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Student Teachers Valued the Practices with Materials in the Subjects of Mathematics

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Abstract: This research study is based on the assessment undertaken by students enrolled at the Faculty of Primary School Education, who valued the usage of didactic materials in teaching mathematics. The students performed twelve practices during an academic year and at the end of the course a Likert scale questionnaire was applied rating two of the dimensions involved in the practices: the first one is the usefulness and teaching interest of practices and the second one is collaborative work. The results reveal that students value them as important in their training process and consider them as a valuable aspect for understanding the concepts. Furthermore, collaborative work during the mathematical practices with teaching materials is valued as important and useful because it emphasizes basic cognitive aspects for the transmission of information or knowledge.

Key words: mathematics, university education, initial teacher education, practical mathematics lessons

1. Introduction

When students enter university they have preconceived ideas about certain subjects. In particular, mathematics is idealized only for its formal component through laws, properties, theorems, etc., rather than its connections with the real world, its applications and history. Those who would like to teach mathematics (graduates, primary and preschool teachers) know that the transmission of formal or institutional knowledge to pupils requires a process of didactic transposition connected with informal but necessary aspects of mathematical learning processes.

2. Theoretical Framework

Comeaux (1991) and Sim (2006) have shown that knowledge about teaching, which student teachers posses, is influenced by their own experiences of learning during their time as pupils in the Primary and Secondary school. Therefore, it is necessary to provide them with learning experiences that they can use in their future teaching.

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In the scientific literature there are several examples of approaches and strategies that have been proposed to promote teaching mathematics. Among these is the adoption of new teaching methods and exploring a solution to a problem created in the classroom (Goodnough, 2010). In any case, new insights into the formation of teachers facilitate the realization of learning experiences which, based on collaboration between students, enable to connect with the everyday experience of teachers with proven good teaching practices (Cochran-Smith & Lytle, 2001; Goodnough, 2010; Loucks-Horsley, Love, Stiles, Mundry, & Hewson, 2003).

During a studying period to become an elementary math teacher, mathematical and didactic knowledge is acquired which will allow them to teach basic mathematics skills. This learning process is characterized by (García Sánchez, Escudero, & Llinares, 2006, p. 110):

- They appear through an active participation in a defined context by the authentic activities understood as common cultural practices;
- learning is based on developing a way to participate in a community of practice;
- activity makes full sense of prior knowledge and beliefs, placing the teacher and the student in the practice (his/her goals, needs, etc.) (Llinares, 2002), and
- participation in the activity may increase and/or modify the meaning of the usage of conceptual instruments.

These considerations make college programs of initial teacher training include among their objectives, the one emphasizing the importance for students to develop some of the didactic skills necessary for teaching. What means, acquisition of a specific didactic knowledge useful in future situations of teaching and learning (Llinares, 2009).

Moreover, in recent years collaborative work is promoted in the classrooms as an appropriate methodology for acquisition of certain skills. It is characterized by dependence of the members of the group while achieving their objectives, therefore there is a shared responsibility. It also forces participants to use and develop communication skills, symmetrical and reciprocal relations and the necessity for sharing the solution of the suggested tasks (Echazarreta, Prados, Poch & Soler, 2009), abilities every teacher should posses.

It is known that mathematical activities undertaken by teachers in the classroom mostly depend on what they know and believe about mathematics and what they understand about its teaching and learning process (Anthony & Walshaw, 2007). According to Jaworki (2004), teachers who are successful in teaching are those who help students make sense out of mathematics. However, it is often forgotten that the primary education teacher is not a mathematician but they must teach mathematics, therefore, they should have great knowledge of mathematics and be familiar with the process of teaching and learning it.

The fact that teachers are not adequately qualified in mathematics means that, in practice, those who are not specialists teach math to many pupils of Primary School, although the teaching of mathematics requires a good level of knowledge in that area (Drake, 2001). Some researchers have shown that teachers with limited mathematical knowledge focus on a narrow range of concepts and do not create connections between mathematical facts, concepts, structures and practices (Walsahaw, 2012).

In general, we can say that students have to master a variable domain of mathematical concepts and procedures of primary education (knowledge of school mathematics). The main issue is “how much” or “what kind” of mathematical knowledge is suitable for future teachers. Shulman (1986) points out that knowledge of the teacher should focus both on the adequate mastery of the discipline and on the teaching approach of their content.

The knowledge of the teaching approach of mathematical content provides the resources for a synthetic field of actions, thoughts, theories and principles in the classroom. The pedagogical knowledge of mathematics is essential for effective teaching and also influences the reactions of the teacher on the pupils' commitment in the classroom (Ball & Baas, 2000), which every teacher should gain through practical experiences during their teacher education.

These classroom practices can improve not only understanding of the mathematical content but also the interactions that occur between teacher and student. Therefore, during their initial teacher education, prepared activities should help future teachers acquire mathematical classroom teaching experiences related to school concepts they will use during their career as a teacher (Walsahaw, 2012).

A change of teaching practices in the classroom, in other words providing them with new learning experiences, may be essential for influencing and changing beliefs about mathematics of future teachers. Such experiences are mathematical practices using teaching materials and collaborative work. For that reason we propose a research based on practices performed by Primary School Teaching students.

3. Methodology

During the academic year 2012–2013 twelve mathematics classroom practices were completed, one hour per week, in the first semester of the primary education studies. The professors of mathematics responsible for supervising the whole process, agreed to use the same pattern in both scripts of work and methodology that students should accomplish in all four groups.

To conduct the experiments in the classroom, students were distributed in pairs or groups of three, according to the practice, and they received a script of activities containing the main issue they should work on, the materials they could use (colors, rods, logical blocks, geoboard, etc.), the recommended goals and instructional materials to be used.

As an example of the suggested practices students may use with their future pupils, we show the first part of one of them (Figures 1 and 2). Thus the future Elementary School teacher is facing a mathematical situation in which they should use the teaching materials and establish visual and non-formal mathematical patterns. This puts them in a situation similar to the one they will confront in the future while teaching and leading pupils in primary school. In the second part they must use the sieve of Eratosthenes to find prime numbers and be able to see the difference between teaching prime numbers in the intuitive and visual way as opposed to using multiplication tables (based on the concept of multiples). Students realize that the first way of teaching is more useful in the early grades, while the upper grades need the second one. All this is compatible with the cognitive development designed by Piaget.

Objectives:	**Materials:**
• Find and identify prime numbers • Find and identify what "factor of" means • Provide mathematical experiences through activities	*Cuisenaire* rods, crayons, paper.

Figure 1 Example of A Practice Header

1
Take a piece 4 cm long (pink), two pieces 2 cm long (red) and four pieces 1 cm long.
Put the 4 cm long piece on the table and two pieces 2 cm long under the table, like this:

4	
2	2

Continue downward putting the pieces 1 cm long.

		4	
	2		2
1	1	1	1

It is evident that the piece 4 cm long has the same length as two pieces each 2 cm long. Thus we say that 1, 2 and 4 are the factors of 4.

2
Now, start with a piece 5 cm long (yellow) and try to do the same thing as before. Draw what you have done. How many rows will you get? Remember that you cannot put pieces of different length in the same row. What are the factors of 5?

3
Repeat this process with numbers up to 12. Draw what you have done. Indicate in the table the factors of each number.

Figure 2 Example of One of the First Training Activities

4. Research Participants and the Study

The participants of this research are all first-year Primary School Teaching students of mathematics, 2012–2013, at the Faculty of Education Sciences of the University of Cordoba, Spain. 142 students, who responded to the test, took part in this study.

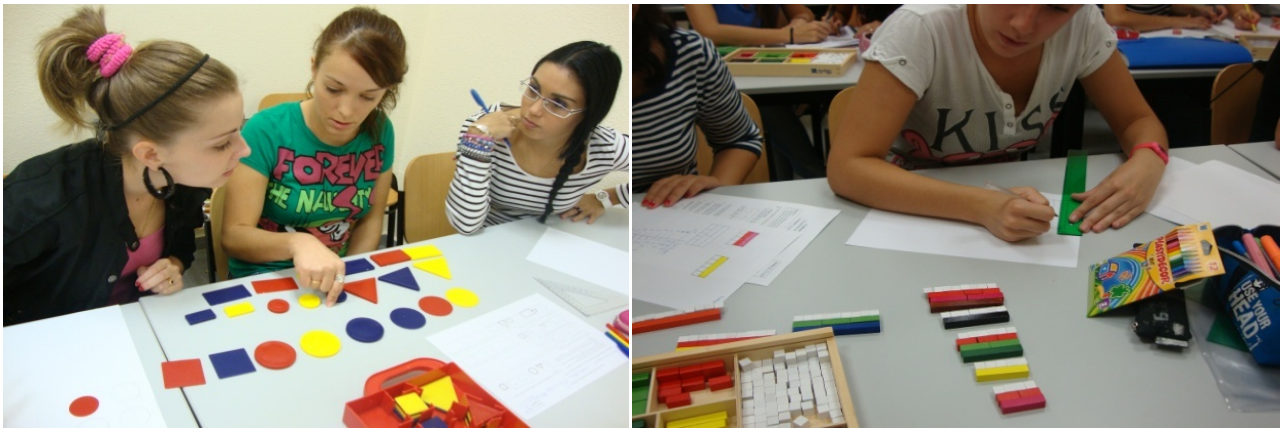


Figure 3 Primary School Teaching Students Teaching Mathematics Using Didactic Materials, During Their Training

5. Instrument

Students used a Likert scale to evaluate the quality of classroom practices carried out during the course. This scale was voluntarily completed by students in the last practice and contained 15 items, with the following options: strongly disagree = 1, disagree = 2, neutral (neither agree nor disagree) = 3, agree = 4, strongly agree = 5.

Validation of the questionnaire was performed by experts in teaching mathematics and conducted using a pilot test done by 30 students from the previous academic year. Analysis of the internal consistency to test

reliability of the scale was conducted using the Cronbach Alpha test obtaining a value of 0.811, considered as acceptable reliability index. The questionnaire classifies the items into two groups:

- Didactic interest and efficiency of mathematical practices using teaching materials: items 1–7
- Training and cooperative work: items 8–15

6. Results

For the first dimension, classroom practices using teaching materials were rated highly interesting and useful, because they allow better understanding of mathematical concepts which Primary School Teaching students should use in their future job (Table 1). Also, they had opportunity to learn, manipulate and use various teaching materials (rods, logic blocks, geoboard, abacus, strings, dominoes, etc) and were able to discover some of its potential uses and disadvantages.

Table 1 Evaluations of the Didactic Value and Utility of Practices

Question	Mean	Standard deviation	1 (F/%)	2 (F/%)	3 (F/%)	4 (F/%)	5 (F/%)
1. Practices helped you understand how to use didactic materials in teaching mathematics	4.28	.634	0	0	14/39.9	74/52.1	54/38.0
2. Practices with teaching materials helped you understand topics studied at university	4.16	.759	0	4/2.8	19/13.4	69/48.6	50/35.2
3. Didactic materials used in practices are suitable for your future teaching career	4.20	.819	1/0.7	3/2.7	21/14.6	59/41.5	58/40.8
4. Teaching materials used during the practices are appropriate and concise	4.24	.704	0	3/2.1	13/9.2	73/51.4	53/37.3
5. Teaching materials used during the practice helped you understand some mathematical concepts	4.06	.779	2/1.4	1/0.7	24/16.9	75/52.8	40/28.2
6. The use of teaching materials during the practice motivates and arouses interest for its realization	4.15	.836	1/0.7	3/2.1	24/16.9	60/42.3	54/38.0
7. The experience of using teaching materials in math practices was useful for my training as a teacher	4.15	.819	0	5/3.5	23/16.2	59/41.5	55/38.7

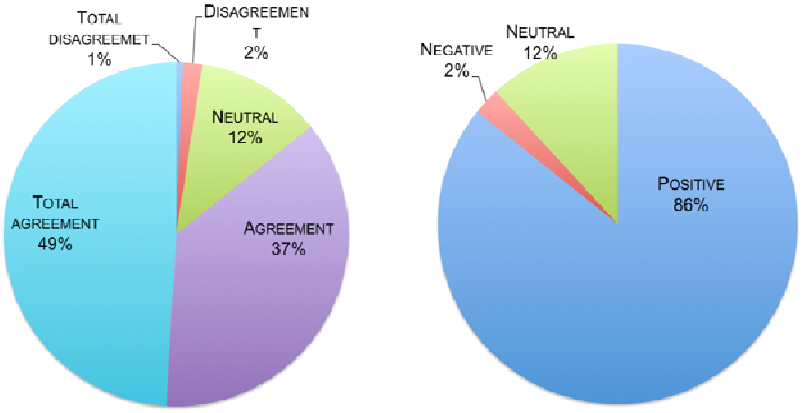
According to these evaluations the first question had the highest scoring average (4.28) and, globally, it received the highest number of positive responses (51.4%). Both questions refer to the understanding of concepts supported by the use of didactic materials. It is noteworthy that responses in this evaluation, who disagree or strongly disagree, have been only 2.2%, while the neutral responses represent 13.8%. This indicates that 84% of respondents considered positive practices with teaching materials.

In the second evaluation test, practices and cooperative work, the mean scores were better than those of the first evaluation (Table 2). This reveals that students are aware of the importance of collaborative work, the involvement of each member of the group practices and the exchange of ideas among them. It is precisely the question 9 which received the highest percentage of maximum score (70.4%). 10.03% of the answers to the questions were neutral and only 2.5 were negative, what means that the 87.47% of ratings are positive.

Table 2 Evaluations of Classroom Practices and Cooperative Work

Question	Mean	Standard deviation	1 (F/%)	2 (F/%)	3 (F/%)	4 (F/%)	5 (F/%)
8. Doing practices in pairs is good enough for its development	4.39	.891	2/1.4	4/2.8	15/10.6	36/25.4	85/59.9
9. Performing math manipulative practices in pairs facilitates the exchange of ideas and beliefs about mathematics	4.59	.755	1/0.7	4/2.8	5/3.5	32/22.5	100/70.4
10. Practices done in pairs require greater involvement and participation of the students for its development	4.30	.823	1/0.7	3/2.1	18/12.7	51/35.9	69/48.6
11. Practices encourage and facilitate teamwork	4.51	.660	0	1/0.7	10/7.0	47/33.1	84/59.2
12. Performing all practices with the same partner facilitates communication and collaboration	4.49	.857	1/0.7	4/2.8	16/11.3	24/16.9	97/68.3
13. The participation and cooperation of my partner(s) in practice has been adequate	4.51	.865	2/1.4	3/2.1	14/9.9	24/16.9	99/69.7
14. teamwork was important for the result of the evaluation of the practices	4.44	.729	1/0.7	0	14/9.9	48/33.8	79/55.6
15. The necessity of presenting the development of mathematical practices guide after class requires more teamwork	4.29	.804	1/0.7	1/0.7	22/15.5	50/35.2	68/47.9

On a global basis, students rated highly positive the practices performed using teaching materials because it enabled them to identify and understand mathematical concepts through processes of induction and deduction in situations and through tasks they confronted (Figure 4).



(a) (b)

Figure 4 Skills Rating Scale (a) and Total Score of the Scale of Positive-Negative Attitudes (b)

6. Conclusion

It is evident that Primary School Teaching students consider using teaching materials during math practices as a useful technique. They think that it allows an understanding of the concepts beyond their formal structure.

Collaborative work is favored and promoted during math practices with didactic materials and students are aware of it and they value it positively.

Such practices help the development of mathematical skills needed in the future. It makes students able to conduct learning processes once they become math teachers. It is important to investigate the students' attitudes (at all levels) when they are informed about different strategies they should use in the classroom.

References

Anthony G. and Walshaw M. (2007). *Effective Pedagogy in Methematics/Pângarau: Best Evidence Synthesis Iteration*, Wellington: Learning Media.

Cochran-Smith M. and Lytle S. L. (2001). "Beyond certainty: Taking an inquiry stance on practice", in: A. Liberman & L. Miller (Eds.), *Teachers Caught in the Action: Professional Development that Matters*, New York: Teachers College Press, pp. 45–58.

Comeaux M. (1991). "But is it teaching? The use of collaborative learning in teacher education", in: B. Tabachnick & K. Zeichner (Eds.), *Issues and Practices in Inquiry Oriented Teacher Education*, London: Falmer, pp. 151–165.

Drake P. (2001). "Mathematics and all that: Who teaches the number stuff?", *Active Learning in Higher Educational Researcher*, Vol. 2, No. 1, pp. 46–52.

Echazarreta C., Prados F., Poch J. and Soler J. (2009). "The competence 'The collaborative work': An opportunity to incorporate ICT in university teaching", Description experience with AGME (UdG) platform, UOC Papers: *Journal on the Knowledge Society*, Vol. 8, available online at: http://www.uoc.edu/uocpapers/8/dt/esp/echazarreta_prados_poch_soler.pdf.

García M., Sánchez V., Escudero I. and Llinares S. (2006). "The dialectic relationship between research and practice in mathematics teacher education", *Journal of Mathematics Teacher Education*, No. 9, pp. 109–128, doi: 10.1007/s10857-006-0003-8.

Goodnough K. (2010). "Teacher learning and collaborative action research: Generating a 'Knowledge-of-Practice' in the context of science education", *Journal Science Teacher Education*, No. 21, pp. 917–935, doi: 10.1007/s10972-010-9215-y.

Jaworski B. (2004). "Grappling with dcomplexity: Co-learning in inquiry communities in mathematics teaching development", in: M. J. Hoines & A. B. Fuglestad (Eds.), *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education*, Vol. 1, pp. 17–36, Bergen: PME.

Loucks-Horsley S., Love N., Stiles K. E., Mundry S. and Hewson P. W. (2003). *Designing Professional Development for Teachers of Science and Mathematics*, Thousand Oaks, CA: Corwin Press.

Llinares S. (2009). "Competencias del maestro en la docenciaenmatemáticas y el diseño de programas de formación", *Uno Revista de Didáctica de lasmatemáticas*, Vol. 51, pp. 92–101.

Llinares S. (2002). "Participation and reification in learning to teach: The role of Knowledge and beliefs", in: G. C. Leder, E. Pehkonen & G. Torner (Eds.), *Beliefs: A Hidden Variable in Mathematics Education?* Dordrech: Kluwer Academic, pp. 195–209.

Sim C. (2006). "Preparing for professional experiences—Incorporating pre-services teachers as 'communities of practice'", *Teaching and Teacher Education*, Vol. 22, pp. 77–83, doi: 10.1016/j.tate.2005.07.006.

Shulman L. (1986). "Those who understand: Knowledge growth in teaching", *Educational Researcher*, Vol. 15, pp. 4–14.

Walsahaw M. (2012). "Teacher knowledge as fundamental to effective teaching practice", *Journal of Mathematics Teacher Education*, Vol. 12, pp. 181–185, doi: 10.1007/s10857-012-9217-0.