Chilean standards and identified gaps in teacher training in primary education with a specialisation in mathematics

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ABSTRACT

The aim of this research was to find out the existing gaps between the current educational model of a specific degree course in Primary Education in Chile and the new pedagogical and disciplinary standards established by the Ministry of Education. To address this objective, a university located in the city of Santiago of Chile with a degree in Primary Education with a major in mathematics was considered. The data were collected from the pedagogical and disciplinary standards for the degree course in Primary Education, from the graduate profile of this degree course and from the syllabuses of the subjects of this degree course that are linked to the area of mathematics. The results show that the curricular design is aligned with the guiding standards for graduates in Primary Education. However, there was not the same congruence between what is indicated in the graduate profile and in the subject programmes with the disciplinary standards. Among the conclusions, it is found that the training of the Primary Education teacher is not deepened precisely in the area of mathematics.

Keywords: Gaps, pedagogical and disciplinary standards, Pedagogy in Primary Education, Learning outcomes.

1. INTRODUCTION

Worldwide, different educational models have been constructed from different theoretical perspectives to generate knowledge structures for higher education. To mention a few examples, in the 1970s the Human Capital Theory was important to carry out the construction of this type of models, being this importance reflected in research such as those carried out by Calderón [1] and Labraña, Bruner and Álvarez [2]. This theory was clearly predominant at the time and showed how it was possible to locate knowledge in higher education [3] and, specifically, in initial teacher education. This theory was optimistic about the development of society, with a focus on content knowledge that considered the subject as responsible for its productivity. Subsequently, in the 1980s, initial teacher training in higher education institutions began to be related to competency-based educational models, with the aim of training professionals who were competent in their environment [4]. In this context, many Chilean universities are currently implementing models based on a competency-based approach for teaching degrees in Primary Education [5].

For this research it is of interest to know what happens in Chile in the year 2023, where there is the National Diagnostic Evaluation of Initial Teacher Training (END, for its acronym in Spanish), which is designed based on pedagogical and disciplinary standards established by the Ministry of Education (MINEDUC, for its acronym in Spanish) and is applied to students of Pedagogy careers. The results of this assessment show the resulting gaps with respect to the guiding standards for teacher training, which correspond to the disciplinary and pedagogical knowledge base that education professionals are expected to have once they have completed their initial training [6]. The END assessment consists of two tests: a test of general pedagogical knowledge and a test of disciplinary and didactic knowledge, and the subjects to be assessed are specific to the areas of Language, Natural Sciences, Mathematics and Social Sciences. The results of the 2019 END assessment showed, in the case of Pedagogy in Primary Education, that the lowest percentage of achievement was in the area of mathematics, with 44.1%, where 53% of students were below the national average percentage (43.6%) [6] (CITA), making the area of mathematics a weakness in the students of this degree programme.

With the purpose of providing guidelines to higher education institutions, that have Pedagogy in Primary Education degree, for the design of educational models that contribute to improve the results in the END evaluation, the objective of this research is to know the existing gaps between the current educational model of a given degree in Primary Education and the pedagogical and disciplinary standards established by MINEDUC.

2. THEORETICAL AND CURRICULAR CONSIDERATIONS

Universities in different parts of the world have been challenged by the needs of 21st century society and political reforms. In this context, MINEDUC [7] developed the guiding standards for graduates of Primary Education teaching programmes, establishing five criteria: 1) consideration of the autonomy of training institutions, 2) relationship with the school curriculum and its objectives, 3) focus on the students of the school system, their characteristics and ways of learning, 4) pedagogical and

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disciplinary standards, and 5) the commitment of the teacher. During the year 2022, MINEDUC, through the *Centro de Perfeccionamiento, Experimentación e Investigaciones Pedagógicas* (CPEIP) published the update of the teaching profession standards for General Primary Education teaching careers, with the aim of responding to international agreements, current social needs and current regulations. In this same order and direction, the teaching standards recognise that the profession is structured on the basis of knowledge associated with the discipline, the learner and his or her context, and teaching for the growth and transformation of the learner. This commitment responds to what is established by law [8] and is based on Shulman's knowledge of content and pedagogical knowledge of content [9,10].

The mathematics disciplinary standards, at the level of disciplinary knowledge, are structured along four axes that permeate the Chilean school curriculum longitudinally, namely a) Numbers and Operations, b) Patterns and Algebra, c) Geometry and Measurement, and d) Data and Probability. These axes attempt to address the fragmentation and disconnection of content knowledge, putting in its place the understanding and development of mathematical thinking, since it is necessary to have a deep and integrated vision of school mathematics. With regard to the didactic aspects of the disciplines (mathematics, in this case), the future teacher is guided in the design of classes, the design of planning and innovations, promoting the use of methodologies and didactic strategies that favour the teaching of mathematics. On the other hand, the trainee teacher is expected to recognise the difficulties and obstacles that students face when constructing mathematical knowledge, and the teacher is expected to question and analyse his or her class performance in terms of evaluation and how to organise the content of school mathematics [11].

3. METHODOLOGICAL ASPECTS

Context and data collection

As in most Latin American countries, initial teacher training in primary education is generalist, i.e. a teacher who teaches all subjects in the first years of schooling (1st to 6th grade of primary school, approximately to students aged 7 to 12). Usually, during the first half of their initial training in Chile, future teachers must decide on mentions or specialisations, which are generally linked to the area of humanities (language, history, geography and social sciences) or basic sciences (mathematics and natural sciences), allowing them to deepen their knowledge and offer a progressive mix of generalist and specialist teachers during the first years of schooling [11]. Subsequently, from 7th to 4th grade (approximately for students aged 13 to 18), teaching is traditionally provided by specialist teachers.

In order to address the research objective, we considered a university located in the city of Santiago in Chile that offers a degree in Primary Education with a specialisation in Mathematics and Natural Sciences. This degree course has more than 10 years of experience in teacher training and currently has a graduation rate similar to the average number of graduates of Primary Education degree courses in Chile. The curricular structure of this degree organises its training processes through the achievement of learning outcomes in 4 areas: general, professional, disciplinary and practical.

The data were collected from the pedagogical and disciplinary standards established by MINEDUC [11], from the graduate profile of this degree and from the syllabuses of the subjects of this degree that are linked to the area of mathematics (mention in Basic Sciences): Mathematics Education I: Numbers and their Didactics (S1), Mathematics Education II: Geometry and its Didactics (S2), Mathematics Education III: Algebra and its Didactics (S3), Mathematics Education IV: Data and Probabilities and its Didactics (S4), Didactics of Mathematics (S5), Deepening the Mathematics Curriculum in Basic Education (S6), Methodologies for the Learning of Mathematics in Basic Education (S7), Design of Evaluative Instruments for Mathematics (S8), Seminar of the Speciality of Mathematics Mention (S9) and Degree Seminar Mathematics Mention (S10).

Data analysis

Using interpretative techniques of content analysis [12], the syllabuses of subjects S1, S2,…, S10, the graduate profile of this degree course and the pedagogical and disciplinary standards for Primary Education degree courses established by MINEDUC [11] were analysed in order to account for the existing gaps between the educational model of this degree course and the pedagogical and disciplinary standards established by MINEDUC.

4. ANALYSIS AND RESULTS

Figure 1 shows the matrix of curricular taxation of the 10 subjects of the curriculum of the degree course in Basic Education linked to the area of mathematics. Specifically, this matrix gives an account of the taxation with the competences that are intended to be developed in this degree course, which are distributed into 8 generic learning outcomes and 26 specific competences (pedagogical and disciplinary), in addition to the competences specific to the area of mathematics (mathematics specialisation).

The description of the learning outcomes shown in Figure 1, distributed according to the general, vocational, disciplinary and mathematical fields, can be found in Tables 1, 2, 3 and 4 respectively.

	Specific learning outcomes (general area)								Specific learning outcomes (Professional domain)										Specific learning outcomes (Disciplinary domain)							Specific learning outcomes (Mathematics)			
Description / Subject	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
S1	x				x								x			x	x				x						x	x	x	x
S2	x	x	x	x	x			x	x	x			x			x			x		x						x	x	x	x
S3	x	x	x	x	x			x		x	x	x	x	x	x	x	x		x		x						x	x	x	x
S4	x	x		x	x			x		x	x	x	x			x			x		x						x	x	x	x
S5	x		x	x	x		x	x	x	x	x	x	x			x	x		x		x						x	x	x	x
S6	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x		x		x						x	x	x	x
S7	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x						x	x	x	x
S8	x	x		x	x			x				x	x	x	x	x	x				x						x		x	
S9	x	x		x	x		x	x	x		x					x	x				x									x
S10	x	x		x	x		x	x	x		x					x	x				x						x	x	x	x

Figure 1. Curriculum taxation matrix. Source: own elaboration

Table 1. Specific learning outcomes (general domain)

N°	Description
1	Develop processes for searching and processing information from different sources, by applying abstraction, analysis and synthesis in the context of their professional performance.
2	Identify, pose and solve problems, linked to decision-making in the work context, evidencing the achievement of superior metacognitive skills.
3	Perform in new situations in order to learn and update continuously, promoting a critical and self-critical attitude towards the daily circumstances of their work and enhancing their professional development as teachers.
4	Communicate orally, in writing and effectively in the work context, considering empathy, respect and a high disposition to collaborative and multidisciplinary work.
5	Interact with others and work in teams in the various contexts involved in their professional work.
6	Use the English language in an instrumental way in the context of their professional performance.
7	Research their own practice and various topics related to their work, demonstrating the ability to investigate, argue and test their ideas in work contexts.
8	Formulate, manage and lead educational projects in the context of professional development.

Table 2. Specific learning outcomes (vocational domain)

N°	Description
1	Apply pedagogical and disciplinary-didactic knowledge with the aim of developing a situated, comprehensive and effective teaching-learning process, showing a high disposition for reflection, permanent updating and leadership in their pedagogical exercise within their educational community.
2	Plan and implement the teaching-learning process based on ministerial regulations, a flexible curricular approach, the social and intercultural context of the students, their characteristics, interests, needs and learning rhythms, and the development of skills, potential and critical thinking.
3	Apply didactic methodologies aimed at achieving meaningful learning and fostering innovative, creative, inclusive, challenging and contextualised educational scenarios, in which high expectations are held for student learning.
4	Evaluate the integral performance of students through different types of evaluation procedures and instruments, analysing the results obtained and providing feedback aimed at encouraging self-evaluation and reflection, decision-making and the definition of improvement actions.
5	Apply information and communication technologies for the optimisation of the teaching-learning process and professional management in educational contexts.
6	Develop curricular and classroom management actions that favour student learning and integrate parents and families into the educational process.
7	Generate an inclusive and collaborative environment, demonstrating an ability to identify educational needs and include all students, through diversified learning spaces.
8	Act in a professional, collaborative and ethically responsible manner, in line with the project, institutional regulations and public policy guidelines, for the benefit of student learning and with the aim of making a contribution to the community.
9	Implement public policy guidelines in a contextualised manner, acting in line with them for the benefit of students' learning and the development of their educational community.
10	Analyse educational interventions carried out in the classroom, with the aim of encouraging critical reflection, evaluation and dialogue with peers on educational issues, and in pursuit of the continuous improvement of teaching practice.
11	Apply teaching and learning strategies to address with students issues of guidance, coexistence and respect for diversity present in the curriculum.

Table 3. Specific learning outcomes (discipline area)

N°	Description
12	Design and implement teaching-learning processes for reading comprehension, writing and oral communication.
13	Design and implement teaching-learning processes for the development of mathematical logic skills, problem solving, argumentation and communication, modelling and representation.
14	Design and implement learning experiences for the development of temporal and spatial thinking skills, critical thinking and analysis of information sources on History, Geography and Social Sciences.
15	Design and implement learning experiences for the development of scientific skills, through the use of learning methodologies that promote scientific thinking about Natural Sciences.
16	Implement learning methodologies for the development of motor skills, promoting fair play and leadership; and active and healthy living through Physical Education and Health.
17	Apply concepts, techniques, methodologies and strategies for the development of Visual and Musical Artistic expression, encouraging aesthetic appreciation and artistic creation.
18	Implement learning experiences that enable the development of scientific thinking and appreciation of technology through the practical skills of designing, making and testing.

Table 4. Specific Learning Outcomes (Mathematics)

N°	Description
19	Articulate the disciplinary content of Mathematics according to the different educational contexts, characteristics, interests and needs of the students, taking into account current educational policies and the use of ICT.

20	Implement methodologies, strategies and learning resources to develop, from inclusive practices, the teaching-learning process of the axes of the subject of Mathematics in different formative contexts of Primary Education.
21	Design and implement evaluative instruments to address and analyse student learning in the axes of the subject of Mathematics in Primary Education, in different educational contexts.
22	Implement research procedures in the classroom and in the subject of Mathematics, in order to promote critical reflection and curricular, methodological and evaluative decision-making in Primary Education.

When analysing the graduate profile of this degree course, the syllabuses of subjects S1, S2,..., S10 and the pedagogical and disciplinary standards for Primary Education degree courses established by MINEDUC [11], the following was observed:

- In the content analysis of the subject programmes, all (100%) of the expected generic learning outcomes have been identified.
- In the content analysis of the syllabuses, the expected pedagogical learning outcomes have been identified in their entirety (75%-99%).
- In the content analysis at disciplinary level of the subject programmes, it is possible to identify in all programmes learning outcome number 13 (design and implement teaching processes for learning mathematical logic skills, problem solving, arguing and communicating, modelling and representing).
- In the content analysis at the disciplinary level of the subject programmes, in only 4 subjects is it possible to identify learning outcome number 18 (implement learning experiences that enable the development of scientific thinking and appreciation of technology through the practical skills of designing, making and testing).

Furthermore, the results of the content analysis show how the learning outcomes in teacher training are organised in the subjects, showing an encapsulated presentation through the curricular proposal, i.e., the development of each of them acts without any major connection between the other learning outcomes, which we consider to be an effect of parcelling out their presentation. Therefore, the pedagogical knowledge of the content is covered, but not the specialised knowledge of the content, both understood in the sense of Shulman [10, 11]. In this sense, a weakness is evident within the curriculum, since trainee teachers are not prepared to interact with their students in the classroom context and to address diverse needs in order to promote integrated learning.

From the above, it can be seen that the curricular design responds to and is aligned with the guiding standards for graduates of Primary Education degree programmes [7]. However, there is not the same congruence between what is indicated in the graduate profile and in the subject programmes with the disciplinary standards.

5. DISCUSSIONS AND CONCLUSIONS

The guiding standards for graduates of Primary Education degree programmes [7] promote the teaching and learning of mathematics from an integrative and situated approach, where the future professional must demonstrate the ability to care for all their students. In this sense, students should not only acquire knowledge, but also have the opportunity to develop practical skills such as teamwork, ethical decision-making and effective communication. Such competences are dynamic and adapt as the individual faces new situations in diverse contexts. In line with the above, Correa [13] recognises that the inclusion of emotional, communicative aspects within a context should also form part of competences. This includes procedures, attitudes, norms.

At the end of this study, it became clear that there is a gap between the disciplinary standards of primary general education and the learning outcomes of the subjects associated with mathematics in the degree course that formed part of this research. In this sense, it should be noted that a congruence was observed between these standards and the graduate profile. Therefore, it is considered that the graduate profile of this degree course should be adjusted to respond to the new demands. In this order of ideas, we agree with Bautista [14], who indicates that a competence-based model should contribute towards an integrating capacity that enables the integral development of the human being. In this sense, the subject must be able to demonstrate disciplinary, interdisciplinary and practical knowledge, cognitive, metacognitive, social and emotional, physical and practical skills, attitudes and values [15].

As a result of the above, at the disciplinary and didactic level, skills should promote the professional practice of teaching mathematics through the use of content knowledge and pedagogical content knowledge [10, 11]. In the same way, techniques that support the praxis of mathematics teaching favour an integrative professional training [16].

In the framework of the above observations, it is evident that in the training of primary education teachers, the area of mathematics is not given a more in-depth training. In this sense, during the training process, trainees must acquire disciplinary and pedagogical knowledge from different areas and this, to a certain extent, significantly restricts the mastery of mathematical content knowledge. In this regard, the literature indicates that trainee teachers have gaps that stem from their own experience or from their beliefs about mathematics [17]. In addition, they replicate educational practices from their years as students in the school context, generating gaps or difficulties that hinder the integration of didactic concepts in their educational practice. In this sense, Thomson et al. [18] and Ma [19] indicate that understanding mathematics is a necessary condition for the correct performance of teaching.

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