DESIGN OF PROBLEMS FOR RESEARCH PURPOSES WITH MATHEMATICALLY TALENTED STUDENTS

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Abstract. *In this workshop, through specific examples, we propose the attendees to "create" their own problems so that they fit specific research needs. The process for the design is based on reviewing the appropriate bibliography, consulting databases and programs addressed to talent, selecting related problems and modifying their components. Participants in this workshop will be organized in small groups and will make their own proposals, which will be discussed in the whole group, where the proposed schema for the design of tasks related to specific research will be completed.*

Keywords: mathematical talent, problem solving, visualization, cooperative work, resolution strategies, problem design

INTRODUCTION

Problem solving acquires a relevant role in the research with mathematically talented students, and it is used both in identification, characterization, and intervention (Davis, Rimm & Siegle, 2014; Neider & Irwin, 2001). A close correspondence between research objectives and characteristics of the problems used as instruments is established. The researcher has access to a bank of resources from bibliographic reviews, specific programs addressed to mathematically talented students, mathematical competitions, etc. But sometimes, the result of this search does not suit the specific needs of the study, and then the researchers are led to "create" their own problems.

A strategy to design problems that best fits the objectives of a specific research is to modify some elements of other problems. It is necessary a detailed analysis of the variation which results from each modification; this enriches the knowledge of the researcher as an expert in the resolution of this specific problem.

PROBLEM DESIGN

There is an initial scheme in which various phases of work are sequenced in order to create the problem that best fits the proposed research.
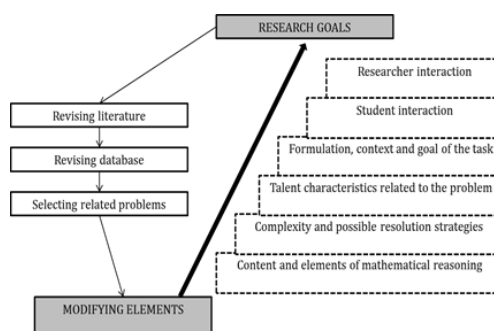

Figure 1. First diagram to design problems

In this workshop, we propose as an example some of the specific objectives of a piece of research that we are carrying out at present. It concerns rich tasks for mathematically talented students that allow the analysis of the skills of visualization and visual argumentation, to analyze the transmission of information to solve a cooperative task and

to analyze the strategies used in proof (Beltran-Meneu, Ramirez, Gutiérrez & Jaime, 2016, Ramírez, 2012).

In relation to the review of the literature, for each research aim we will present the participants problems considered in similar research, as well as a search in the databases of problems in the NRICH project (University of Cambridge http://nrich.maths.org) and in the International Mathematical Olympiad (https://www.imo-official.org).

For the modification of the problems, we will take into account the following elements: formulation, context and goal of the task; content and elements of mathematical reasoning; complexity and possible resolution strategies; talent characteristics related to the problem; student interaction among students and researcher interaction.

In this workshop we will offer the participants some problems to modify the elements and progressively adjust them to the proposed objectives. Subsequently, after working in small groups and a general discussion, the proposed variations will be analyzed and an evaluation of the richness of the problem will be done regarding the research intention. Finally, the scheme presented in Figure 1 should be enriched with other possible strategies addressed to create problems or with some variations of the elements that characterize them.

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