Santillana has evolved towards a more innovating model by incorporating more participative activities. The publishing houses Guadiel and McGraw Hill are two examples of technologically innovating methodologies. The students become protagonists of the construction of the knowledge using a sequence of activities, which are similar to a didactic situation with activities of exploration, formulation and validation of a theory. Also, we are interested in characterising the knowledge that the textbooks develop about randomness and analysing the arguments, interpretations or meanings that textbooks' authors give to the random phenomena in probabilistic terms and the definitions and strategies of the probability notion that are introduced in the textbooks.

Table 2 shows the first results in relation with the randomness notion included in the textbooks' explanations. The left column contains the different indicators collected in the analysis form, which permits the characterisation of the randomness notion for all the publishing houses. Each one of the indicators can present more than one description in terms of the differences that we detected between the educational levels.

Indicators	Ed. Bruño	Ed. Santillana	Ed. Guadiel	McGraw Hill
Chance	Causal Luck	No reference	Luck	Causal Luck
Phenomena /experiment	Indistinct use, no specification of differences	Only notion of experiment	Only notion of experiment	Indistinct use, no specification of differences
Random	Uncertainty	Uncertainty	Uncertainty	Uncertainty

Experiments	Multiple possibilities			
Determinist Experiments	Prediction of result a priori Always same result	Prediction of result a priori	Completely determined result	Prediction of result a priori
Process/outcome	Presents Distinction	Does not Present Distinction	Does not Present Distinction	Presents Distinction
Outcome	Axis of calculation of probability. High level of formalisation	Axis of calculation of probability. High formalisation level	Favours the calculation of probability	Favours the calculation of probability
Operations (union and intersection)	Able define the notions of compatibility	Able define the notions of compatibility	No relation to notion of outcome	No relation to notion of outcome
Properties of outcome	Includes	Includes some	Any reference	Any reference
Illustration and context	Games	Games	Games	Games and daily situations

Table 2.- Treatment of randomness in the publishing houses

The Table 3 shows the probability's treatment that each publishing house promotes in its texts.

Indicator	Ed. Bruño	Ed. Santillana	Ed. Guadiel	Ed. McGraw Hill
Quotidian notion	Possibility Probability	Possibility Probability	Probability	Possibility Probability
Definition	Classical Laplacian	Classical Laplacian	Frequency Stability	Frequency Stability
Treatment of the frequential	Theoretic study	Theoretic study and application activities	Exploration of the meaning of the stability	Exploration of the meaning of the stability

notion of probability				activities about heuristics
Equiprobability	Only equiprobability	Meaning of equiprobability, activities with outcomes not equiprobables in games context		Study of the meaning of the equiprobability and activities to obtain the probability in equiprobability or not in all kind of context
Probability properties	Calculate probability	Validation of relationship between outcomes	Calculate probability	Validation of relationship between outcomes and analysis of interpretation's errors
Dependency and independency	Distinction between situations with or without replacement	Analysis of the influence in the occurrence of the outcome	As an identity of probability properties	Distinction between situations with or without replacement and as an identity of probability properties
Strategic instruments	Basic to calculate probability		A previous work to introduce combinatory	As a support to calculate probability

Table 3.- The Probability in the publishing houses

The overall conclusions of the units dedicated to “Hazard’s treatment” in the textbooks give us information about the planning phase of the intervention for teachers that use the textbooks as classroom material. How the teacher plans to use the textbook and the adjustments made to carry out the phase of the development of the intervention will be analysed.

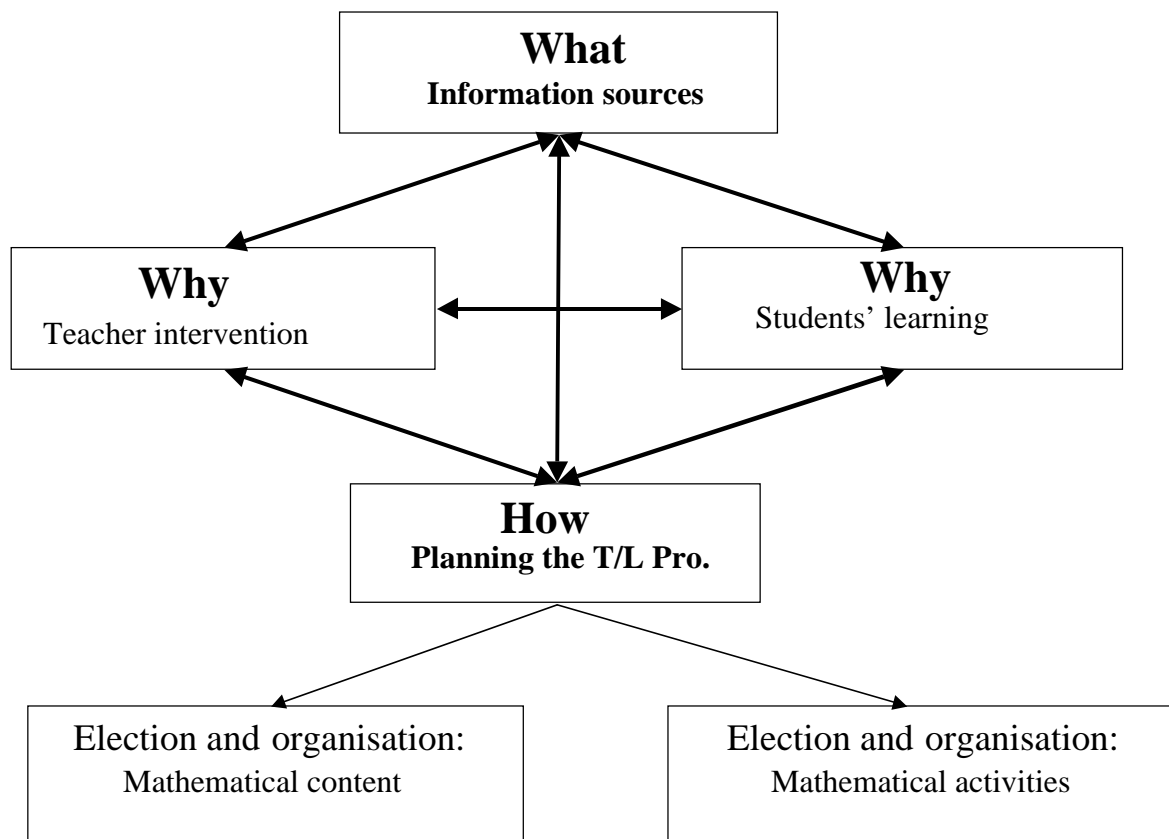
Finally, we are interested in characterising the use the teachers make of the textbook during the intervention’s planning in the Secondary Schools’ classrooms.

We analyze different questions (graph 2), about the use of the information sources for the planning of the teaching and learning process with five professors of secondary school.

We present the first results about the systems of ideas that teachers develop when they are preparing the teaching and learning process. The information sources that they use in this process influence these systems of ideas.

With relation to the information sources they use when they prepare the teaching and learning process, most of them take the information from textbooks.

These textbooks give them information about the selection and the organisation of the unit, contents and activities. In this case, we find to different manners of use. In the first place, these teachers use the book in a lineal manner without changing the order of units or contents. In the second place, teachers that use the textbook as a complement of their own system of ideas, informing them about what they must teach.



Graph 2: Questions about the use of the information sources

In both cases, they use the curriculum as a document that gives general information about the official programming they must include in papers, but not develop in class.

Therefore, textbooks and curriculum give them information about the content they must prepare. They say that the information about applications of the content or information about methodological strategies, analyses about difficulties in the learning process or activities to motivate the students is not included in textbook. In this case, some of them expressed that they obtained this information in articles of investigation or in innovation courses.

They express that they are not conscious of using the conceptions of the students when they are preparing the process. These conceptions crop out in class, and teachers use them in order to connect with student's previous concepts or misconceptions. The teaching and learning process give information about the heuristics and the context that are involved in the student's process of learning.

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