Observing how future primary school teachers reason about general statements

ERIE INTERNATIONAL CONFERENCE 2020

Abstract: The contribution belongs to a larger empirical qualitative study that focuses on various possible ways of using an educational tool called Concept Cartoons in professional preparation of primary school teachers. In this particular case, we use the tool for observing future teachers' modes of reasoning about general mathematical statements. We created a new Concept Cartoon with four general statements about the properties of results of multiplication, and assigned it to future teachers to respond in the written form. Collected data enable us to connect the responses to various modes of reasoning belonging to various levels of proof schemes (inductive, deductive) and various types of examples (counter-examples, generic examples).

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Introduction

In recent years, we have been analysing an educational tool called Concept Cartoons and its possible use in professional preparation of future teachers, especially in assessing teachers' knowledge about calculation tasks and word problems solved by calculations. And so, questions arose whether and how it would be possible to use Concept Cartoons also for assessing reasoning about mathematical statements. Our research question is "What kinds of reasoning about general statements can be observed in future primary school teachers when using Concept Cartoons as a diagnostic instrument?"
This contribution belongs to an international educational project *Digital Support for Teachers' Collaborative Reflection on Mathematics Classroom Situations (coreflect@maths)*. The goal of the project is to bring together and exchange good practices of vignette-based professional preparation of teachers, and then develop a multilingual digital tool to provide an environment for such a preparation. In that sense, Concept Cartoons are considered vignettes.

Materials and methods

Participants

Participants of the study were 28 future primary school teachers – students of the third year of a five-year master degree program at the Faculty of Education.

Diagnostic instrument

As a diagnostic instrument, we used an educational tool called Concept Cartoons (Samková, 2018). Concept Cartoons are pictures showing several children in a bubble dialog and in this particular case we employed a dialog comprising of four general statements on multiplication based on four common misconceptions about the operation (Figure 1). The domain set of the numbers in focus is not specified, intentionally; it might be either natural numbers, integers, fractions, rational numbers or real numbers.

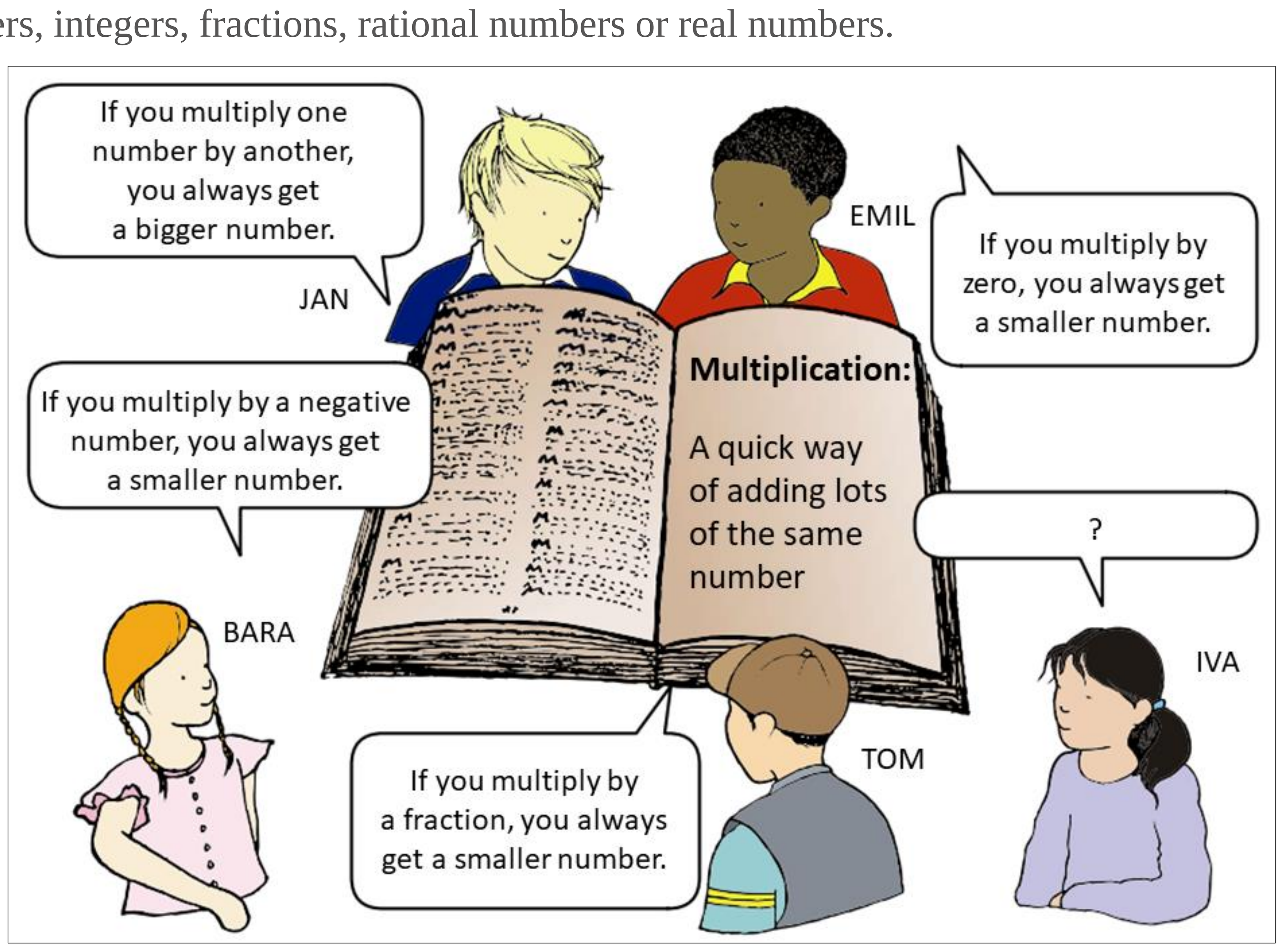


Figure 1: A Concept Cartoon on multiplication; (source of the template of the book and children with empty bubbles: Dabell, Keogh and Naylor, 2008: 3.2)

Data collection and data analysis

During data collection, we assigned the respondents a worksheet with the Concept Cartoon and asked them to decide which children in the picture are right and which are wrong, and justify the decision. The participants worked individually, in a written form, with a time allocation of 20 minutes.
Collected data went through qualitative analysis using open coding and constant comparison. First, we registered which bubbles were chosen as correct by individual respondents and under which additional conditions. Afterwards, we openly coded all the material, looking for various aspects related to mathematical reasoning, justification and argumentation. Then we applied the method of constant comparison – from the overall perspective, from the perspective of individual bubbles across all participants and from the perspective of individual participants across all bubbles.
At the end of the process, each of the participants was assigned exactly one code category for each of the bubbles (i.e. 28 · 4 = 112 assignments were made).

Results

Code categories related to argumentation

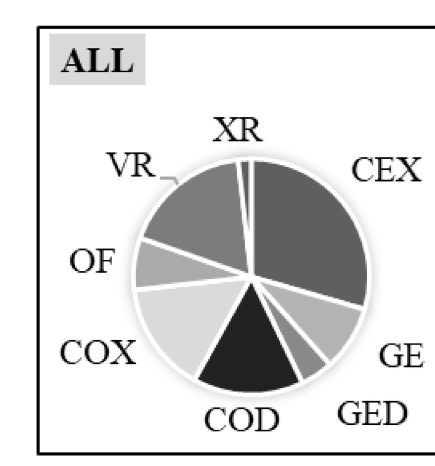
Eight different code categories appeared in data during data analysis, see Table1.

Table 1: The list of code categories and their descriptions

category	description	proof scheme
XR	no response	
OF	erroneous response (over-fixation to previous learning)	
VR	vague response	
COX	conditions of validity indicated, with no justification	
CEX	one or more counter-examples	inductive
GE	generic examples with no justification	deductive
GED	generic examples with deductive justification	deductive
COD	conditions of validity indicated, with deductive justification	deductive

Frequency and relative frequency of code categories

Among the 112 responses, 2 were blank and 32 belonged to the code categories GE, GED, COD that fell under the highest level of proof schemes – deductive proof schemes. The most frequent category (33 responses) was the category CEX that fell under inductive proof schemes; this category covers counter-examples without justification. From the perspective of individual bubbles, the Jan's bubble seems to have been the most difficult since it provided the least number of deductive responses.



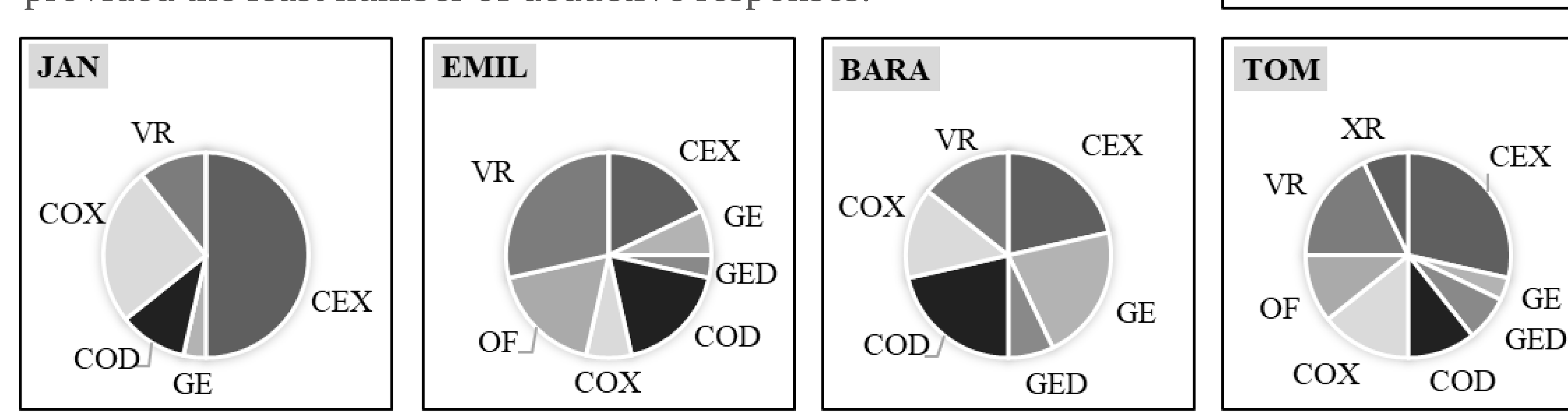


Figure 2: The diagrams of relative frequency of the code categories among the participants: for all bubbles (up) and for individual bubbles (down), n=28, 2016 (source: own calculation)

Conclusion

In this contribution we showed how Concept Cartoons might be employed in professional preparation of future primary school teachers in activities related to reasoning and argumentation, namely in activities related to reasoning about general mathematical statements. Our empirical qualitative study confirmed the motivational and diagnostic role of Concept Cartoons since the tool provided us with enough relevant content-related data about argumentation knowledge and skills of the respondents. The analysis of collected data enabled us to connect the responses to various modes of reasoning belonging to various levels of various types of examples (counter-examples, generic examples; Balacheff, 1988) and various levels of proof schemes (inductive, deductive; Harel and Sowder, 2007).

References

Balacheff, N. (1988) 'Aspects of proof in pupils' practice of school mathematics', in *Mathematics, teachers and children*, London: Hodder & Stoughton, pp. 216-238.
Dabell, J., Keogh, B. and Naylor, S. (2008) *Concept Cartoons in mathematics education*, Sandbach: Millgate House Education.
Harel, G. and Sowder, L. (2007) 'Toward comprehensive perspectives on the learning and teaching of proof', in *Second handbook of research on mathematics teaching and learning*, Charlotte: NCTM, pp. 805-842.
Samková, L. (2018) 'Concept Cartoons as a representation of practice', in *Mathematics Teachers Engaging with Representations of Practice, ICME-13 Monograph*, New York: Springer, pp. 71-93. http://doi.org/10.1007/978-3-319-70594-1_5

Supported by the European Commission under Erasmus+ Programme Grant *'Digital Support for Teachers' Collaborative Reflection on Mathematics Classroom Situations*', project No. 2019-1-DE01-KA203-004947.

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