PEL

Pensamiento Educativo. Revista de Investigación Educacional Latinoamericana
2020, 57(1), 1-16

Pontificia Universidad Católica de Chile
Facultad de Educación

The Performance of Beginning Sciences Teachers: The Professional Competencies Developed During the First Years of Professional Experience

El desempeño de los profesores noveles de ciencias: las competencias profesionales que desarrollan durante los primeros años de ejercicio profesional

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Abstract

Nowadays, several higher education institutions have adopted a competency-based learning model, whose profiles are defined as essential performances, according to specific professional requirements. This article shows some results of a case study, developed in the professional performance scope, in which it describes and characterises the professional teaching competencies of a group of biology, chemistry and physics beginning teachers analysing the professional teaching practices. For this, eight professors with few years of professional experience were monitored, through the study of film recorded classes. Perrenoud's postulates on professional teacher performance competencies were used as a theoretical reference. The results allow recognising professional performances associated with specific competencies of a different kind, and with a varied presence within the classroom. The implications of this research are to provide feedback to the training programs for science teachers in the country.

Keywords: beginning teachers, professional teaching competencies, sciences.

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Financiamiento: Este trabajo deriva del Proyecto Fondecyt 11130445 "Competencias profesionales docentes y modelos didácticos de profesores noveles de ciencias", financiado por la Comisión Nacional de Investigación Científica y Tecnológica (Conicyt). La autora agradece al Plan de Mejoramiento Institucional (PMI), Convenio de Desempeño en Formación Inicial de Profesores (2013-2015), Vicerrectoría Académica, Pontificia Universidad Católica de Valparaíso, Chile.

ISSN:0719-0409 DDI:203.262, Santiago, Chile doi: 10.7764/~~PEL.56.2.2019.9~~

Resumen

En la actualidad, diversas instituciones de educación superior han adoptado un modelo de formación por competencias, cuyos perfiles están definidos como desempeños clave de acuerdo con ciertos requerimientos profesionales. En este artículo se muestran algunos resultados de un estudio de casos, desarrollado en el ámbito del desempeño profesional, en donde se describen y caracterizan las competencias profesionales docentes de un grupo de profesores noveles de Química, Física y Biología, a través del análisis de sus prácticas docentes. Para ello, se monitoreó a ocho profesores con pocos años de ejercicio profesional, a través del estudio de filmación de clases. Como referente teórico se emplearon los postulados de Perrenoud respecto de las competencias de desempeño profesional docente. Los resultados permiten reconocer los desempeños profesionales asociados a ciertas competencias de diferente naturaleza y con variada presencia dentro de la sala de clases. Las implicancias de esta investigación tienen como finalidad retroalimentar los programas de formación de profesores de ciencias en el país.

Palabras clave: competencias profesionales docentes, ciencias, profesores noveles.

Introduction

Integration of teachers into the profession has been a subject of constant interest in educational research in recent times (Flores, 2014; Marcelo, 2009; Solís, Núñez, Vásquez, Contreras, & Ritterhaussen, 2016). On the one hand, this is due to the need to study the transition from student to teacher as a complex stage for beginning teachers and which is marked by the interaction between beliefs and principles of action, routines and guides of action, academic knowledge and implicit theories (Porlán, Rivero, & Pozo, 1997), and, on the other, because of the curricular changes associated with the implementation and development of a competency-based performance assessment model, with an emphasis on the professionalization of teaching.

The competency-based training model has generated a great deal of uncertainty in the university community, due to the difficulty of programming and assessing professional performances (of people who are not yet working as such) and of incorporating training methods that facilitate the integration of knowledge, skills, and attitudes (Gairín, 2011). Although this model has been implemented on a large scale in teacher training processes—which has required changes in the training approach of pedagogy careers (the focus of which was mostly on content and centered on the expert teacher in the subjects taught)—there are no clear implications of the influences of these changes on professional performance.

It is therefore important to produce empirical evidence that helps and guides training centers—and particularly higher education institutions—to implement training and monitoring programs that are in accordance with the new requirements and which contribute to increasing the percentages of competent teachers. Along these lines, research referring to beginning teachers paves the way for the production of evidence on professional performance in order to establish relationships with previous training processes.

It is for this reason that this research proposal is intended, on the one hand, to analyze the professional performance of beginning science teachers and, based on this, to demonstrate "true teaching competencies". For example, being familiar with or mastering the content taught (widely disseminated as professional competency) would not be a true teaching competency, since it is not sufficient for science teachers to merely have mastery of the subject, but instead the most important thing is how this knowledge is linked with teaching objectives, learning situations, or teaching strategies (Perrenoud, 2005). Based on this logic, the study of other competencies allows evidence to be gathered on the strengths and weaknesses that are typical of science teachers in their professional work.

Based on the above, the proposal is that, in order to progress with the consolidation of improvements in the quality of science education, it is necessary to understand the curricular, pedagogical, and didactic aspects that comprise the practice of beginning science teachers, that is, their teaching competencies. For this reason, the following research question arises: What are the competencies that science teachers develop during their first years of professional practice?

To answer this question, the study was aimed at identifying and characterizing the competencies developed by eight beginning science teachers during their professional performance, through the analysis of their school practices at different educational centers in the Valparaíso Region (Chile), in order to obtain information that allows the recognition of aspects related to professional performance and, through this, identify emerging needs from the educational environment that can be addressed in the training process.

Theoretical Basis

The quality of teaching can be studied from multiple perspectives. Fenstermacher and Richardson (2005) contend that good teaching adheres to high standards regarding the way of teaching, distinguishing it from successful teaching, the concern of which is to provide students with the skills they need to achieve high scores on standardized tests.

In Chile, since 2003 the model that has underpinned the system to assess professional teaching performance has been based on standards. This mechanism favors the delivery of feedback to promote personal reflection and guide professional development decisions that allow teaching practice to be improved. Although these models of teacher assessment do not include direct measurements of student achievement, they are not detached from it (Centro de Medición MIDE UC, 2011).

An example of these systems for continued training is the *Marco para la buena enseñanza* (2003), or the Framework for Good Teaching, which identifies a set of responsibilities that the teacher must assume when carrying out their work to contribute to the learning of their students; while an example for initial training is the *Estándares orientadores para las carreras de Pedagogía en Educación Media* (Ministerio de Educación de Chile, Mineduc, 2012), or Guiding Standards for Pedagogy in Secondary Education. These enable the achievements made during the training process to be monitored and, thus, diagnoses to be produced on the needs for reinforcement and continuous training, in order to help institutions train quality teachers. Both systems describe a series of expected teaching performances to achieve student learning.

Meanwhile, various higher education institutions have adopted a competency-based training model, the profiles of which are defined as key performances according to certain professional requirements (Peluffo & Knust, 2009). A competency-based university teaching model is aimed at training not only as the acquisition of specific knowledge and skills, but also of attitudes. Therefore, the training objective involves the acquisition of knowledge, the development of skills, and the ability to apply these resources appropriately to each of the situations that arise (Rodríguez, 2008).

The concept of competency has spread very rapidly in education, which is justified given the need to move beyond teaching in which rote learning of knowledge is predominant, a fact that hinders its application in real life (Zabala & Arnau, 2007).

Perrenoud (1997) defines competency as the ability to act effectively in a certain type of situation that is supported by, but not limited to, knowledge. Meanwhile, for Euryce (2002, cited in Adúriz-Bravo, 2012) a competency is a general ability based on the knowledge, experiences, values, and attitudes that a person has developed through their commitment to educational practices. Therefore, one is "competent" when they can mobilize knowledge, procedures, and attitudes in an integrated manner in the face of a given problem situation so that it may be resolved successfully (Zabala & Arnau, 2007).

It is therefore considered that the concept of teaching competency should refer to the set of knowledge, skills, and values that can enable a teacher to successfully deal with the problems, conflicts, and difficulties that occur most commonly during their professional practice (Adúriz-Bravo, Merino, Jara, Arellano, & Ruiz, 2012; Chamizo & Izquierdo, 2007; Mineduc, 2011; Perrenoud, 2005). Thus, professional teaching competencies represent a set of knowledge (disciplinary and didactic), skills (techniques and strategies), and values (ideologies) to carry out activities in the classroom to teach the subject.

Bolívar (2006) refers to the term of competencies, mentioning the problem situations that occur on a day-to-day basis in the classroom and which require the mobilization of teaching knowledge to make pertinent and effective decisions.

In this regard, this study addresses the professional knowledge of teachers, based on the professional competencies defined by Perrenoud (2005), for which it is considered that, in the process of insertion into the profession, beginning teachers must first acquire this knowledge before then advancing with the consolidation of skills to solve problems depending on the needs of the context (Quiceno-Serna, 2017).

Table 1. Perrenoud's reference competencies (2005)

Reference competencies	Specific skills to work upon in continuous training (examples)
Organize and encourage learning situations.	• Know, through a certain subject, the content to be taught and its translation into learning objectives. • Work based on representations from the students. • Work based on errors and obstacles in learning. • Construct and plan didactic devices and sequences. • Involve the students in research activities and knowledge projects.
Manage the progression of learning.	• Conceive of and address problem situations in accordance with the level and possibilities of the students. • Acquire a longitudinal view of the objectives of teaching. • Establish links with theories that support learning activities. • Observe and assess students in learning situations, according to a formative approach. • Establish periodic oversight of competencies and make progression decisions.
Develop and evolve differentiation devices.	• Address heterogeneity in the same class-group. • Compartmentalize, that is, extend class management to a broader space. • Practice integrated support and work with students with greater difficulties. • Develop cooperation between students and certain simple forms of mutual teaching.

Involve students in their learning and in their work.	• Promote the desire to learn, explain the relationship with knowledge, the meaning of school work, and develop the capacity for self-assessment in the child. • Establish and operate a student council (class or school) and negotiate various types of rules and agreements with them. • Offer optional “à la carte” educational activities. • Promote the definition of the student's personal project.
Work as a team.	• Prepare a team project with common representations. • Encourage a working group and lead meetings. • Form and renew a pedagogical team. • Jointly deal with and analyze complex situations, and professional practices and problems. • Deal with crises or conflicts between individuals.
Participate in school management.	• Prepare and negotiate an institutional project. • Administer the school's resources. • Coordinate and promote a school with all the components (extracurricular, neighborhood, parents' associations, language teachers, and culture of origin). • Organize and evolve the participation of students in the same school.
Inform and involve the parents.	• Encourage informational and debate meetings. • Lead meetings. • Involve parents in valuing the construction of knowledge.
Use new technologies.	• Use document editing programs. Take advantage of the didactic potential of programs regarding the objectives of the teaching domains. • Communicate remotely through telematics. • Use multimedia tools in their teaching.
Face the ethical duties and dilemmas of the profession.	• Prevent violence at school or in the city. • Fight against prejudice and sexual, ethnic, and social discrimination. • Participate in the creation of common life rules regarding school discipline, punishments, and observation of behavior. • Analyze the pedagogical relationship, authority, and communication in class. • Develop a sense of responsibility, solidarity, and a sense of justice.
Organize one's own continuous training.	• Know how to explain one's practices. • Establish oversight of competencies and a personal program for one's continuous training • Negotiate a common training project with colleagues (team, school, and network) • Get involved in the tasks of teaching or the educational system in general. • Accept and participate in the training of colleagues.

Source: Prepared by the author.

Beginning teachers

Various authors have used a wide variety of terms to refer to the novice teacher: for example, beginner, inexperienced, young, new, and neophyte, among others. In the educational sphere, the beginning teacher is considered to be a recent university graduate who teaches for the first time at an educational institution and typically has little or no previous teaching experience (Bozu, 2010). In this respect, Imbernon (1994) states that beginning teachers are those who have less than three years' experience in their professional work, although others extend that definition to the first five years.

Studies about this type of teaching staff show that their problems are mainly in the didactic field and they involve teaching decisions above all else. In this vein, Feiman-Nemser (2000) argues that beginning teachers are both learners and teachers, since in this period they have to learn how to teach. Meanwhile, Flores (in Marcelo, 2009) states that the high number of students per classroom, their motivation, the individualization and differentiation of teaching, attention to learning rates, indiscipline, assessment procedures, and time management are very problematic factors for teachers in their first few years of professional practice. Other studies demonstrate the need for mentoring programs in the first years of work, in order to reduce the tension that occurs at the start of the professional stage (Solís et al., 2016). This background information allows us to visualize a set of problems associated with the awareness of the “pedagogical theories” learned at university and the management of the reality of classrooms, which requires immediate and effective decisions to manage students and promote significant learning situations. In addition to this, there are beginning teachers' conceptions about what science is and, in most cases, that is related to the existence of a standardized method, comprised of a succession of stages that guide the production of scientific knowledge (Siry & Lara, 2011). This traditional view of science, where novice teachers tend to repeat the behaviors and methodologies observed in those who worked as their science teachers at school, creates tensions between new teaching paradigms and traditional forms of science education in the classroom (Siry & Lara, 2011), particularly if we consider that teaching work is based on certain conceptions of teaching and learning that are the product of the educational culture (Pozo, 2000).

In other words, it is recognized that the teaching provided is often based on approaches that teachers take with respect to other teachers—both those they had at school and at university—and not necessarily in the preceding training process. In the study by Quiceno-Serna (2017), she concludes that, since there are still no class routines established in this type of teacher, the manner of taking on their practice responds to the confrontation of the imaginaries constructed during professional training.

The above means that the stage of professional insertion is complex, both for beginning teachers and for training institutions, so the experience of the novice teacher in their early years will depend on their abilities to be familiar with the institution and to overcome difficulties with those they meet, regardless of the preparation that the training institution has given them and the support they receive at the institution where they work (Solís et al., 2016).

Methodology

In order to approach the proposed objective, this study was framed in a qualitative paradigm using a case study design, because of its aim to provide a comprehensive and profound view of a certain reality (Flick, 2012; Sandín, 2003).

To do this, we analyzed the transcribed verbal discourse that was produced as a consequence of observing classes that were video-recorded (90-minute sessions, two sessions for each teacher) using codification and categorization processes. The reference and specific skills described by Perrenoud (2005) were used for this, with the MAXQDA11 software (2014) used as support.

Meanwhile, to recognize the competencies, the author's description was taken as a basis and those aspects that can be considered competent performances in the textualities obtained from the class transcripts were acknowledged, associating them with the specific competencies and, therefore, with the reference competencies. We carried out this process using open coding, that is, by assigning codes to segments of data that describe the content of these segments as accurately as possible (Restrepo-Ochoa, 2013). Subsequently, we performed axial coding that allowed the subcategories (specific competencies) to be related to categories of analysis (reference competencies) and the identification of their properties and dimensions (Strauss & Corbin, 2002).

The textualities were studied using content analysis methods, understood as an empirical approach of methodologically controlled analysis of texts in their contexts of communication, following analytical content rules without quantification by means (Mayring, 2000). This procedure allows the content of any communication to be analyzed in detail and depth and it can be used in all types of data recording instruments, which, in this case, were class observation records.

As regards the list of reference competencies, this study focused on the first four, so, on the one hand, it took into account that these can be recognized in professional practice (observable) and they are also part of the basic competencies that should be acquired in the initial training of science teachers. Furthermore, for purposes of analysis, the specific competencies were categorized as either didactic (related to the teaching of the subjects) or pedagogical (related to pedagogical practice).

Eight beginning science teachers were chosen (Table 2) with between one and four years of professional experience. They were chosen because of their voluntary participation in a stage prior to this research (they answered a questionnaire about didactic models). Therefore, this is incidental sampling that directly and intentionally selected individuals, taking into account that this guaranteed access to classrooms, in addition to ensuring the interest and enthusiasm of the participants. All of these novice teachers work in secondary education and were trained at the same higher education institution in the Valparaíso Region of Chile. This institution (accredited in all areas for six years) has a long history of teacher training (more than 70 years) and has solid mechanisms of self-regulation at the undergraduate level. To date, all of its graduate profiles for Pedagogy courses have been based on competencies and it was in the process of updating subject programs along these lines.

Table 2. Characterization of the participating teachers.

Teacher	Area	Years of experience	Financing of establishment	District	Vulnerability index of establishment[1]	Postgraduate studies
Teacher 1	Chemistry	1	Private-subsidized	San Antonio	49.2	No
Teacher 2	Chemistry	4	Private	Viña del Mar	33.9	Yes
Teacher 3	Chemistry	1	Private-subsidized	Valparaíso	42.4	No
Teacher 4	Biology	2	Private-subsidized	Quillota	82.0	No
Teacher 5	Biology	1	Municipal	Quilpué	79.4	Yes
Teacher 6	Biology	2	Private-subsidized	Valparaíso	37.6	No
Teacher 7	Physics	2	Private-subsidized	Valparaíso	42.4	No
Teacher 8	Physics	4	Private-subsidized	Villa Alemana	49.7	No

Source: Prepared by the author.

1. Vulnerability index taken from the catalogue of data of Junaeb (2018). Available at en http://junaebabierta.junaeb.cl/catalogo-de-datos/indicadores-de-vulnerabilidad/

The analysis of the data collected was carried according to the didactic interaction model proposed by Irigoyen and Jiménez (2004), where the analytical unit is didactic interaction, understood as the reciprocal exchange between subjects (students and teachers) and objects or situations (formal knowledge content explained in teaching materials), under conditions defined by the area of performance (discipline or profession). Based on this model, the assessment of competencies implies the verification of competent performances, since the concept of competency necessarily implies that the performance is effective. This is why the results of this research are displayed based on the presence or absence of the competency and not its quantification.

Results

The results are presented based on the analysis of the competencies identified for each case.

Table 3 shows that, of the total number of specific competencies analyzed (18), several of them are present in the teachers, in a range from four competencies (Teacher 2 of Chemistry) to 13 competencies (Teacher 5 of Biology).

Table 3. Competencies typified in the total sample of the case studies (n = 8)

Reference competencies (observable)	Specific competencies	Nature of competency	P1 Chemistry	P2 Chemistry	P3 Chemistry	P4 Biology	P5 Biology	P6 Biology	P7 Physics	P8 Physics
1. Organize and encourage learning situations.	1.1 Know, through a certain subject, the content to be taught and its translation into learning objectives.	Didactic	X	X	X	X	X	X	X	X
	1.2 Work based on representations from the students.	Didactic	X	X	X	X	X	X	X	X
	1.3 Work based on errors and obstacles in learning.	Didactic		X	X	X			X	X
	1.4 Construct and plan didactic devices and sequences.	Didactic and pedagogic	X	X	X	X	X	X	X	X
	1.5 Involve the students in research activities and knowledge projects.	Didactic					X	X		
2. Manage the progression of learning.	2.1 Conceive of and address problem situations in accordance with the level and possibilities of the students.	Didactic				X	X	X		X
	2.2 Acquire a longitudinal view of the objectives of teaching.	Didactic	X			X	X			
	2.3 Establish links with theories that support learning activities.	Didactic			X	X	X	X	X	X
	2.4 Observe and assess students in learning situations, according to a formative approach.	Didactic	X		X	X	X		X	X
	2.5 Establish periodic oversight of competencies and make progression decisions.	Didactic and pedagogic	X			X	X	X	X	X

3. Develop and evolve differentiation devices.	3.1 Address heterogeneity in the same class-group.	Pedagogic								
	3.2 Compartmentalize and extend class management to a broader space.	Didactic and pedagogic					X			
	3.3 Practice integrated support and work with students with greater difficulties.	Pedagogic								
	3.4 Develop cooperation between students and certain simple forms of mutual teaching.	Pedagogic					X	X		
4. Involve students in their learning and in their work.	4.1 Promote the desire to learn, explain the relationship with knowledge, the meaning of school work, and develop the capacity for self-assessment in the child.	Didactic and pedagogic	X		X	X	X	X	X	X
	4.2 Establish and operate a student council (class or school) and negotiate various types of rules and agreements with them.	Pedagogic				X				
	4.3 Offer optional "à la carte" educational activities.	Didactic					X			
	4.4 Promote the definition of the student's personal project.	Pedagogic								

Source: Prepared by the author.

Reference competency 1: "Organize and encourage learning situations"

The analysis carried out makes it possible to see the presence of specific competencies associated with this reference competency in all of the teachers analyzed, mostly in the specific competencies "Know, through a certain subject, the content to be taught and its translation into learning objectives" or "Work based on representations from the students". This shows that teachers generally identify the concepts or disciplinary nuclei and use them to establish learning objectives.

> We're going to work at the ecosystem level and the relationship between human activity and the environment and how human activity influences pollution, therefore, today we're going to start working on the following objective: we're going to work on recognizing the organization of ecosystems and on relating abiotic and biotic factors with ecosystems... What we're basically going to do is address biotic factors, relate them to abiotic factors, see how they are composed in systems... and then we will carry out an activity. (P6 Biology)

> Today's objective is related to studying nuclear integration and the behavior of circular movements with angular acceleration, so today's objective is associated with understanding and applying the conceptual and operational definition of angular acceleration to problems of various types. (P7 Physics)

At the same time, beginning science teachers promote spaces for the students to express their ideas about topics or concepts, although they are not necessarily able to explicitly recognize the origin and coherence of these ideas.

> You're going to see biotic factors involved here, right? And in this image there are no biotic factors involved. Why do you think... that on one side there is life and on the other side practically none can be observed? (P6 Biology)
>
> Because there is no water. (Student 1)
>
> Because there may be water present and the organism can't tolerate much salt water. (P6 Biology)
>
> Perhaps the humidity. (Student 2)
>
> There could be more humidity in that environment than the other, right? (P6 Biology)

Another specific competency present among all of the novice teachers participating is "Construct and plan didactic devices and sequences".

> (Exploration activity) Is there is an element here that appears in the guide that isn't in the activity? You should bring the element close to the nose of your classmates, not touching the nose. It's not disgusting, guys, okay? Be confident. Bring the element close, you can't touch it, just smell it. Try to separate the elements. (P5 Biology)
>
> When we talk about qualities, how can we differentiate a concentration of something according to its qualities? By looking? (P1 Chemistry)
>
> By its color. (Student)
>
> By its color, right? If we prepare a powdered drink that has a concentration... how can I see if it is more or less concentrated? (P1 Chemistry)
>
> By the color, the darker it is the more concentrated it is. (Student)

We can see this in the creation of activities, many of which are framed within stages of the constructivist learning cycle. The application of planned teaching devices is seen, based on work in groups or of an experimental nature, with substances known to the students, according to which the teacher plans certain associated learning, following a structure that goes from the problematic to the conceptual.

Regarding the specific competency "Involve the students in research activities and knowledge projects", the following dialogues describe the promotion of activities focused on school scientific research and, specifically, on the development of research questions and objectives, adapted to the level of the students.

> I want to identify tissues of the organisms in the school, of plants, to see them through a microscope. (Student)
>
> So the territory would be descriptive, and what are the objectives? And what is the research question you might have? How would you ask a question that attracts your attention and allows you to do that research, or what did you ask yourself when you decided to do that? (P5 Biology)

Reference competency 2. "Manage the progression of learning"

This competency is less prevalent than the one above. In this regard, the specific competency "Conceive of and address problem situations in accordance with the level and possibilities of the students" could be identified as follows:

> Why are they distributed in this way? How can the southern belloto and the patagua be seen there? Why do you think they are in the wettest areas and at the lower part of the ravines? (P5 Biology)

> First because they have more shade. (Student 1)
>
> Because that's their habitat. (Student 2)
>
> Yes, they do have more shade, but why do you think that is their habitat? Is that really the right place, where they don't need as much light, or is there another explanation? (P5 Biology)
>
> So now we're going to talk about key concepts, for example, afferent neuron, efferent neuron, stimulus, receptor, senses, sensation, and perception, those are more or less the concepts that we have discussed in this time. What you're going to do is build a conceptual map; remember that a conceptual map goes from the general to the most specific, from the most general to the most specific, right? Using connectors, we're going to try to connect this information so that when you see this conceptual map, you can understand what today's class was about. You can work in pairs. (P4 Biology)
>
> I'm not going to give you the definition. You play with it in history, with just the history you're ready to create a definition... very good, very good, let's hear some of the definitions that you've just given. Who wants to share their definition of thermal sensation with the class? (P8 Physics)
>
> It's the sensation of being hot or cold. (Student)

The teachers generally contextualize the topics covered in classes and, during interaction with students, ask them a series of questions that have the characteristics of problem situations.

In the case of the specific competency "Establish links with theories that support learning activities", teachers promote the relationship between information (content) and activities in the sessions by explaining, corroborating, and correcting the procedural aspects in the resolution of the proposed tasks.

> Why is it important to know about the structure of the atom? Because we start by showing and recalling what models of the atom existed. What do you think? (P3 Chemistry)
>
> Because that gives us the mass of the atom. (Student 1)
>
> In some way, remembering atomic models because the structure of the atom is related to the nuclear energy, which, as the group here said, is an energy that comes from the nucleus, something happens in the nucleus, something happens in the nucleus of the atom that generates energy and we know that as nuclear energy, right? But will the chemical reactions be the same as nuclear reactions? What do you think? Where do chemical reactions take place? Which are the reactors? The ones that move and are added or removed are the electrons and if we talk about a nuclear reaction, what is it that reacts? (P3 Chemistry)
>
> What's in the nucleus (Student 2)
>
> What's in the nucleus, right? There we have a great difference. (P3 Chemistry)
>
> Therefore, in order to better define the kinematics of angular movements, it is necessary to establish certain parameters based on what we recently reviewed. We define angular position as the location of an object relative to an angular reference system, but what happens if the position of an object changes? For example, we will first consider that it is at a point A located at 0° and it moves to point B located at 90°. How many degrees did it travel? The object is located at a point A, that point A has an angular position, the angular position will be equal to 0° or 0 pi radians, which would be the same. How far did it travel from A to B? (P7 Physics)

Lastly, regarding the specific competency “Observe and assess students in learning situations, according to a formative approach”, the formulation of questions during the class is seen, which enables students to realize what they are learning and with what objective they are doing it, while self-assessment is also promoted.

> In a nuclear reaction do I obtain the same thing that reacted initially? Does the structure in an atom change when there is a chemical reaction? Is the identity of the atom altered? (P3 Chemistry)
>
> No. (Student)
>
> Why? (P3 Chemistry)
>
> Therefore, the development of this response occurs so that we can interpret our environment, and this is modified according to the culture of the individual, according to the geography where the individual develops, right? A greater or lesser level of perception depending on my culture, depending on geography, depending on my life experience, because if the smell [holds ginger in hands], this smell and you were saying to me before, what is it? I called it a tuber, because it is a tuber, but it's ginger; as it's not well known in our Chilean culture it was difficult to interpret. In fact, at first glance we didn't know what it was and if we're seeing it exactly. (P4 Biology)

Reference competency 3: “Develop and evolve differentiation devices”

This competency is uncommon among the teachers analyzed. In the case of the specific competencies “Compartmentalize and extend class management to a broader space” and “Develop cooperation between students and certain simple forms of mutual teaching”, in the analysis of classes, only one teacher in the study is recognized as having them. (P5 Biology)

> We left yours pending, we're finished with the ideas that there are and we're looking for different ideas. Even so, if you want you can start now with the ideas, let's start preparing. Antonia, do you just want to make a healing cream? (P5 Biology)
>
> Can I make a shampoo? (Student)
>
> Now think, what questions attracted your attention? We've already gone out three times... the first time, guys, was when we went to the hill... also to Santiago, where we went to the Museum of Natural History and the Pre-Columbian Art Museum. (P5 Biology)
>
> What do you like? Or do you want to work with someone? Do you want to work with Roberta? She offered the job. Roberta, what's your idea? (P5 Biology)
>
> My idea is to work with land and water. (Student)
>
> Well did you understand something? Explain it again, explain it in different words, explain it so that Dago can understand your idea. (P5 Biology)
>
> The idea consists of promoting self-support through that, self-cultivation at home, to feed oneself. (Student)

In this case, the teacher promotes differentiating spaces in the actions proposed in the class, which are not restricted solely to the classroom. In fact, it encourages scientific activity by explaining how it can improve people's quality of life and allows students to develop scientific thinking through the creation of research projects and by participating in school competitions. Likewise, it also promotes the active and collaborative participation of students in the work.

Reference competency 4: "Involve students in their learning and in their work"

Except in the case of "Promote the desire to learn, explain the relationship with knowledge, the meaning of school work, and develop the capacity for self-assessment in the child", this reference competency has a low presence in all the teachers analyzed. Here are some examples where this is evident:

> When you talk about a nuclear reactor, Homer Simpson works at a nuclear company, right? And what does the nuclear company generate? (P3 Chemistry)
>
> Energy. (Student 1)
>
> Energy that they use in the city in the form of electricity, right? Now, I ask you, why wasn't a chemical reaction used? Why are chemical reactions not used to generate light? (P3 Chemistry)
>
> Because it has to light up the entire city and it requires a lot, more power is needed. (Student 2)
>
> We could instead translate that into saying that the energy obtained from chemical reactions is not as great as the energy in a nuclear reaction, right? (P3 Chemistry)
>
> If you go to the Barón dock and I say to you, I'm giving you a task: "Go to the Barón dock, go out there where that concrete structure is" and if I say, "make an inventory of the community, identifying the populations." What would you say to me? What's there? (P6 Biology)
>
> Seagulls. (Student 1)
>
> Sea lions. (Student 2)
>
> Jellyfish. (Student 3)
>
> The first image, yes I know it is a series and they know that I am a fan of that series, I have it as the background on my cell phone and it uses the phrase "winter is coming" and it says that the temperature of that city reaches more or less minus 20º Celsius. What do the townspeople do? They cover themselves with animal skins and very thick hides to be able to survive that and what you're saying was to try and explain why people put that on, people put on cloth capes and animal skins. (P8 Physics)

In this example, motivation is encouraged, focused mainly through the contextualization of teaching and the generation of links with the ideas and interests of the students.

Discussion and conclusions

The competencies that comprise the practice of science teachers are varied in terms of their nature (pedagogical and/or didactic). This means that, of the total reference competencies, some of them are similarly present in the analyzed classes of all the beginning science teachers taking part in the study, but centrally in the reference competencies "Organize and encourage learning situations" and "Conceive of and address problem situations in accordance with the level and possibilities of the students"

In particular, in the analysis of the classes, actions were recognized that indicate that science teachers are aware of the importance of establishing learning objectives, conducting work based on representations, errors and obstacles in learning, and supporting their work with devices and didactic sequences.

Likewise, beginning science teachers are aware that the presence of a learning objective that is consistent with the curricular topic to be addressed, as well as learning experiences, serves as didactic resources for student learning (Biggs & Tang, 2012). This, is because their didactic knowledge (referring to the characteristics of the students and their forms of learning, the teaching sequences, the design of activities, the assessment strategies and procedures, and the planning models) are a characteristic that defines the future. teacher (De Pro Chereguini, Pro Bueno, & Serrano Pastor, 2017). This can be explained due to the impact that specific didactics have had on initial teacher training processes, as an area that contributes to the construction of didactic content knowledge (Shulman, 1987). As regards science education, the participants manage to incorporate certain assumptions of pedagogical and didactic theories learned during initial training into their routines (Quiceno-Serna, 2017).

Meanwhile, there is scant evidence of the presence of the reference competencies “Develop and evolve differentiation devices” and “Involve students in their learning and in their work”, although the specific competency “Promote the desire to learn, explain the relationship with knowledge” is seen in seven of the eight cases studied. On the one hand, this shows the difficulty for beginning teachers to address individual differences (Veenman, 1984), as well as the importance of motivation in science classes and the promotion of a positive environment for learning (Regan, Anctil, Dubea, Hofmann, & Vaillancourt, 2002).

At the same time, we can also identify specific competencies that are not present in the teachers' performances, such as the reference competencies “Facing heterogeneity in the same group-class” or “Practice integrated support and work with students with greater difficulties”. These competencies imply that the teacher creates differentiating spaces in the activities carried out in the classroom and explicitly promotes the active cooperation of their students when carrying them out, which represents a recurrent difficulty recognized among novice teachers (Marcelo, 2009). As well as this, for the development of these competencies, beginning teachers are required to know their students, the institution, and the families, in addition to which they must teach and take responsibility for their students' learning (Solís et al., 2016).

This research has provided data to begin a diagnosis of the competencies developed by recent new graduates of science pedagogy courses, which is a first step to recognize possible adaptations in initial teacher training processes.

Finally, the findings of this research show the need for actions to be carried out in the training of science teachers that allow beginning teachers to be adequately inserted in the school system, for example, by strengthening the processes of early and professional pedagogical practices, where the training institution has the responsibility of directly supporting the process, thereby promoting constant and intentional reflection. Similarly, it is necessary for the relationships established by teachers in training between curricular, didactic, and pedagogical knowledge to be possible to visualize, as well as for spaces to be created to promote effective separation from previous models focused on the transmission of teaching, where the trainers of teachers become models of how to promote teaching that is focused on the student and their learning.

The original article was received on March 31st, 2019
The revised article was received on January 28th, 2020
The article was accepted on March 9th, 2020

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