EUROPEAN EDUCATIONAL RESEARCH ASSOCIATION

Mathematical Investigations In Early Years – Fifth Grade Students

Author(s):Manuel Vara Pires (presenting)

Conference:ECER 2014, The Past, the Present and the Future of Educational Research

Network:24. Mathematics Education Research

Format:Poster

Session Information

24 SES 05.5 PS, General Poster Session

General Poster Session

Time:2014-09-03
12:30-14:00

Room:Poster Area A (between B030 - B036)

Contribution

Mathematical Investigations In Early Years – Fifth Grade Students

This poster reports on a learning experience aiming to present and analyze the work produced by 5th grade students in solving a mathematical task with investigative characteristics.

Creating stimulating learning environments implies the diversification of the type and nature of mathematical tasks in the classroom, in the perspective of the valuation of mathematical experience through problem solving, investigations and other situations involving students in the processes of mathematical thinking and communication. Thus, the tasks proposed to the students should (i) appeal to their intelligence, (ii) develop understanding and their mathematical skills, (iii) stimulate them to make connections and develop a coherent framework for mathematical ideas, (iv) appeal to the mathematical reasoning and formulating and solving problems, (v) promote the communication about mathematics, (vi) show mathematics as a permanent human activity, based on different experiences, and (vii) promote the development of students' mathematical competence (National Council of Teachers of Mathematics, 2000).

Mathematical tasks, according to their type and nature, can provide different ways of *understanding* or *doing* mathematics (Pires, 2011). The tasks may appeal to routine processes or be a challenge to exploration or discovery, require a repetitive or a creative reasoning, allow a uniformity of learning rhythms or foster the diversification, have a convergent or a divergent character, reinforce a static view of mathematics as "end product" or point to a dynamic view as "construction", establishing mathematical connections and providing more meaningful mathematical experiences.

Mathematical investigations appear as an expression of a non-routine work, referring to complex mathematical processes and involving a strongly problematic activity (Martins, Maia, Menino, Rocha & Pires, 2002). These tasks may provide a divergent activity that encourages students to be curious, to search for alternative strategies, to consider what would

happen if certain conditions change or to generalize the situation (Chamoso & Rawson, 2001). Usually the investigations require a similar work to the one produced by mathematicians: towards a particular situation that must be answered, the students have to ask questions, to make and test conjectures, to justify these conjectures based on mathematical arguments and to validate the results (Ponte, Ferreira, Brunheira, Oliveira & Varandas, 1998).

This process of testing and validation is also a social practice (Boavida, 2005) because the students have to argue and communicate their results to the others, possibly argue against, so that the results may be validated by all. Assigning a central role to the "practice of argumentation" (National Council of Teachers of Mathematics, 2000) in the classroom means empowering all students not only to present and explain their reasonings, but also to understand and accept the others' argumentation.

Method

This experience is part of a broader study (Pires, 2011), involving an experienced 5th grade mathematics teacher, aiming to know how teachers integrate investigation tasks in the (current) curriculum development and how they reflect upon their teaching practices. This learning experience focused on the work of one lesson by the twenty-five 5th grade students of the teacher, who proposed them to discover, record and validate "interesting relationships" in the Pascal triangle. Previously the students had already solved, although quite sporadically, tasks of the same nature (investigation tasks).
The study followed a qualitative and interpretative approach (Bogdan & Biklen, 1994; Bolívar, Domingo & Fernández, 2001), seeking to understand the students' point of view, how they could interpret the different experiences they were dealing with and the meanings that were assigned to them.
In particular, the data collection of the learning experience was supported by: (i) teacher's written productions; (ii) written productions by the students while solving the task; and (iii) field notes recorded by the author in the classroom.
The data analysis process involved a floating approach to the work developed by the students and followed by a systematization and a categorization (Bogdan & Biklen, 1994), seeking to give a coherent ordering to the various materials.

Expected Outcomes

The students began the resolution of the task working in pairs, which facilitated the communication process of presentation and validation of the conjectures "with the partner". The presentation of a particular conjecture has required to each student pair a certain level of organization and structure of his argument in order to be understood and eventually validated by the colleague. It was often heard comments like: "this can not be, in this line it does not happen", "and if we did ... no it's not possible!", "you may be right, but it does not seem to me", "this is very easy, we must try another discovery", "teacher, which of us is right?"...
The pairs recorded a significant number of conjectures: some of them quite obvious, much based on direct observation (natural numbers, double...), and others more sophisticated, involving connections between mathematical concepts (symmetry, powers, sequences, patterns...). However, this categorization does not intend to rank or compare the students' conjectures, because each one of them had a mathematical meaning to those who had established it (Pires, 2011).
After all pairs have validated, at least, a relation in the Pascal triangle, it took place the large group discussion. Generally, the students were able to present and defend their reasoning and productions. Also, to a lesser extent, they were able to listen and understand the opinions of the others. But, as they showed a good general behaviour, the collective validation (or refutation) environment of the conjectures has not been negatively contaminated by their postures (Boavida, 2005), which could disarrange the management of the activity.
The exploration of relations between numbers of the Pascal triangle allowed the students to follow forms of investigative work, whose characteristics produced a stronger sense and meaning to students' learning (NCTM, 2000), developing their ability to communicate, argue and generalize.

References

Boavida, A. M. (2005). A argumentação na aula de matemática: Olhares sobre o trabalho do professor. In J. Brocardo, F. Mendes & A. M. Boavida (Orgs.), XVI SIEM – Atas (pp. 13-43). Setúbal, Portugal: Associação de Professores de Matemática.
Bogdan, R., & Biklen, S. (1994). Investigação qualitativa em educação. Porto, Portugal: Porto Editora.
Bolívar, A., Domingo, J., & Fernández, M. (2001). La investigación biográfico-narrativa en educación: Enfoque y metodología. Madrid, Espanha: La Muralla.
Chamoso, J., & Rawson, W. (2001). En la búsqueda de lo importante en el aula de matemáticas. SUMA, 36, 33-41.
Martins, C., Maia, E., Menino, H., Rocha, I., & Pires, M. V. (2002). O trabalho investigativo nas aprendizagens iniciais da matemática. Em J. P. Ponte, C. Costa, A. Rosendo, E. Maia, N. Figueiredo & A. Dionísio (Orgs.), Atividades de investigação na aprendizagem da matemática e na formação de professores (pp. 59-81). Coimbra, Portugal: SEM, Sociedade Portuguesa de Ciências da Educação.
National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Reston, VA: NCTM.
Pires, M. V. (2011). Tarefas de investigação na sala de aula de matemática: Práticas de uma professora de matemática.

Quadrante, XX(1), 31-53.
Ponte, J. P., Ferreira, C., Brunheira, L., Oliveira, H., & Varandas, J. M. (1998). Investigating mathematical investigations. In P. Abrantes, J. Porfirio & M. Baía (Eds.), Les interactions dans la classe de mathématiques: Proceedings of the CIEAEM 49 (pp. 3-14). Setúbal, Portugal: ESE de Setúbal.

Author Information

Manuel Vara Pires (presenting)
School of Higher Education, Polytechnic Institute of Bragança, Portugal, Portugal