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The Importance of Experience with Children in the Professional Training of Primary School Teachers

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Abstract. The research literature has comprehensively demonstrated that teacher training must include the analysis of subject-specific teaching proposals, tools and methods for the transition from knowledge to competence to occur, and for the future teacher to know how to create learning environments in which students' personal involvement is as valuable as their mastery of different subjects. The model that integrates the Metacultural, Experiential, Planning and Situated modalities, and which has been studied and tested over the past two decades within the Physics Education course at the University of Udine's 5-year Master's degree for prospective primary teachers, has proven its worth in the transition of subject appropriation from knowledge to competence. This then enables those who will become teachers to create learning environments in which there is effective personal involvement of learners. In this model, the Situated phase – which involves the implementation in classrooms of pathways designed by prospective teachers – plays an important role both for the in-training or in-service teacher and for introducing research-based instructional innovation and materials into schools. The model envisions an in-school micro-apprenticeship in science education, in this case Physics, capable of producing school-university links and collaborations on two levels: firstly, the sharing of trainee teacher skills assessments and, secondly, the contribution of educational innovation and professional development of in-service teachers from the research-based teaching paths and materials. Situated learning, produced by field experiences carried out in the classroom and by the monitoring and analysis of children's learning pathways and outcomes, allows for the consolidation of professional competence which is complemented with the reflection and evaluation of the entire training path taken by future

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teachers. Responsibility for the implementation and evaluation of Teaching Intervention Modules (TIMs) in the context of the Physics Education Course has produced a new model of institutional collaboration between university and school. In this model, triangulation between the Course, Laboratory and Internship is created, an integration that is achieved through innovative models of teaching interventions based on educational research into science education in primary school. Moreover, this approach has encouraged the integration of the professionalism of the experienced teacher with that of the teacher-in-training. This paper analyses the impact on schools of teaching interventions involving 360 in-service teachers and an equal number of trainee teachers over three years.

Key words. Situated learning, teacher training, innovative teaching interventions.

1. Introduction. The training of future primary school teachers includes new challenges compared to the past, one of which is the building of competence in science education that is capable of combining basic disciplinary knowledge with didactics, so as to also gain transverse professionalism (Michelini 2004). The Physics Education course (henceforth PEC) at the University of Udine's 5-year Master's degree course in Primary Education Sciences (henceforth PES) has, since 2000, been studying tools, methods and models in a research experiment, bringing together and integrating multiple educational models (Michelini 2015). The integration of lectures, discussions of teaching paths, workshops for analysis and reflection on the teaching of specific contents, and direct action with children are distinctive features of the Master's degree course. This course, which finds fertile examples for students in many fields of knowledge in internships, requires particular support for science education, because experiences of active science teaching that can be taken as a reference are rare in school. Therefore, specific moments have been designed in which students are asked to reframe their educational and disciplinary knowledge to design micro-interventions with children and to monitor their learning.

2. Pre-service teacher education and training. The building and development of teaching professionalism are fundamental aspects in education (Elbaz 1983). Closely related to these, are student learning, the renewal of the acted curriculum, and the introduction of innovation in teaching (Calderhead 1996, Borko and Putnam 1996, Park and Oliver 2008). These elements have driven increased educational research interest in teacher education over the past two decades (Michelini 2004, Taşar and Çakmakcı 2010, Cassan and Michelini 2010). Surveys conducted internationally have shown worrying educational deficiencies in students, particularly in the area of science (IJSE 2011, OECD 2007, Holbrook and Rannikmäe 2001) and have identified, as an essential element for improvement, the upgrading of science teaching to teaching/learning models that manifest evidence of effectiveness. Science education cannot be resolved with information or the simple narration of research results, but must be the site of meta-reflection, in which tools and methods of science are known and recognised (Fensham 2001, Hesteness 2007, Viennot 2008, Michelini 2010).

Science education must be improved with organic experiences that can be reasoned over, and with laboratories that allow people to explore phenomena with their senses, with their brains, and with sensors and instruments as extensions of their senses. Therefore, it is crucial to start science education very early on, with trained teachers from the earliest school levels (Buckberger et al. 2000, Michelini 2004).

3. Physics Education in Udine. In the 56 hours of the PEC within the Master's degree course in PES, to which 10 hours of laboratory work should be added, various physics topics are addressed – for each of which the concepts, conceptual cores, content structure and operational and problematic contents are discussed – through disciplinary training, the proposed teaching path for preschools and elementary schools and laboratory activities, which each year sees the involvement of 150 students attending the third year of the degree course in PES.

On the theoretical design of the Model of Educational Reconstruction MER (Duit 2006), the MEPS training model in the PT course implies the integration of the Metacultural, Experiential, Planning and Situated (PCK[1] in action) teacher training models. Personal involvement of PES students on conceptual cores (PCK test), multi-perspective individual and group reflection, design and testing of teaching paths, and the documentation and discussion/analysis of learning, have proven to be indispensable conditions for success of professional development that reinforces partial skills (Davis 2009, Michelini 2013), integrating them on multiple levels. Specifically, the Cultural model involves discussion on disciplinary, didactic and pedagogical plans, while the Experiential and Planning models involve (through tutorials) personal experimentation with teaching proposals to reflect on conceptual cores, to recognise the characteristics of coherent pathways that promote children's reasoning and involvement in the learning process, and to design and construct activities based on problematisation *(Inquiry Based Learning)*. In the Situated model, which is based on teaching intervention (Teaching Intervention Modules) and reflection on action, meta-reflection on educational practices is activated.

[1] PCK is the acronym for "Pedagogical Content Knowledge".

4. The research. In the context of the PEC and Laboratory of the Master's degree programme in PES, a research study of the whole process of training and implementation in schools in the area of intervention has been set up as a contribution to a joint project with the school. The overall study includes these elements, set out as research questions:

a) the role of individual training stages according to the MEPS theoretical model;
b) the gathering of difficulties at each stage of the training process for the achievement of teaching professionalism in science teaching;
c) the role of the PES student's field experience in changing the perspective from instructional to operational;
d) the contribution the school makes in relation to the experience of trained interventions;
e) the management characteristics of the school-university collaboration model;
f) the impact of the experience on teacher training and school-university collaboration.

5. Stages of implementation of the Teaching Intervention Modules (TIMs). The stages of conducting the TIMs for preparation of classroom interventions are:

a) focusing attention on preparing interventions on the topic;
b) study of the disciplinary content pertaining to this topic;
c) reconstruction, for teaching purposes, of the foundational and conceptual cores related to the topic;
d) analysis of teaching proposals, exploration of teaching materials prepared and already tested with children as workshop activities;
e) individual design of a two-hour TIM;
f) group work to compare designs by school level;
g) critical discussion of an emblematic design with the lecturer from the disciplinary education course and the internship supervisor co-responsible for the project;
h) design review based on:
   – critical observations of the lecturers and primary education students involved;
   – content proposals received from schools interested in the activity;
   – experimental explorations and materials needed for the teaching intervention
i) public presentation and advocacy of their project by students before the intervention in class, for a detailed evaluation of the planned activity;
l) implementation and monitoring of the educational intervention;
m) drafting of the project documentation and analysis of the learning data collected.

6. Situated Learning: research questions. This paper focuses specifically on the study of the Situated phase in terms of the prospective primary teacher's professional gain, impact on the school and connection with the local area, through the following research questions:

RQ1) how were the TIMs evaluated by the school?
RQ2) how do the design and implementation of TIMs and the in-school experience contribute to the professional preparation of future teachers?
RQ3) how does the classroom implementation of the TIMs contribute to the school?

7. Outcomes of data analysis

7.1. RQ1: how were the TIMs evaluated by the school?

The answer to the first question (RQ1) emerges from the return of the questionnaire that had been administered to 360 in-service teachers. These were intended to collect data that were then analysed for three consecutive years regarding TIMs on three topics: astronomy, energy and sound. The questionnaire was divided into five sections, with a total of 14 questions, which asked in-service teachers to assess the TIM, the validity of the materials, the time management, the degree of satisfaction and the impact on teaching. The assessment was based on a score from 1 to 5, where 5 carried the highest value. The questionnaire had an 80% response rate and provided results in terms of host teachers' satisfaction with the TIMs.

The data highlight the great value attributed to experience by the in-service teachers who were asked to express their opinions on the aspects presented below.

Regarding student preparation, the in-service teachers recognised: clarity, consistency and motivation skills (Fig. 1).

In relation to the setting of the TIM, referring to the student, the evaluation shows high approval for the laboratory approach, the way in which they were designed and proposed, as well as for the appropriate use of specific language and attention to the stimuli coming from the learners (Fig. 2).

The evaluation of the materials – in terms of richness, validity and content support – was very high (Fig. 3).

The open and flexible approach of the TIMs was experienced as a novelty, where interaction between different school disciplines became productive, and has been accepted by schools as an innovative element that can be effectively reused in teaching (Fig. 4).

The results underscore in-service teachers' appreciation for a work model, characteristic of TIMs, in which the transmissive style of addressing content is replaced with an operational method (Inquiry Based Learning, IBL).

For the impact on teaching, in-service teachers recognise the quality of the teaching interventions and have asked to repeat the experience; however, they are also willing to return to offer activities and content themselves (Fig. 5).

7.2. RQ2: How do the design and implementation of teaching intervention modules and the in-school experience contribute to the professional preparation of future teachers?

The design and implementation of the TIMs and the in-school experience provide gains in professionalism. In

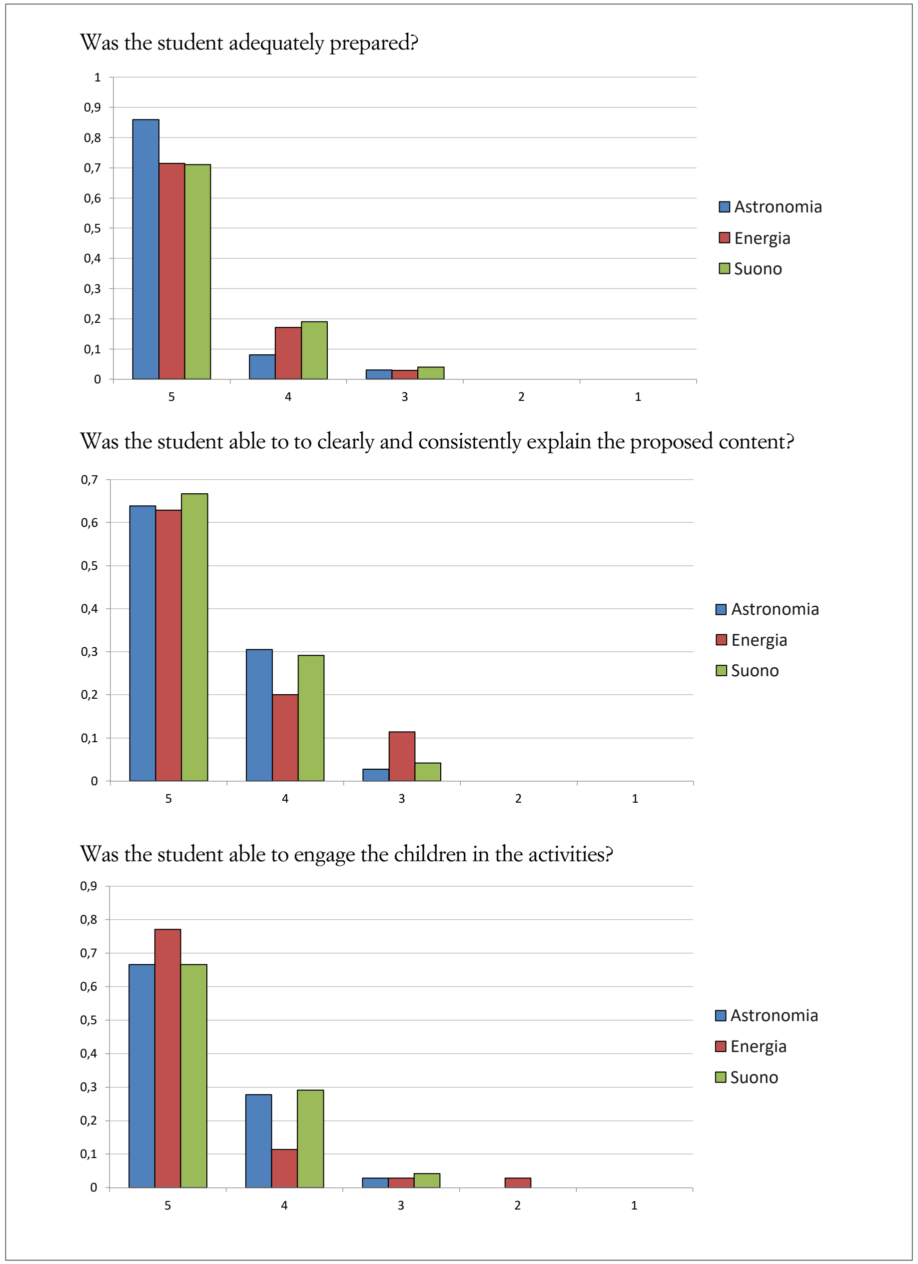

Figure 1. Distribution of responses to questions Q1, Q2 and Q3. Results (in terms of the satisfaction among the in-service teachers who received students) on the preparation, clarity and consistency, and ability to motivate demonstrated by the prospective teachers

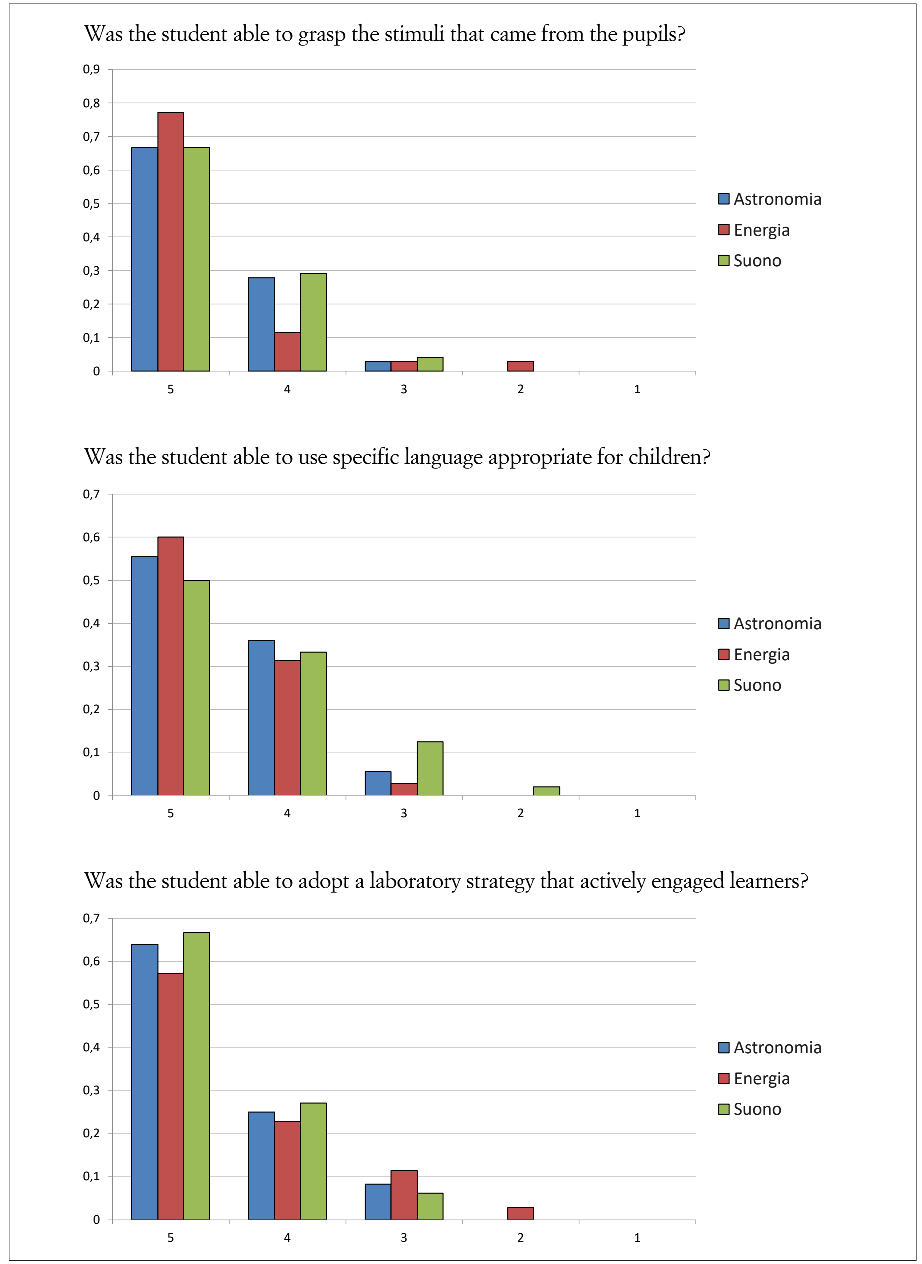

Figure 2. Distribution of responses to questions Q4, Q5 and Q6. Results (in terms of the satisfaction among in-service teachers who received students) on the setting of the Teaching Intervention Modules.

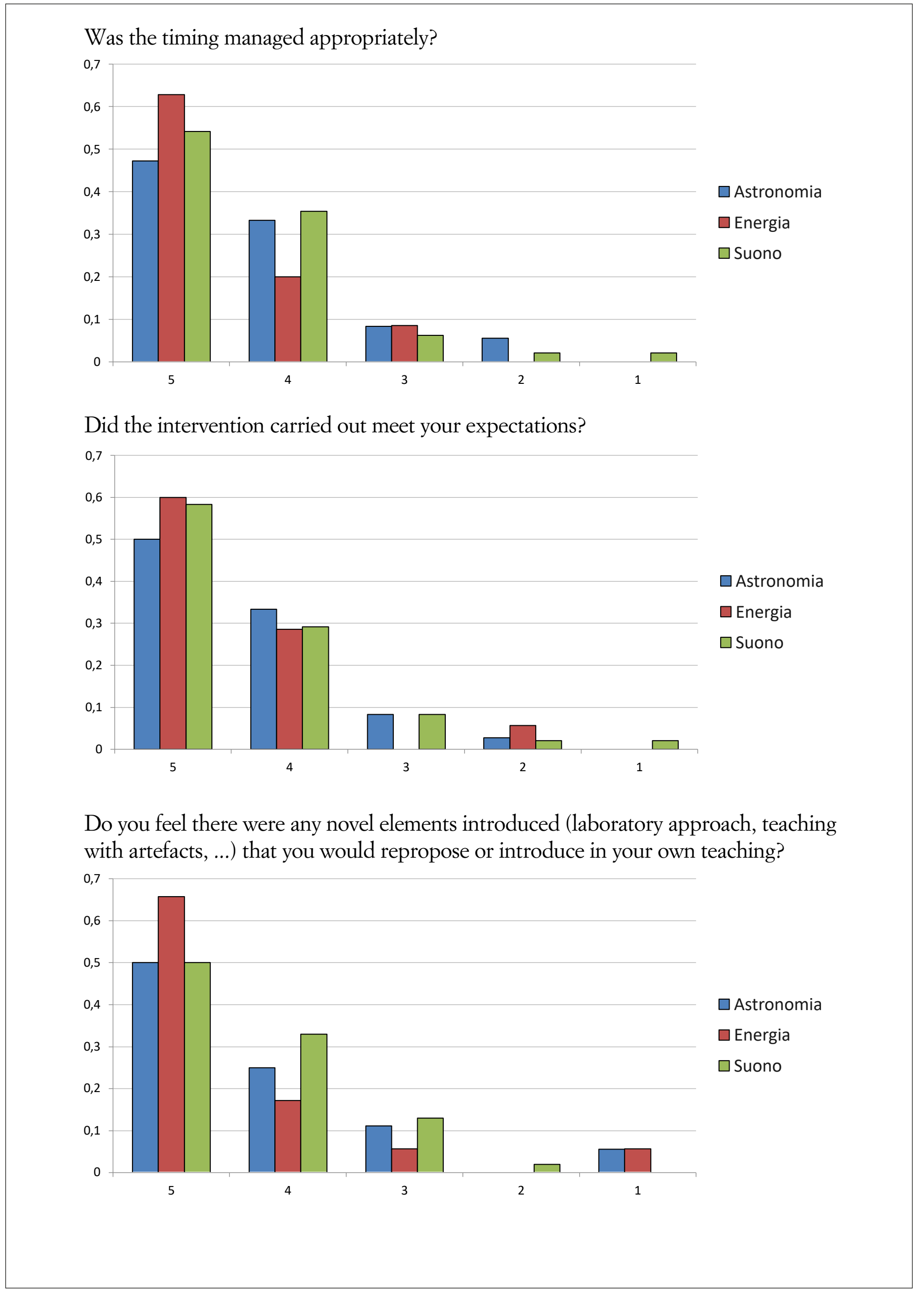

Figure 3. Distribution of responses to questions Q7, Q8 and Q9. Results on the evaluation of materials used by in-service teachers who received students.

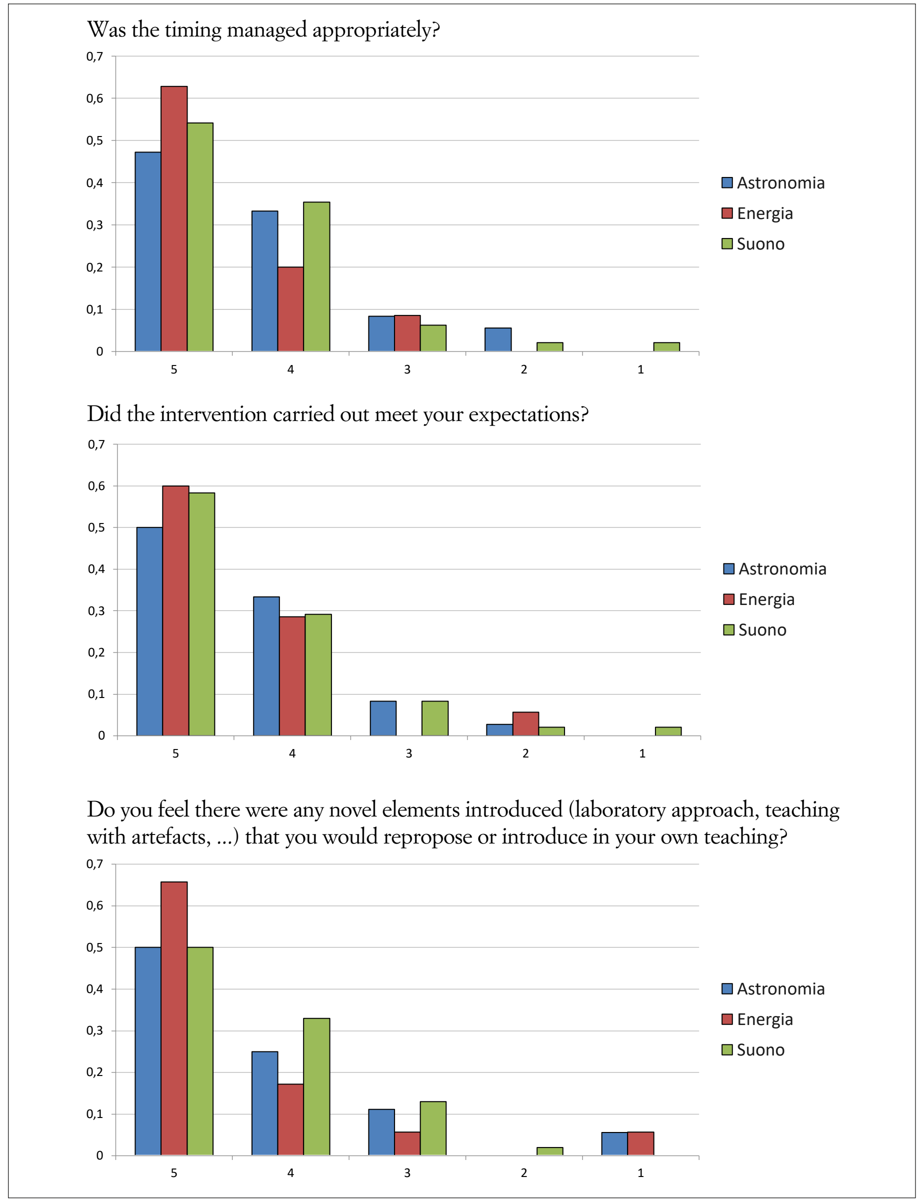

Figure 4. Distribution of responses to questions Q10, Q11 and Q12. Results (in terms of the satisfaction among in-service teachers who received students) on time management and how well the intervention implemented met expectations, and results on the willingness of in-service teachers who received students to repropose and introduce into their own teaching the novel elements proposed in the TIMs.

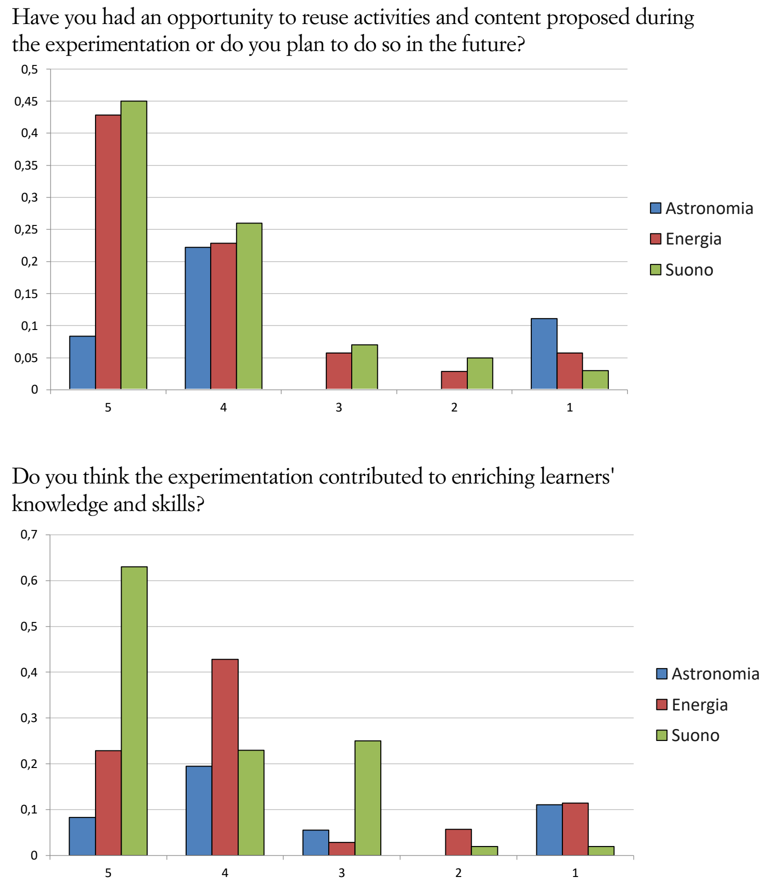

Figure 5. Distribution of responses to questions Q13 and Q14. Results on the willingness of in-service teachers who received students to repropose activities and contents proposed in the TIMs and results on the evaluation of the impact on teaching by in-service teachers who received students.

this school-based experience, the role of the in-service teacher proved to be crucial, as they were able to accompany and make welcome the in-training student and to recognise the quality of the project, both in innovation and operational terms with respect to strategies, methods and materials. Mutual acquisition of professional skills with a positive

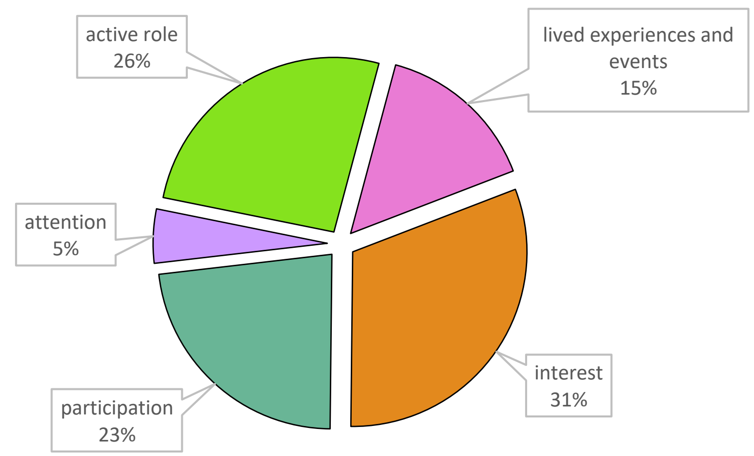

Figure 6. Aspects deemed most valuable throughout the situated experience.

impact on student learning was seen. If we compare the students who carried out the project in class with those who did not, we see that the former presented a focused project in which curated, rich and quality materials had been prepared for the activity. They had also developed good skills in data analysis and the monitoring of children's learning, demonstrating the ability to reflect on design and implementation. The latter submitted generic projects, prepared incomplete or excessive materials, and found it difficult to design monitoring tools.

The data show that skills acquisition comes from classroom implementation of the designed proposal and the related monitoring of children's learning. PES students have learned to look at many aspects concerning children's learning (see Figures 6, 7, 8 and 9).

Classroom experimentation with a designed proposal and the monitoring of children's learning after going through this process, contribute to a meta-reflection that results in professional growth.

7.3. RQ3: How does the classroom implementation of the TIMs contribute to the school?

The analysis of the collected data, as well as a consideration of the participants' experiences during the course, the workshops and the work in schools, allows us to affirm that the classroom implementation of the TIMs contributes to the school through the training of students in

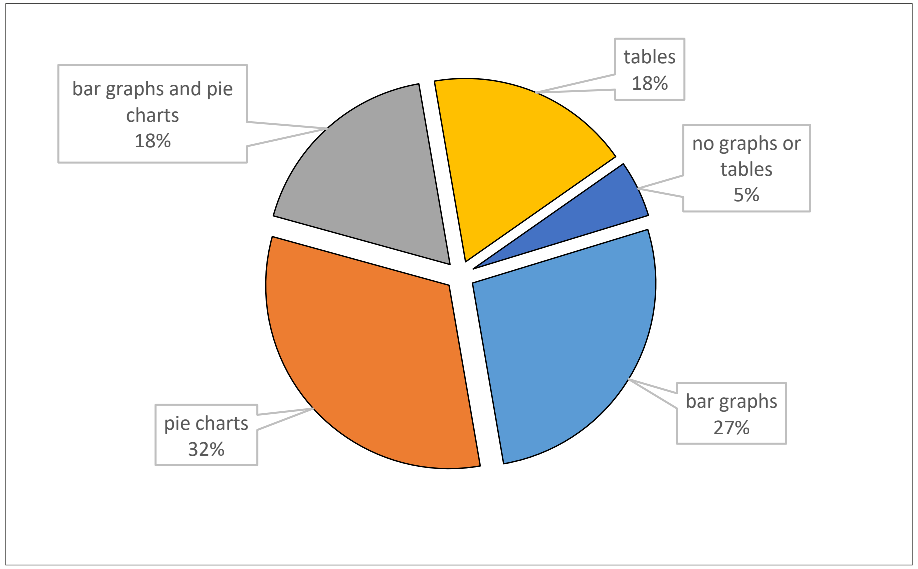

Figure 7. Tools used by prospective teachers to represent learning data.

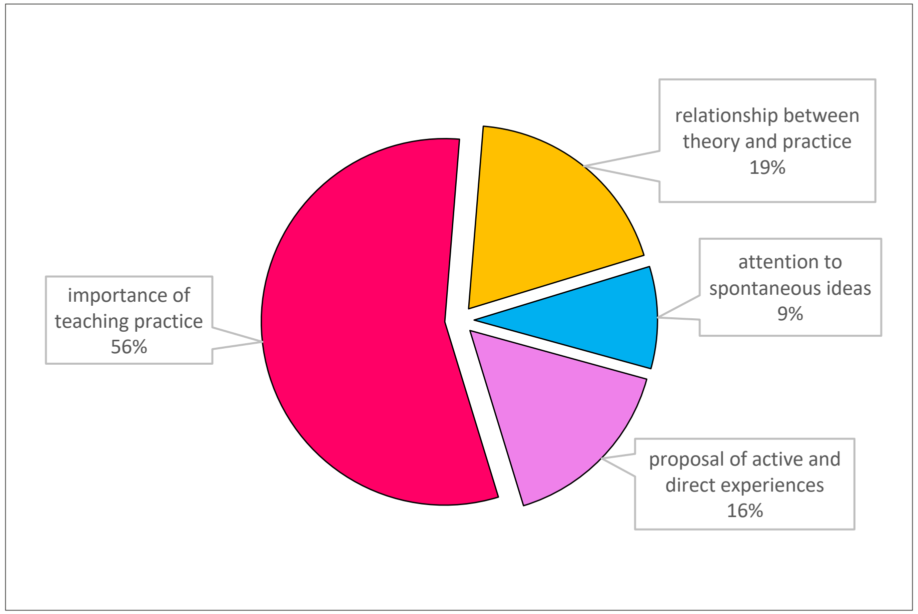

Figure 8. Important aspects with respect to meta-reflection.

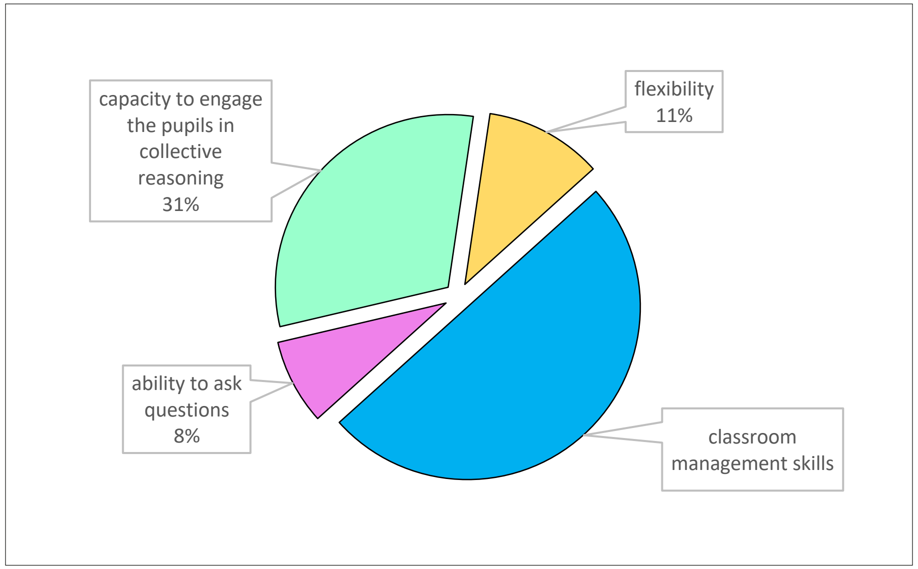

Figure 9. Important aspects in the acquisition of professional skills.

the implementation of teaching interventions in the field of science based on the laboratory method, and with the development of competence in creating learning environments with Inquiry Based Learning (IBL) methodologies. It also contributes through the development of innovative proposals for science education in schools, the study of how to integrate expert teacher (the host teacher) expertise with that acquired by the prospective primary teacher, and the contribution of research-based university experience to the professional development of in-service teachers and the qualitative improvement of science learning in primary school.

8. Conclusions. Innovative aspects of the Teaching Intervention Modules are their transversality, laboratory-based format, reference to research in teaching, and school-university collaboration. The cross-curricular and open educational model becomes a novelty and a desire for interaction between different "school subjects". If you are going to make culture transversal, you have to start from a culture that is formed transversally. The teaching model is characterised by the integration of the informal education typical of the GEI[2] (Games, Experiments, Ideas) exhibition learning environment with (formal) activities carried

[2] GEI is the acronym for *Giochi, Esperimenti, Idee*.

out at school. It proposes using experimental strategies, materials and work tools that can follow and adapt to the needs of in-training teachers. Especially innovative is the inclusion in training of observation and research phases in conducting Conceptual Labs of Operative Exploration (CLOE) of a model that we have defined. Educational research and the initiation of pupils into a scientific approach to the phenomena explored, constitute the reference point of the project in terms of its theoretical framework, the materials used, the strategies and methods employed, and finally because the course design and materials used throughout the course will be subject to research monitoring and analysis. This approach represents a proposal for experimental models of institutional collaboration between university and school in the context of initial primary teacher education.

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