

## PROSPECTIVE MATHEMATICS TEACHERS INTERACTING IN ONLINE CHAT CONCERNING THE DEFINITION OF POLYHEDRON

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**Abstract:** Research that analyze the construction of geometric concepts through interactions on online are scarce. This study focuses on pre-service mathematics teachers (PSMTs) discussing about the definition of polyhedrons. One case study will be discussed. The chat proved to be a scenario that improved reflecting about the definition in three scopes: one in the context of solids, one focused on its elements (faces, vertices and edges) and still another one centered in the number of dimensions.

### Introduction

VEL are mediated by different technologies. In VEL individuals can exchange ideas and develop their mathematics concepts, without hierarchy or domination from one participant on another (Çakir et al., 2009). In our VEL one way to exchange ideas is through the use of writing, and learning is understood as forms of participation and changing in discourse (Sfard, 2008). In our study we focus on written online interaction regarding the definition of polyhedrons<sup>1</sup>. Writing about mathematical ideas allows individuals to review, at different moments, their understanding concerning some concepts. Practices that allow PSMTs to develop an understanding about the nature and function of definitions contribute to improve their professional knowledge (e.g., Zazkiz & Leikin, 2008). Assuming defining and conceptualization are important processes in mathematical thinking, we believe that those processes could be improved even in virtual environments, because in VEL reflections could be interchanged in different discursive ways and moments.

### Research Context and Data Source

The Gepeticem environment (<http://www.gepeticem.ufrrj.br/cursos.php>) is structured around a vision of work that breaks with the axiomatic approach and the memorization of formulae in geometry classes. Although we agree with Tanguay and Grenier (2010) about the importance of the proof in the geometry classroom, we decide, at this moment of our study, to construct our VEL based on a situation related to the activities of defining, exploring and experimenting via different sources. The chat proposal was: *See below how four future teachers characterize polyhedron: PSMT 1 (A polyhedron is a three-dimensional geometrical solid, the faces of which are polygons), 2 (A figure of 3 dimensions formed by polygons), 3 (A polyhedron is made of polygonal regions and the space limited by them), and 4 (It is a solid, the surface of which is a finite number of faces (polygons)). Analyze and discuss with your partners the definition of polyhedron expressed by each one.* The proposal was sent to them, by e-mail, 10 minutes before the online chat. The chat takes about 120 minutes (two regular classes of 60 minute each). We used the following procedures for data reduction: chat transcription (a file provided by the platform itself), numbering (in lines) of interactions, removal of lines which contained no ideas related to the concepts we were intent on focusing, re-reading interactions and organizations in turns.

### Results

We found that PSMTs interacted in three scopes regarding polyhedron definition: aspects associated with geometric solids in general; aspects focused on the elements (faces, vertices and edges), and reflected focusing on the number of dimensions. At the first moment, we observed the development of the whole interactive process, as is shown in the following sequence over the first 4 minutes of the debate.

Figure 1. Part of the transcription of the online chat.

fmagalhaes (10:18:30) : my answer was incomplete mary (10:18:59) : taking into account it's a first contact with the concept of polyhedrons I guess the ideas 3 and 4 were the simplest to understand fmagalhaes (10:19:13) : ... they are too formal for the pupils' understanding thiago (10:19:33) : I've already got 4 erj (10:21:12) : I found the definitions 3 and 4 are more understandable. thiago (10:21:21) : I guess 3 was a bit complicated researcher (10:22:06) : what's making 3 more complicated? rschiaro (10:22:10) : It's a solid, the surface of which is a finite number of faces
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At this *first moment*, we tried to have an overview of interactions, the subjects' motivations, their curiosity and the elements that appeared to have caused them some cognitive unbalance. For example, the perceptions about the answers that had initially been presented, familiarity (or lack of it) with the subject, doubts or questioning addressed to the group, and agreements. That is why we consider important to get to know the cognitive group

as it constitutes itself in the first place (Stahl, 2006), and, from there, later develop an analysis oriented toward one of the participants. So, at a *second moment*, we randomly chose one PSMT, the first one who entered the chat to interact: *erj*.

Figure 2: Focus on a single student.

erj (10:23:13) : I guess when the definition talks about a number of dimensions it gets difficult for the pupils to learn. That's why I like 3 and 4 better  
 erj (10:24:52) : The problem in 1 is the "three-dimensional"  
 erj (10:28:50) : I think a solid, kids already understand better what it is without a definition that's too formal  
 erj (10:36:06) : One more thing, ... I think we should define a polyhedron without prior citing its elements (faces, vertices and edges) and then identify them later  
 erj (10:45:23) : How about: "A polyhedron is a geometric solid, formed by a finite number of polygonal regions (polygons)"

At this analytical moment, what interests us mainly is to identify the movement from individual ideas to collective thinking (*but, wait a minute, hey you guys*) and backwards, as all the participants have a possibility to think and talk, without asking for permission. It is also important to highlight that even selecting just one interlocutor, it is visible that his/her thinking process is constituted and takes into consideration the contributions from his/her pairs. The contribution from *erj* (10:45:23) shows that the PSMT considered a definition for a polyhedron. Nevertheless, as the chat encourages the collective reflection and a belonging to the group, then he/she has the possibility to analyze the idea together with the group. At a *third moment*, we analyzed PSMT (*erj*) in the constituted collective group.

Figure 3: Focus on the students as a collective unit.

fmagalhaes (10:19:13) : ... they are too formal for the pupils' understanding  
 thiago (10:19:33) : I got 4  
 erj (10:21:12) : I found the definitions 3 and 4 are more understandable  
 thiago (10:21:21) : I found 3 a bit complicated  
 erj (10:28:50) : I think a solid, kids already understand better what it is without a definition that's too formal

The above interactive process shows us how the answers can be revised (10:18:30), challenged (10:31:05) and caused (10:36:41) within the collective group. Besides, examples are requested (10:37:04) and relations with the PSMT's practice (10:28:50). This individual/collective back and forth movement has to be valued in the processes of initial training of teachers. Finally, at a *fourth moment*, we highlighted words related to the definition of a polyhedron.

## Concluding Remarks

We analyzed online PSMT interactions that focused on ways to define polyhedrons. Participants showed they deepened conceptual aspects in three scopes. These approaches are not sequential, hierarchical, nor individual. In order to identify the three scopes, our analysis switched from a global look on the interactions to a focus where we tried to highlight the mathematical ideas that were most explicit in their interactions. Based on the implemented analysis strategies, we verified that the online chat can be an educational space where the ideas of the PSMTs can be challenged and reviewed by the individual within the collective group. Perceptions of previously given answers, familiarity with the subject under discussion, doubts or questionings addressed to the collective group, among others, can be observed in the interactive dynamics. Examples are continuously required and relations with the teacher-to-be practices may emerge.

## Endnote

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## References

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