# Prospective primary teachers posing problems: some characteristics

Israel Garcia-Alonso1, Diana Sosa-Martin1, Mirela Vinerean2, Karin Våge2, and Yvonne Liljekvist2

1University of La Laguna, Department of Mathematical Analysis, Spain;

2Karlstad University, Department of Mathematics, Sweden.

This presentation focusses on a preliminary study about the characteristics of the posed problems by prospective primary teachers (PPT). In this case, we analyse the plausibility, the reasonability and the mathematical structure of the 61 tasks on fractions that 21 students enrolled in the Primary Teacher degree have posed. The initial results imply that PPT can pose plausible and reasonable problems, but the variety of the mathematical structure selected could be improved by further development of the teaching practice on PTP. Educational design studies will be conducted in order to deeper understand problem posing as a tool for developing subject specific knowledge.

## Introduction

*Problem posing* (PP) is the activity through which one creates mathematical problems. It is known that PP allows students to assess and understand their thinking (Cai & Hwang, 2020) and it also contributes to the construction of knowledge from the integration of existing mathematical structures (Kiliç, 2015). There is still a need for more research on PP (Cai & Hwang, 2020).

This study is focused on problems on fractions posed by PPT of Primary Education and we analyse some characteristics of the problems posed (see Table 1).

|  |  |
| --- | --- |
| **Plausibility**(Grundmeier, 2015) | *NP: Not plausible* (if it contains invalid statements and it is not solvable ) |
| *P1: Plausible without sufficient information*  |
| *P2: Plausible with sufficient information and one computation step required* |
| *P3: Plausible with sufficient information and several computation steps required* |
| **Reasonability** | *Reasonable* (the statement and the expected answer are realistic in real life) |
| *Unreasonable* (otherwise) |
| **Mathematical structure** | *Concept* (describing a situation that is expressed by a fraction) |
| *Order* (ordering fractions from lowest to highest or vice versa) |
| *Additive* (addition or subtraction of fractions) |
| *Multiplicative* (multiplying or dividing fractions) |

Table 1. Categories of analysis of posed problems.

In the overarching project we work together (Primary Teacher Program in Laguna & Karlstad) studying how PP can be a tool for PPTs to develop their subject didactical knowledge. In this paper we describe the preliminary results from a sub study. The main objective of this study is to investigate whether PPT are able to pose coherent problems on fractions. The research question is: Which characteristics have the problems on fractions posed by PPT?

This study is carried out within the Primary Teacher Program (grades 4-6) at Karlstad University Sweden during the spring semester 2023. The participants are 21 PPT completing the following assignment: *Construct three tasks with three different degrees of difficulty where 1/4 and 3/8 appear, either in the task itself or in the solution. You can add whatever type of information you think is appropriate (numbers, text, images, etc.).*The working time was 20 minutes, the students used paper and pencil and no aids were allowed. No previous intervention in PP was given.

## Results and analysis

The 21 students posed 61 tasks (two students only wrote two different examples). Twenty-eight tasks were exercises with fractions (computation or visualisation). We analyse the left 33 problems using the characteristics in Table 2. Three tasks had some mistakes or did not contain fractions. Thus, we obtained 30 plausible problems.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | **Mathematical structure** | **No. problems** |
|  |  |  |  |  | Additive | 15 |
|  |  |  |  |  | Multiplicative | 4 |
| **Plausibility** | **No. problems** |  |  |  | Concept | 0 |
| NP | 3 |  |  |  | Order | 0 |
| P1 | 9 | **Reasonability** |  | **No. problems** | Additive, Multiplicative | 9 |
| P2 | 5 | Reasonable |  | 29 | Additive, Concept | 1 |
| P3 | 16 | No reasonable |  | 1 | Multiplicative, Concept | 1 |
| **Total** | 33 | **Total** |  | 30 | **Total** | 30 |

Table 2. Results of the analysed categories of the posed problems.

The initial results suggest that PPTs can pose plausible and reasonable problems (29 out of 30). However, nine of these are P1. The variety of mathematical structure and plausibility (see Table 2) suggest a need to further develop the teaching practice on PTP. Educational design studies will be conducted in order to deeper understand PP as a tool for developing subject specific knowledge.

## References

Cai, J. & Hwang, S. (2020). Learning to teach mathematics through problem posing: Theoretical considerations, methodology, and directions for future research. *International Journal of Educational Research*, *102*, 1-8.

Grundmeier, T. A. (2015). Developing the problem-posing abilities of prospective elementary and middle school teachers. In F. M. Singer et al. (Eds), *Mathematical problem posing* (pp. 411-431). Springer.

Kilic, C. (2015). Analyzing pre-service primary teachers’ fraction knowledge structures through problem posing*. Eurasia Journal of Mathematics, Science and Technology Education*, *11*(6), 1603-1619.