



HAL
open science

Researching the use of old professional journals as a tool for infant education prospective teachers training

José M. Muñoz-Escolano, Antonio M. Oller-Marcén

► To cite this version:

José M. Muñoz-Escolano, Antonio M. Oller-Marcén. Researching the use of old professional journals as a tool for infant education prospective teachers training. Thirteenth Congress of the European Society for Research in Mathematics Education (CERME13), Alfréd Rényi Institute of Mathematics; Eötvös Loránd University of Budapest, Jul 2023, Budapest, Hungary. hal-04422585

HAL Id: hal-04422585

<https://hal.science/hal-04422585>

Submitted on 28 Jan 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Researching the use of old professional journals as a tool for infant education prospective teachers training

José M. Muñoz-Escolano and Antonio M. Oller-Marcén

Universidad de Zaragoza, Spain; oller@unizar.es

In the context of teacher training, it has been seen that use of original sources is an interesting tool in developing prospective teachers' professional knowledge. The existent literature is usually based on the use of mathematical texts or, at least, it focuses mostly on the mathematical aspects of the considered sources. In this work, we present the design of a research project in which, using some 1940s excerpts about elementary arithmetic coming from a Spanish journal called Escuela Española [Spanish School], we design and implement some activities with prospective infant education teachers. We also provide some initial results coming from the analysis of the prospective teachers' written productions. These results seem promising in order to determine the usefulness of this type of source material in a context of infant teacher training, and to understand the way in which our students interact with the mathematical and pedagogical aspects of a historical document.

Keywords: History of mathematics education, pedagogical journals, teacher training, infant education, MTSK.

Introduction and objectives

The use of original sources is a useful tool not only to be used with school students (Jahnke et al., 2000) but also with prospective mathematics teachers (Furinghetti, 2007). Even if many works on this topic deal with aspects that go beyond mathematical knowledge, like the way in which prospective teachers engage with a historical text (Guillemete & Radford, 2022), or the impact of working with original sources on teachers' classroom practice (Chorlay, 2022), we find that most of these works are usually centred on the mathematical aspects of the considered sources. However, Arnal-Bailera and Oller-Marcén (2020, p. 254) point out that “working with original sources that involve pedagogical content [...] might be an interesting line of research in the context of mathematics teacher training”. In this regard, we think that original sources involving a strong pedagogical content can be particularly useful in the training of infant and primary education teachers.

If we are interested in finding original sources containing both mathematical and pedagogical content, with an emphasis on the latter, old professional pedagogical journals immediately come to mind. Pedagogical journals played a very important role in the development of professional teacher associations (Krüger, 2017), which was a world-wide phenomenon (Schubring, 2015). Thus, prospective infant and primary education teachers may find professional journals closer to their own interests and to their future professional practice than a fragment coming from a mathematical text, even if it is a textbook. However, their use as a tool in a teacher-training context does not seem to have been explored yet.

Thus, the following general research question arises: Is it possible to use old professional pedagogical journals in a context of infant education teacher training in order to develop and improve their professional knowledge? The existent literature does not seem to have explored this question, and our

paper aims to give the first steps in that direction. In fact, the main goal of this work is to determine which elements of their professional knowledge are put into practice by prospective infant education teachers when they are asked to analyse and to reflect upon a fragment from an old Spanish professional journal. In order to do so, we have designed a sequence of activities based on such source and we have implemented them with a group of prospective infant education teachers. More particularly, in this communication we provide the main features of our research design, and we give some preliminary results coming from the analysis of a convenience sample of four participants.

Theoretical framework

In his work about teachers' professional knowledge, Shulman (1987) distinguished between subject content knowledge (CK), pedagogical content knowledge (PCK) and curricular knowledge (Shulman, 1987). Since then, different models have developed and adapted Shulman's ideas. In the case of mathematics, one of them is the so-called Mathematical Knowledge for Teaching (MKT) model developed by Ball et al. (2008), which restructures and specifies Shulman's three categories into six subdomains.

The MKT model has been extensively used in the general context of teacher training and it has proved to be useful as an analytical tool to determine which elements of professional knowledge prospective secondary teachers used when reading original sources (Arnal-Bailera & Oller-Marcén, 2020). However, there seem to be some limitations in the particular case of prospective early childhood teachers. Although there are studies that characterize the PCK of early childhood teachers (Lee, 2010), it has also been found (Mosvold et al., 2011) that the application of the MKT model (originally developed in a US school context) might present difficulties when applied in a context of infant education. These difficulties are sometimes derived from the fact that the different social and pedagogical tradition of the countries have an impact over teaching practices.

Based on the MKT model, Carrillo-Yáñez et al. (2018) propose an analytical model, the so-called Mathematics Teacher's Specialised Knowledge (MTSK). Among other features, this model strongly considers the specialized nature of teachers' mathematical knowledge, it leaves out general pedagogy and psychology, and it embraces the important role of beliefs. For these reasons, different recent studies have found this model to be particularly useful in an early childhood education context (Muñoz-Catalán et al., 2022). The MTSK model (Figure 1) distinguishes six subdomains of knowledge, divided between Mathematical Knowledge (MK) and Pedagogical Content Knowledge (PCK), and it also includes in its core another domain (Beliefs) related to the teachers' conceptions about mathematics, its teaching and learning that influences their knowledge in other domains.

Mathematical Knowledge domain is further divided into three subdomains: Knowledge of Topics (KoT), Knowledge of the Structure of Mathematics (KSM) and Knowledge of Practices in Mathematics (KPM). According to Carrillo et al. (2018), KoT "describes the *what* and *in what way* the mathematics teacher knows the topics they teach" (p. 242). It comprises a deep knowledge of mathematical topics, including definitions, properties and foundations, the phenomenology and applications of a concept, and the various registers of representation. KSM describes the teachers' knowledge of connections between concepts coming from different mathematical domains. Muñoz-Catalán et al. (2022) point out the presence of the first two connections in the knowledge of early

childhood teachers. Finally, KPM comprises mathematics teachers' knowledge about mathematical practice, about the work of constructing mathematics itself. It includes aspects such as mathematical communication, argumentation and reasoning, or using strategies to solve problems.

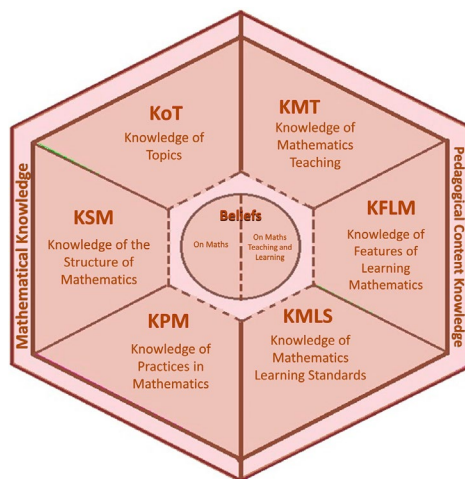


Figure 1: The MTSK model (Carrillo et al., 2018, p. 241)

On the other hand, Pedagogical Content Knowledge domain is also divided into three subdomains: Knowledge of Mathematics Teaching (KMT), Knowledge of the Features of Learning Mathematics (KFLM) and Knowledge of Mathematics Learning Standards (KMLS). KMT comprises specific knowledge that relates to the teaching of mathematics. It integrates personal or institutional knowledge of theories of mathematics teaching, limitations and potentialities of the physical or digital manipulatives for teaching; and strategies, techniques, tasks, examples and metaphors that are useful for teaching mathematics. KFLM covers knowledge associated with the inherent characteristics of learning mathematics, focusing on the mathematical content rather than on a specific learner. It considers knowledge about the theories of mathematical learning that allow understanding the process followed in developing understanding of different content; knowing the errors, difficulties or obstacles that students face when learning a particular content; perceiving different ways in which students interact with mathematical content; and identifying and being aware of the emotional aspects involved in learning mathematics. Finally, KMLS is the knowledge of what mathematical content is taught at a particular level and what the learner should achieve, together with what he/she has studied previously and what he/she should achieve at later levels.

Methods

Choice of the source material

We selected two fragments from the journal *Escuela Española* [Spanish School]. This weekly journal was founded in 1941 (Figure 2, left), and it “had a wide number of readers among primary education teachers” (Hernández Díaz, 2021, p. 39). The journal included book reviews, information about public examinations, papers on general pedagogy, and examples of teaching sequences for different subjects, etc. The selected fragments originally appeared in the issue 437 from September 1949. They described in detail a sort of teaching sequence dealing with elementary aspects of arithmetic. The first one was originally supposed to be implemented with 5–6 years old pupils, while the second one was

conceived for 6–7 years old pupils (Figure 2, right). Both of them included the reading and writing of numbers from 1 to 9, their interpretation as cardinals and ordinals, and basic ideas related to addition and subtraction (including easy verbal problems).



Figure 2: Cover of the first issue of *Escuela Española*, and one of the selected fragments

In conclusion, this source material was relevant and potentially useful for promoting professional knowledge of Spanish infant education prospective teachers due to different reasons. It is historically important; it reflects the state of the actual teaching of arithmetic in Spain at that time; it deals with topics that are still covered in today’s Spanish curriculum for pupils of the same age, and it involves both mathematical and pedagogical content.

Design and description of the activities

The experience consisted of a sequence of three different activities. These activities were designed in such a way that the participants would have to work individually and in group, and they would also have to interact and engage in discussions with other participants and with the teachers of the subject.

1. In the first activity, the participants were given a 3 pages dossier that contained a brief introduction providing some contextual and historical background (page 1) as well as a reproduction of the selected fragments (pages 2 and 3). Then, they were explicitly asked to globally analyse the fragments from the point of view of a teacher’s professional practice. This analysis had to be carried out individually.
2. The second activity involved working in groups. Each group was required to analyse an excerpt of one of the fragments at a more microscopic level. To do so, they had to answer a set of three questions directly related to the content of the relevant excerpt.
3. The third activity took place in the classroom. Each group had to give a short presentation based on their work on the previous activity. This presentation was followed up by a short discussion with their fellow participants and with the teachers of the subject.

Participants and context

The experience was carried out with 119 students (8 males and 111 females) from the Degree on Infant Education at the University of Zaragoza (Spain) during the fall semester of the academic year 2020–2021, within the context of the subject Didactics of Mathematics. This is a sophomore year basic training subject with a teaching load of 6 ECTS credits (60 hours), which constitutes the only training specifically related to Mathematics Education that future infant education teachers receive at this university. The subject covers some generalities about the teaching of Mathematics in Infant Education (0–6 years) and then proceeds to focus on four main topics: logical-mathematical abilities, numbers, magnitudes and measure, and geometry and spatial organization. The designed activities were implemented just after the topic “Numbers in Infant Education” had been covered. Thus, we assume that the participants had sufficient relevant theoretical knowledge related to mathematics education. In addition, the prospective teachers should also have at this point general pedagogical knowledge acquired in other basic training subjects related to developmental psychology, sociology and history of education, etc.

For this paper we selected 4 students (3 females and 1 male) who were the members of the same group. In fact, the teaching methodology in this subject included regular work in groups, and these students had been working together during all the semester. The students had different levels of performance, according to their instructor’s perception.

Data collection and analysis

We collected data by different means. In particular, our sources of information were the following.

- The participants’ written productions arising from their individual work in the first activity.
- The groups’ written productions, that were the output of the work in groups during the second activity.
- The short presentations given by each group, as well as the interactions that took place after them, were video recorded.

Our analysis of the participants’ written productions was essentially qualitative. In fact, according to our research objectives, we adopted a descriptive and interpretive approach. Our main analytical tool was based on the MTSK model and in this work, we do not address the domain of beliefs. Carrillo-Yáñez et al. (2018) provide categories and indicators for each of the different subdomains of knowledge that shape their model (see Table 1 for some examples).

Some results

In the four individual productions that we have analysed, we have been able to identify the six subdomains of knowledge of MTSK. However, the presence of some of them is very limited, and it is deemed anecdotal. For example, we have found just one mention to KSM and one mention to KPM. In addition, the KFLM domain appears rather infrequently, and usually related to the pupils’ emotional aspects. On the other hand, the KMLS domain is present in the four participants’ productions, but only in one of them in a significant way (five times in less than two pages). The more frequent subdomains are KMT and KoT, in this order.

The references to KoT are generally related to the sole description of the topics covered in the source (definition of ordinal and cardinal number, registers of representation of numbers and operations, and related procedures). On the other hand, the references to KMT are mainly related to the use of resources (either to describe the ones in the source or to propose alternatives), or to aspects related to the design of activities and, in particular, to the sequencing of tasks.

Two of the four students were able to articulate more than two MTSK subdomains in a single judgment in their work. Usually these were KoT, KMT, and KFLM, as in the example in Table 1.

Table 1: Example of articulation on subdomains in a participant’s production

	Domains	Indicators (Carrillo-Yáñez et al., 2018)
“... <i>The second and third activities are didactic situations of tracing and recognition of numbers and symbols such as subtraction, plus and equal...</i> ”	KoT	Registers of representation
	KMT	Theories of mathematics teaching
<i>...the third activity also proposes to perform addition through problems, however these situations, despite being contextualized, the child does not have a material at his disposal to perform these operations...</i>	KMT	Teaching resources
<i>...Finally, the child must also complete some sentences which are decontextualized and in which numbers are worked in an abstract way without being able to have contact with any material, only pencil and paper”</i>	KMT	Teaching resources
	KFLM	Ways pupils interact with mathematical content

It has been rather surprising that only one of the participants made significant use of the institutional theoretical knowledge (of topics, teaching or learning) that they were supposed to have. However, as we will see, when they were explicitly required during the second activity, as a group, they put into practice some of that knowledge in their answer.

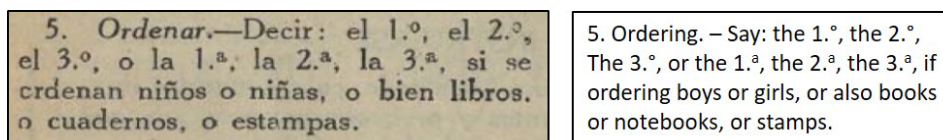


Figure 3: Excerpt for the group work (translation by the authors)

In their group work, these students had to reflect on the excerpt given in Figure 3. The excerpt gave the journal readers an example of an activity about ordering to be carried out with their pupils. The students were asked if this was indeed an activity about ordering, and not about counting or reciting the number sequence. Then, they were asked to outline a learning situation about ordering the cardinal numbers using stamps. Finally, they were asked to identify other places in the complete original fragment dealing with ordering and with the concepts of ‘greater than’ and ‘smaller than’.

The group answered successfully the three questions. They realized that the activity was not really about ordering, and they identified actual activities about ordering in other segments of the whole fragment. In this way, they showed theoretical knowledge related to KoT that was lacking in some of their individual productions. Moreover, when outlining their learning situation they made correct and significant use of technical terminology introduced in the subject. This is evidence of theoretical knowledge regarding KMT that was also lacking in some individual productions.

Finally, the interventions of this group during the third activity were quite KMT oriented. For example, after a presentation by another group, they asked them about how they would promote a more active role of pupils, and about the influence of the different mentioned manipulatives.

Final comments

Even if we have only analysed a very small sample of four students, the findings provide interesting ideas to guide the subsequent complete analysis that we are carrying out. We also think that the MTSK model can be more suitable than MKT in order to analyse infant education teachers' productions, because it pays more attention to the particularly specialized features of their professional knowledge.

We see that KoT and KMT are the most commonly present subdomains. This may be explained by the fact that we are working with prospective teachers lacking classroom experience. Another explanation might be related to the source itself. It essentially consists of a sequence of task that could bias the participants' analyses. We also observe shortages in theoretical knowledge in the individual written productions which was later covered in the group work. This suggests the importance of carefully choosing different sources, and designing the activities in order to promote the use of as many elements of their professional knowledge as possible.

Regarding the historical character of the source, only one of the four students made it clearly explicit in his individual production in relation to KMLS subdomain, which was not so present in the other participants' productions. Finally, we decided not to address the domain of beliefs in this work. Its central role in the model makes the presence of this domain rather difficult to assess, because it usually appears interlaced with some of the knowledge domains (Aguilar-González et al., 2018).

Acknowledgment

This research was carried out within the research group "Investigación en Educación Matemática".

References

- Aguilar-González, Á., Muñoz-Catalán, M. C., & Carrillo, J. (2018). An example of connections between the mathematics teacher's conceptions and specialised knowledge. *EURASIA Journal of Mathematics, Science and Technology Education*, 15(2), em1664. <https://doi.org/10.29333/ejmste/101598>
- Arnal-Bailera, A., & Oller-Marcén, A. M. (2020). Prospective secondary mathematics teachers read Clairaut: Professional knowledge and original sources. *Educational Studies in Mathematics*, 105(2), 237–259. <https://doi.org/10.1007/s10649-020-09988-7>
- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389–407. <https://doi.org/10.1177/0022487108324554>

- Carrillo-Yáñez, J., Climent, N., Montes, M., Contreras, L. C., Flores-Medrano, E., Escudero-Ávila, D., & Muñoz-Catalán, M. C. (2018). The mathematics teacher's specialised knowledge (MTSK) model. *Research in Mathematics Education*, 20(3), 236–253. <https://doi.org/10.1080/14794802.2018.1479981>
- Chorlay, R. (2022). From the historical text to the classroom session: Analysing the work of teachers-as-designers. *ZDM – Mathematics Education*, 54(7), 1583–1596. <https://doi.org/10.1007/s11858-022-01434-7>
- Furinghetti, F. (2007). Teacher education through the history of mathematics. *Educational Studies in Mathematics*, 66, 131–143. <https://doi.org/10.1007/s10649-006-9070-0>
- Guillemette, D., & Radford, L. (2022). History of mathematics in the context of mathematics teachers' education: A dialogical/ethical perspective. *ZDM – Mathematics Education*, 54(7), 1493–1505. <https://doi.org/10.1007/s11858-022-01437-4>
- Hernández Díaz, J. M. (2021). Revistas pedagógicas de divulgación en España [Pedagogical journals in Spain]. *Aula*, 27, 33–47.
- Jahnke, H. N., Arcavi, A., Barbin, E., Bekken, O., Furinghetti, F., El Idrissi, A., Silva da Silva, C. M., & Weeks, C. (2000). The use of original sources in the mathematics classroom. In J. Fauvel & J. van Maanen (Eds.), *History in mathematics education* (pp. 291–328). Kluwer. https://doi.org/10.1007/0-306-47220-1_9
- Krüger, J. (2017). Mathematische Liefhebberye (1754-1769) and Wiskundig Tijdschrift (1904-1921): Both journals for Dutch teachers of mathematics. In K. Bjarnadóttir, F. Furinghetti, M. Menghini, J. Prytz, & G. Schubring (Eds.), *“Dig where you stand” 4. Proceedings of the fourth international conference on the history of mathematics education* (pp. 175–188). Edizioni Nuova Cultura.
- Lee, J. (2010). Exploring kindergarten teachers' pedagogical content knowledge of mathematics. *International Journal of Early Childhood*, 42(1), 27–41. <https://doi.org/10.1007/s13158-010-0003-9>
- Mosvold, R., Bjuland, R., Fauskanger, J., & Jakobsen, A. (2011). Similar but different—investigating the use of MKT in a Norwegian kindergarten setting. In Pytlak, M., Rowland, T., & Swoboda, E. (Eds.), *Proceedings of the Seventh Congress of the European Society for Research in Mathematics Education* (pp. 1802–1811). University of Rzeszów.
- Muñoz-Catalán, M. C., Ramírez-García, M., Joglar-Prieto, N., & Carrillo-Yáñez, J. (2022). Early childhood teachers' specialised knowledge to promote algebraic thinking as from a task of additive decomposition. *Journal for the Study of Education and Development*, 45(1), 37–80. <https://doi.org/10.1080/02103702.2021.1946640>
- Schubring, G. (2015). The emergence of the profession of mathematics teachers – an international analysis of characteristic patterns. In K. Bjarnadóttir, F. Furinghetti, J. Prytz, & G. Schubring (Eds.), *“Dig where you stand” 3. Proceedings of the third international conference on the history of mathematics education* (pp. 355–368). Uppsala University.
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1–23. <https://doi.org/10.17763/haer.57.1.j463w79r56455411>