

FEEDBACK AND WRITTEN MATHEMATICS COMMUNICATION – A PEN PAL EXCHANGE

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Abstract

This paper describes a study that aims to understand and characterize the written communication of future primary education teachers in a context of a pen pal exchange with 3rd grade students (8 years old), in particular the nature of the feedback. We followed a qualitative methodology, where data were collected through observation, written productions (letters) and an interview with the participants. Each future teacher was paired with two students, and four letters were written by the participants over the course of ten weeks. The first letter had the intent of presenting themselves and knowing the recipient. In the following letters the dialogue was continued and the pre-service teachers posed challenging mathematical tasks for the students to solve and for them to give feedback. We focused our analysis in the quality of written communication/feedback, the perceptions of future teachers about the potential of this experience and difficulties experienced. The dynamics of the correspondence exchange allowed the records to be prepared with great commitment. When selecting the tasks, they realized the importance of knowing the curricular guidelines, as well as the contents that the students were addressing. The tasks posed varied from exercises/problems centred on contents addressed by the students. The feedback sent was quite diverse. In some cases, it was not informative, and was even quite superficial; in other situations, the comments provided indicated hints for future action, seeking to promote learning. The exchange of correspondence by letter enabled the sharing of ideas, access to mathematical knowledge, the formulation of tasks, promoting the development of written communication.

Keywords: Mathematical communication, Written feedback, Teacher training.

1 INTRODUCTION

Communication is a fundamental component of mathematics education and of the teaching and learning process. This idea is reflected in a great diversity of curricular documents. It is considered as a transversal ability to all mathematical activity that contributes to the construction of meanings, consolidation and dissemination of ideas, and also as an essential skill to develop in school and apply in future careers. Particularly, by encouraging communication in the mathematics classroom, students have the opportunity to reflect, clarify and expand their knowledge about mathematical relationships [1]. Considering the different forms of mathematical communication, verbal communication is perhaps the most natural and simple way for students (and teachers) to express emerging ideas. However, written communication is also of special importance, as it provides students with a record of their own thinking, allowing them to reflect on the work developed [2]. It also provides the teacher with insights into students' reasoning. As this paper focuses on written communication, we consider pertinent to highlight some aspects that are inherent to it. Writing in the mathematics classroom can help students deepen the processes of exploring mathematics and to reflect on their own mathematical processes [3]. It also helps them organize their knowledge and understand the questions raised at a deeper level [4]. Writing in mathematics can enhance the learning of specific vocabulary and its proper use, essential for the development of mathematical proficiency [2]. When students communicate their thinking through written form, they tend to gradually clarify their ideas and provide the teacher with valuable information that they would likely not have access to otherwise. Overall, writing can be seen as a process that enhances the development of communication skills.

As it is not as regularly used as oral communication, it is urgent to create opportunities in the mathematics classroom to highlight written communication, in ways that are meaningful to students. Thus, the exchange of correspondence by letter, or a pen pal exchange, emerges as a strategy that offers its participants a rich and genuine experience, in the sense that there is an effective and intentional interaction with regard to communication [5]. It is recognized as a context that implies different facets of communication, since it encourages reading, writing and the discussion of ideas. Also, the fact that it is not a form of immediate communication implies a deeper attention in explaining ideas for the reader to

understand. According to McCaffery [6], the exchange of correspondence by letter contributes to the development of literacy, communication processes and, globally, to the learning of the contents involved, among other aspects of a more affective nature (e.g. motivation, interest, curiosity). It is an experience that triggers intrinsic interest and greater engagement in the activity to be developed. Participants tend to show enjoyment in contacting with the recipient of the letters, while showing, in parallel, an increase in their knowledge without the constant reinforcement of the teacher, when the dynamics occurs in the educational context. The fomented discussion between those involved enhances the understanding of concepts and motivates critical thinking. Although this is a short-term experience, it is rarely forgotten by the participants, having lasting implications for learning [7].

In the context of teacher education, particularly pre-service teacher training, in addition to the attention given to aspects related to the clarity and correctness of writing, this strategy makes it possible to raise awareness about the adequacy of the speech to the recipient. The pen pal exchange constitutes an opportunity for future teachers to access the thinking of the students with whom they communicate and be able to send feedback, through evaluative writing that must obey certain conditions, like: be appropriate to each student; be descriptive and incisive in a given task; refer and recognize students' efforts; be dialoguing; be informative; give hints for future action; encourage the student to reanalyse the given answer [8]. Written feedback is generally considered as a formative assessment practice used to lead students to achieve well defined learning objectives. It is a teaching practice that has implicit relational interactions between teachers and students and enhances opportunities for learning and self-regulation. It is a communicative and dialogic process which is translated into discursive interventions and recorded comments [9]. Formative feedback in its written form has potential to helping minimize the hiatus that tends to exist between a student's actual level of performance and the desired level of performance [10]. It allows the adoption of timely actions by the teacher, in order to fill this gap. On a more pragmatic level, it has the advantage of being able to be recorded on paper and be re-read by students later.

2 METHODOLOGY

This study aims to understand and characterize the written communication of future primary education teachers in a context of a pen pal exchange with 3rd grade students (8 years old), in particular the nature of the feedback. To conduct this investigation, we followed a qualitative approach [11]. The choice for an interpretative paradigm is sustained by the fact that the main goal is to understand how the participants react to and perceive a specific situation.

The participants were seven future teachers enrolled in a Masters Course in Primary Education (6-12 years old). The study was conducted in the scope of a unit course in Didactics of Mathematics, of the responsibility of the researchers, in which these future teachers were enrolled. The syllabus of this curricular unit contained modules about the nature of mathematics, curricular management in mathematics (e.g. types of tasks used in mathematics education, requirements for their selection and implementation), digital resources for mathematics education, and learning assessment (e.g. evaluative writing/written feedback). In the context of this discipline, the future teachers were engaged in a pen pal experience, over the course of a ten weeks period, with 3rd grade students, each one being randomly paired with two students. Four letters were written by each individual and the respective recipients: the first served as a presentation letter to get acquainted with the pen pal; the following ones continued the initiated dialogue and included mathematical tasks, chosen by the participants, for the students to solve and the future teachers to give feedback. During the period of this experience, the participants read the letters and organized their responses in order to include feedback about the students' work, writing comments and sending new tasks.

Data was collected during the classes of the abovementioned curricular unit, in a holistic, descriptive and interpretative manner, through: participant observation (classes), written productions (letters), and an interview at the end of the experience. The fact that the researchers were the teachers of this unit course facilitated the accomplishment of the participant observation, accompanying the work developed by the future teachers. In the data analysis, we used descriptive and content analysis methods [12], trying to find behavioral patterns related to the characteristics of the feedback/written communication, pre-service teachers' perceptions about the potential and the difficulties of a pen pal exchange in the scope of evaluative writing.

3 RESULTS

Although several data collection techniques were used, the results presented in this paper derive only from the observations made in the classroom and from the written productions.

The pen pal dynamics, established between the participants in this study and the 3rd grade students involved, triggered an attitude of great engagement and attention with the production of the written records. They had time to read the letters received, reflect about the response and send the correspondence within an appropriate time frame. Initially, the future teachers showed difficulties with the dissertation structure expected in a letter, but they quickly overcame this problem, realizing the need to write the texts in the form of dialogue, to encourage communication with each correspondent. This difficulty was expressed in a general way and was attributed to the scarcity of letter writing experiences. There was a visible concern in adapting the language to the recipients, so that the message was clearly understood, an aspect highlighted as positive by future teachers who had, with this experience, the opportunity to contact with primary school students. When selecting tasks to be included in the letters, the future teachers realized the importance of acknowledging the curricular guidelines for 3rd grade mathematics, as well as the contents the students were addressing at the time of the letter exchange. They considered that this was an opportunity for students to “apply” or “revise” what they were learning, considering that “it could be a learning opportunity for them”.

The tasks sent by the future teachers varied between exercises and problems centred on contents being addressed by the students at the time (e.g. multiplication tables, mode, roman numerals, relative position of line segments), multiple-step problems and process problems. The latter had greater predominance, due to previous experiences of these future teachers with this type of problems and their desire to “challenge the pen pal”. Also, it was justified by the fact that “these problems are more transversal”, not necessarily having to “address specific mathematical contents”. Thus, in this case, the purpose was not so much the application of contents taught at the time, but the “development of mathematical reasoning”. It should be noted that, in most cases, the context of these problems was related to aspects shared by the corresponding student. As an example, in Fig. 1, it is possible to observe that underlying the option for this task was the inclusion of contents identified by the correspondent student.

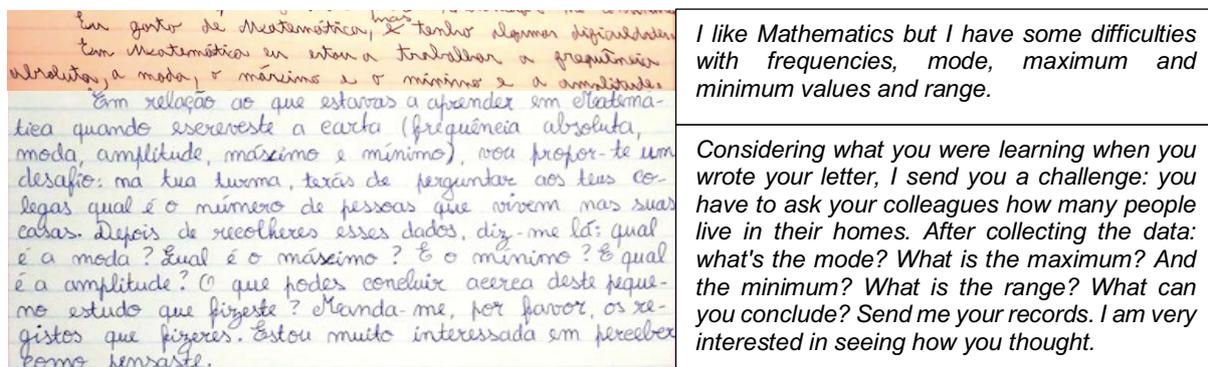


Figure 1. Example of a task emerging from the contents.

The type of feedback sent by the future teachers through the letters was quite diverse, however, the concern to adapt the written comments to each student was common to all of them. Based on the characteristics of evaluative writing, positive aspects of the written productions were often highlighted, recognizing the students' efforts. The teacher should highlight not only what is wrong or what should be improved, but also identify the strengths of the analysed work. The future teachers realized the importance of including comments of this nature in the letters sent. In some of these cases the feedback was not informative for the recipient, and it was even quite superficial: *I really liked your letter!*; *Regarding the answer to the first challenge, it is correct.* Nonetheless, most participants chose to write clearer comments about what they wanted to positively highlighted: *You managed to solve the problem correctly. You used a diagram and explained your reasoning well. So, congratulations!* In several situations, comments were provided that pointed out hints for future action, seeking self-regulation on the part of the student in question and, of course, promoting learning. Fig. 2 shows an example. Faced with a student's doubt, a comment was made with the intention of contributing to deepen mathematical knowledge, a comment that was valued by the recipient. The 6 times table was one of the difficulties pointed out by the student, an aspect considered relevant by his correspondent and which led him to formulate a suggestion that, in his opinion, could be useful to help the student to reflect.

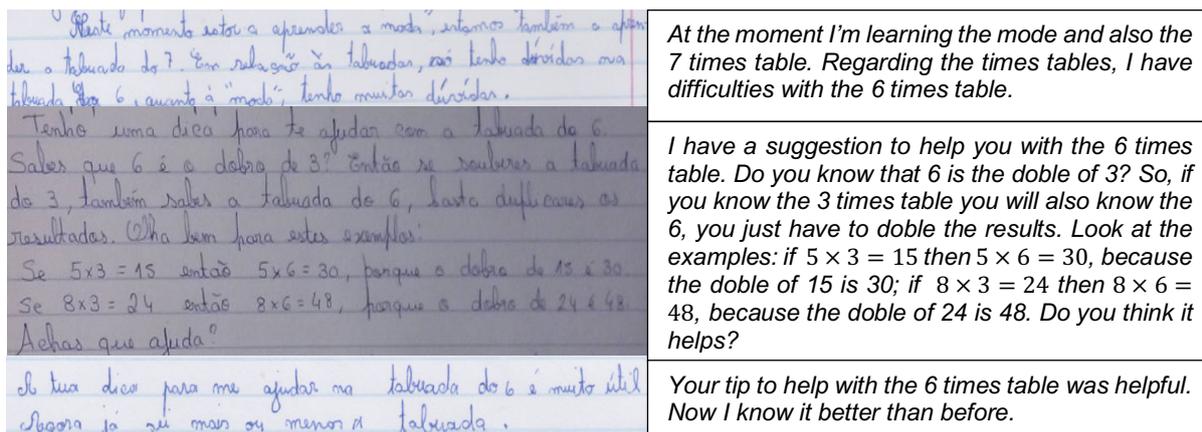


Figure 2. Excerpts from a letter with hints for future action.

The future teachers who participated in this study also evidenced, through the comments in the letters, the importance given to the explanation of reasoning in the process of written communication. In many of the letters, they encouraged the recipient students to explain how they thought or to clarify their ideas, focusing on the process. This situation was evident in expressions such as: *Explain how you thought; How do you know?; Explain how did you reach the solution; I am very interested in understanding how you thought*. These students were not used to this type of records in mathematics classes, putting on paper only the essential records of their reasoning. The lack of written communication habits results in the difficulty in clearly expressing a set of ideas to the reader. This fact implied that, in many of the letters, the future teachers felt the need to encourage students to explain how they thought or to clarify their ideas. This type of comments allowed students to reflect on their written productions and refine the text in the following letter.

During the pen pal exchange, and as would be expected, errors were also identified in the students' productions, mainly in the solution of some of the tasks proposed. Great attention was given not only to identify these errors but also to clarify and inform the recipients about the mistakes made, seeking to help them overcome their difficulties. Feedback was written in an informative manner for the reader. The same happened in situations that the participants felt need for clarification or correctness of mathematical language. The example presented in Fig. 3 illustrates a case in which one of the future teachers, after analyzing the student's response to a task about the concept of perpendicularity between straight lines, intends that the student improves the scientific correction of the records, highlighting, nonetheless, the fact that the concept is correctly applied.

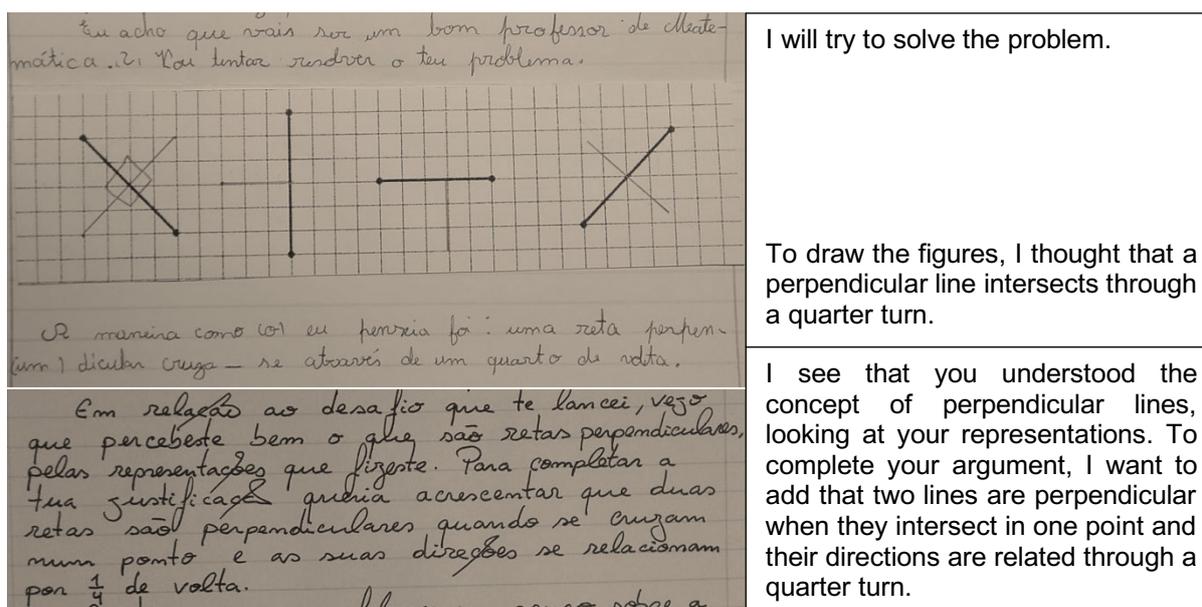


Figure 3. Excerpts from a letter with hints to improve scientific correctness.

The evaluative writing carried out by these future teachers stood out by its dialogic structure. The fact that the correspondents did not know each other and that the communication was established through letters, naturally led to the establishment of rich interactions, translated into questions, comments and sharing of ideas.

Finally, it is also important to point out more transversal aspects highlighted by the participants throughout this experience. They were not aware that a pen pal exchange could be a strategy to foment the development of mathematical communication and the implementation of evaluative writing/feedback. After this experience, they valued the potential of this approach and some considered the possibility of using strategies of the same nature in the near future, such as journals or diaries, mainly due to the emphasis given to written communication, which is undervalued in mathematics classes. In addition, they found that this component of communication is somewhat complex for students, due to the lack of regular experiences at this level. They became more conscious, as future teachers, of the importance of feedback, mentioning that it should be “concrete”, “precise”, “clear”, but “not too revealing, as it is not intended to give the answer but rather guide the student’s activity”. Finally, they mentioned that the exchange of correspondence by letter enhances the engagement and motivation of those involved, helping them maintain interest and the levels of concentration in the mathematical activity to be developed.

4 CONCLUSIONS

Through this study, we could conclude that a pen pal exchange facilitates written mathematical communication and promotes effective engagement on behalf of the participants [6]. We believe that the dynamics underlying this strategy and its dialogic nature can lead to more intentional and reflective communication. The letters constituted a vehicle to share ideas, accessing information/mathematical knowledge, formulation of questions/tasks, promoting, in a natural way, the development of written communication [2,5]. They also allowed future primary education teachers to apply their evaluative writing skills, sending feedback in a genuine context with a real recipient.

It was a widely valued experience by the participants, who were able to access the thinking of the students with whom they established communication, giving them diversified feedback in the context of evaluative writing. They sought to adapt the comments to each student, highlight positive aspects of their work, provide information to guide them in subsequent reflection, formulate hints for future action and reinforce the importance of improving certain aspects, such as the clarity and correctness of writing [8]. The possibility of putting into practice many of the contents covered in the curricular unit of Didactics of Mathematics that they were attending, and which served as the context for this study, allowed the future teachers to value these aspects and mobilize them with greater meaning.

To conclude, the pen pal exchange provided these future teachers with a new lens on aspects such as communication and written feedback. They were able to see, through direct contact with a real recipient, the importance of creating opportunities for students to communicate their reasoning and the role of evaluative writing in self-regulation and consequently in learning.

ACKNOWLEDGEMENTS

This work was partially funded by CIEC-UM, Research Centre on Child Studies, Universidade do Minho, and by FCT - Foundation for Science and Technology, I. P., in the context of the project PTDC/CED-EDG/32422/2017.

REFERENCES

- [1] OME, *The Ontario Curriculum, Grades 1 to 8: Mathematics*. Ontario: Queen’s Printer for Ontario, 2005.
- [2] NCTM, *Principles to Actions: Ensuring Mathematical Success for All*. Reston/VA: NCTM, 2014.
- [3] D.K. Pugalee, “A comparison of verbal and written descriptions of students’ problem-solving processes,”. *Educational Studies in Mathematics*, vol. 55, 27-47, 2004.
- [4] B. Braun, “Personal, expository, critical, and creative: Using writing in mathematics courses,” *Primus*, vol. 24, n.º 6, 447-464, 2014.

- [5] S. Crespo, "Using Math Pen-pal letters to promote mathematical communication," *Teaching Children Mathematics*, vol. 10, 34-39, 2003.
- [6] R. McCaffery, "Birds across borders: International pen pals correspond about ecology lessons," *Science and Children*, vol. 49, n.º 7, 31-38, 2012.
- [7] E.M. Hughes, L. Evering, J.A. Malloy, & L.B. Gambrell, "Do you have a brother? I have two!: The Nature of Questions Asked and Answered in Text-Focused Pen Pal Exchanges," *Reading Horizons: A Journal of Literacy and Language Arts*, vol. 53, n.º 4, 65-86, 2014.
- [8] L. Santos, & S. Semana, "Developing mathematics written communication through expository writing supported by assessment strategies," *Educational Studies*, vol. 88, n.º 1, 65-87, 2015.
- [9] J.C. Terroso, J. Dias, & F. Machado, "O feedback escrito como elemento regulador na resolução de problemas," *Educação e Matemática*, vol. 149-150, 62-66, 2019.
- [10] V. Shute, "Focus on formative feedback," *Review of Educational Research*, vol. 78, n.º 1, 153-189, 2008.
- [11] F. Erickson, "Qualitative methods in research on teaching" in *Handbook of Research on Teaching* (M.C. Wittrock ed.), 119-161. New York: Macmillan, 1986.
- [12] M.B Miles, & A.M. Huberman, *Qualitative Data Analysis*. Thousand Oaks: Sage Publications, 1994.