Key competencies: Developing an instrument for assessing trainee teachers' understanding and views

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Key competencies straddle an educational reform that has taken on a central role within the European Union. However, there lack empirical instruments aimed at assessing preservice teachers' opinion of competency-based policies, their self-evaluation regarding such policies, and how a competency mandate's intended rationale is understood. Instruments with similar aims in other contexts suffer psychometric shortcomings. Therefore, our aim was to design an instrument to examine primary preservice teachers' beliefs about the role of key competencies in education, self-evaluate their understanding of the concept of key competencies, and determine if they understood the intended interdisciplinary focus. A three-phase pilot (n = 295, n = 277, n =263) was carried out with each phase aimed at progressively improving the instrument's psychometric soundness. Drawing from data obtained from the third pilot, the psychometric scale properties are reported for a much-needed assessment tool.

Keywords: primary preservice teacher attitudes; educational policy; key competencies; self-evaluation; policy evaluation.

Introduction

Key competencies, which are defined as an interdisciplinary application the harmonization of knowledge, skills, attitudes and values (see De-Juanas Oliva, Martín del Pozo, and Pesquero Franco 2016), play a central role in education reform within the European Union across many levels of education. This is evident in the Lisbon Strategy and the Recommendation on Key Competencies for Lifelong Learning, adopted by the European Parliament and the Council in December 2006 (see Council of the European Union 2018; Finsterwald et al. 2013; Halász and Michel 2011; Valle and Manso 2013). This means that primary preservice teachers are not only expected to develop professional competencies themselves during their university education, but also are expected to be prepared and ready to teach their own primary students guided by competency-based educational mandates.

Within the EU, Spain is no exception in their undertaking of a complete restructuring of educational policies based on the aforementioned Council of the European Union educational guidelines. The term "competency" became commonplace in Spain as a reflection of European educational reforms and Spanish secondary students' less-than-desirable performance in international assessment programs, such as PISA. There is an emphasis on competencial learning in both the Spanish 2006 Education Act (LOE) and the currently mandated 2013 LOMCE (*Ley Orgánica de Mejora de Calidad Educativa*). Educational reforms over the past three decades have encouraged a leap for many who have been forced to emerge from entrenched practices of rote memorization and discipline-focused learning (see Gil Flores 2014, Pamies et al. 2015). Pamies et al. write:

> The Spanish educational system experienced a great shift in earliest nineties: Primary and Secondary Education curricula changed from a conception based on conceptual knowledge that was meant to be learn[t] by heart, to a[n] educational system that focused on learning knowledge, skills, attitudes and values. That shift implied a massive training of in-service teachers. More than one decade after, the incorporation of the competence

> based approach [shook once] again the co[m]fort zone of teachers, but this time [fewer] training opportunities have been provided…Despite the reforms and efforts for implementing the competence-based approach, there are many internal contradictions in the educational system that hinder a proper development….Teachers are struggling with the assessment of competences achievements. It is not fully clear how to handle it, and how to split it into learning outcomes units of assessment (2015, 72-73).

It is not difficult to argue that in order to successfully implement educational political mandates at a large scale, current and future teachers must fully understand these policies and act as active participants in their day-to-day classroom application (Brindley 2013; Brown and Poortman 2018; Pantic and Wubbels 2010; Schleïcher 2011; Struyven and De Meyst 2010). It is increasingly recognized that the training of current and future teachers is key to the development of effective, innovative political mandates (e.g. Brindley 2013; Schleicher 2012). However, many argue that most teachers, and teacher trainees for that matter, have not received the necessary training required to implement competency-based strategies in a consistent, comprehensive, and integral way (Pamies et al. 2015; Hoogveld, Kaldi and Xafakos 2017). As Jasman writes, "Even when governments embrace a 'future' perspective in order to ensure competitive advantage in a global knowledge economy, the teaching workforce may not be able to engage with this agenda" (2009, 328).

We would like to differentiate between professional competencies that Spanish (and other EU) primary-level preservice teachers are expected to acquire as students themselves, which is more often studied (e.g. De-Juanas Oliva, Martín del Pozo, and Pesquero Franco 2016), from their own views and attitudes on competency-based teaching as applied with their primary school students once they are in the classroom, first in practicum experiences and later as teachers. It is in regard to the latter where we notice a gap in the literature, both in Spain and in the EU in general, and a lack of psychometrically-sound instruments.

This study aimed to develop and pilot an instrument for primary preservice teachers to measure: 1) their opinion of the current primary education competency-based educational

policy mandate; 2) how confidently they apply this competency-based mandate in the classroom during their practicum teaching experiences; 3) how confidently they apply this competency-based mandate in the classroom during their practicum evaluation experiences; and 4) how completely they understand the intended rationale for this mandate.

Clearly, without effective training, achieving the educational improvements expected in a competency-based system is unlikely (Day 2002; Lask 2005; Pamies 2015; Pantic and Wubbels 2010). Many teachers and preservice teachers find they do not feel qualified to implement innovative educational policies, like those centered on key competencies (Pamies et al. 2015, Pantic and Wubbels 2010; Spiel and Strohmeier 2012). However, teachers and future teachers are crucial stakeholders in any reform process, whether they act actively or passively (Datnow et al. 2002; Null 2016). The true merits of key competency application cannot be assessed if those that are supposed to implement these policies do not fully understand what its application implies.

Curricular innovation, particularly when it takes the form of a top-down policy, can be problematic and slow to implement. Ruiz Tarragó and Wilson argue that attempts to improve education through political mandates on key competencies fail:

> [T]op-level school system administrators in many EU countries claim that curriculum adaptations harmonizing subject disciplines and competencies frameworks have already been carried out. Yet this "harmonizing" is not so straightforward for teachers, who face the daily realities of such changes, decided on and dictated in a far-removed, top-down manner (2010, 390-91).

If, indeed, such harmony is not a reality for most teachers, this truly proposes a problem in that competency-based curricular innovation is not fully effective unless it is carried out in an effective manner in the classroom. Teacher trainees are in a potentially privileged position as they can potentially receive many hours of both practical and theoretical training in key-competency-based educational policy; however, at least in the context of Spain, where our

data were gathered, it is unclear to what extent teacher trainers at the university and active classroom teachers who take on teacher trainees hold similar understandings of how key competency-based educational policies should manifest themselves in the primary classroom (De-Juanas Oliva, Martín del Pozo, and Pesquero Franco 2016).

Other complications arise when teachers and trainee teachers use their beliefs about how to teach, which are often based on personal experiences from when they were students of early childhood, primary and secondary education, to filter new concepts introduced in university teacher training (see, for example, Calderhead and Robson 1991; Pereira 2009). Some authors consider that teachers' and teacher trainee knowledge and personal beliefs are inseparable and can strongly influence their perceptions and educational behavior in the classroom and assessment practices (Miller et al. 2017; Pantic and Wubbels 2010; Suprayogi et al. 2017; Smith et al. 2014; Tigchelaar, Vermunt, and Brouwer 2014). For this reason, it can be difficult to change existing knowledge structures, as they help to focus understanding and can contribute to the rejection of new information (Buehl and Beck 2015; Chinn and Brewer 1993; Ertmer et al. 2015). Teachers and trainees are more likely to understand new information by adapting it to what they already know, which leads to knowledge gaps (Smith, diSessa, and Roschelle 1994). This pattern has also been observed in relation to new educational policies (Beck, Czerniak, and Lumpe 2000; Spillane 2000).

There continues to be a general lack of instruments for identifying misunderstandings, negative attitudes, or lack of confidence associated with the use of key competencies during university teacher training, which can make it even harder to implement any policy based on competency mandates. Some instruments, such as that created by Mérida Serrano, González Alfaya, and Olivares García (2011), have been designed to study university lecturers' and students' perceptions of competency-based learning in the university environment (see also Oser, Salzmann, and Heinzer 2009; Tigelaar et al. 2004; Zhu et al. 2013). However, we are

unaware of any research that has examined teacher trainee beliefs, understanding, or attitudes on self-assessment of competencies or their comprehension of the concept of key competencies with the exception of Juanas Oliva, Martín del Pozo, and Pesquero Franco (2016) who assess the value teachers and teacher trainees place on different key competencies in their teaching practices. This study, however, does not attempt to assess teacher attitudes and opinions of the educational policy as a whole. Furthermore, instruments with similar aims in other contexts, intended to measuring teacher views on Common Core in the US, for example, suffer psychometric shortcomings (e.g. Ajayi 2016; Troia and Graham, 2016). Therefore, we argue that it is essential to create a diagnostic tool for researchers to gauge (a) the general opinion of future teachers on the political mandate of key competencies, (b) their understanding of competencies, and (c) their belief in their own capacity to implement this policy in the classroom in order to support teachers in their efforts to navigate this educational policy change. Here it is argued that understanding current and future teachers' knowledge and opinions toward key competency-related policy mandates constitutes an important aspect of efficient curricular innovation.

The purpose of this study was to develop and examine the psychometric properties of a questionnaire to provide a crucial step toward enhancing both scholar and practitioners' ability to assess preservice teachers' beliefs and understandings of a key-competency-based educational policy. Future teachers' perceptions of the new standards and assessments are important to understand they will be frontline implementers of a policy meant to shape their classroom instruction and assessment practices (e.g. Cooper et al. 2004; Porter 2013). When teachers hold positive beliefs and attitudes about a policy, they are more likely to support it with words and deeds; when they view a policy unfavorably, teachers may begrudgingly adhere to it, simply ignore it, or subversively disrupt its intended effects (e.g. Biggs et al. 2008; Brown and Poortman 2018, McCoss-Yergian and Krepps 2010; Spillane, Reiser, and

Reimer 2002; Stein and Wang 1988). The proposed questionnaire aims to fill an imperative empirical gap given the lack of instruments of its kind.

Theoretical perspectives used as the basis of the instrument

The relationship between trainee teachers and curricular innovation and education reforms is part of a complex dynamic comprised of previous and current personal experiences, beliefs, contexts, and authority. The initial stages of instrument construction was carried out with the following themes in mind: a) teacher trainee (or teacher's[1]) opinions on the importance of implementing education reform; b) an attempt to tap into teacher trainees' understanding of what the proposed education reform entails, c) teacher trainees' self-assessment of their understanding of education reform, and d) teacher trainees' self-assessment of their ability to assess students within a competencial framework.

Teacher trainees' opinions of key competency-based educational reform

Reforms in education legislation are highly dependent on changes in the beliefs of the teachers who are involved. For many dedicated to the teaching profession, this is not an easy issue to address when the curriculum policy requires major changes (Minor et al. 2002; Pajares, 1992; Pamies et al. 2015, Prawat, 1992). Furthermore, as mentioned earlier, it is much easier than not for teacher trainees to apply the same methods they have observed year in and year out during their schooling experience as students (see Buehl and Beck 2015, Ertmer et al. 2015, Smith, diSessa, and Roschelle 1994). Although teachers' and future teachers' beliefs influence their behavior in the classroom (Buehl and Beck 2015; Fang 1996;

[1] The current scales were piloted with teacher trainees, but through slight modification and additional piloting could potentially be used with current teachers. It is our aim to use these items in longitudinal and multilevel analyses in the future.

Richardson 1996), contradictions may arise between these beliefs, opinions, and teaching practices (e.g. Wilcox-Herzog 2002). As Pajares notes:

> [E]ducational beliefs of preservice teachers play a pivotal role in their acquisition and interpretation of knowledge and subsequent teaching behavior and that unexplored entering beliefs may be responsible for the perpetuation of antiquated and ineffectual teaching practices (1992, 328; see also Buehl and Beck 2015; Ertmer et al. 2015).

Cognitive understanding of education reform

Education reforms fail due to a misalignment between theory and practice (see Null 2016; van den Berg, Vandenberghe, and Sleegers 1999). This misalignment can be caused by a lack of understanding of new concepts. It can be hard to comprehend the intentions of an education reform. For example, Hill (2001) established that US teachers did not understand the aims of a reform that should have radically changed the previous education policy. The teachers perceived little difference between what they had done before the reform, and what they should implement afterward (see also Spillane 1996, 1998). Furthermore, there may be considerable variation in teachers' understanding: a reform may be interpreted as a radical change or simply a superficial addition to existing policy (Haug 1999) that is easier to implement.

General self-evaluation of the key competency-based teaching understanding

When teacher trainees and active teachers assess themselves, the process influences their beliefs in their ability to be a capable teacher and affects their future decisions on how to teach (e.g. Ross and Bruce 2007). If a teacher or future teacher suffers from anxiety, confusion, frustration, or other negative emotions arising from the implementation of education policies that they have not experienced or observed in practice, they may give up trying to adopt these policies in their own classroom or in student teaching experiences (Huberman and Miles 1984).

Specific self-evaluation of ability to assess students within a key competency framework

The key competencial framework requires specific innovation and change regarding assessment tools (Halász and Michel 2011; Harlen and Deakin Crick 2003; Voogt and Pareja Roblin 2012), which seem to cause some unease among teachers and trainees alike (Buchs et al. 2017; Smith et al. 2014). Given the specific change and innovation required in changing the way that teachers assess their students within a competencial framework it was deemed necessary to create a scale to specifically measure how prepared student teachers felt they were for this particular challenge. It is hypothesized that this scale may load as a separate factor from their general level of self-evaluation, although we expect some correlation with general self-evaluation.

Based on the above research results and observations, the aim of the study was to develop, test, and validate an instrument for use as a research tool in longitudinal and multi-level studies, and as a means for university professors in the EU to assess their students with respect to whether they grasp the utility of key competencies, understand the basic principles of the competency concept, and feel comfortable applying and assessing their achievement in the classroom setting. Those who are largely responsible for teachers' initial training—university lecturers or Departments in teacher training faculties—could find the instrument of great use to assess their own teaching practices relating to key competencies.

Method

Participants and context

The sample pertaining to the third pilot run of the questionnaire reported here consisted of 263 students from a third-year course of University of Barcelona's Bachelor's Degree in

Primary Education (79.8% female, average age 21.8). Students were surveyed in Catalan[2] their usual classrooms by a member of the research team (not their own professor). Answering the survey was optional, but those who participated received 1% in extra points towards their final grade. When students turned in surveys, they signed a separate sheet of paper used to calculate extra grade points.

Importantly, the Faculty of Education at the University of Barcelona has a high percentage of part-time adjunct lecturers (over 70% at the time of carrying out the field work for this study), who do not necessarily combine their work at the university with work at early childhood, primary, or secondary schools and may or may not be familiar in theory or in practice with the concept of key competencies when they teach the teacher trainees surveyed in this study.

Process

The process of generating the items reported here was carried out in the following seven stages: (1) identification of goal categories and initial item generation; (2) first draft of revisions by a six-member panel consisting of two academic experts, two active teachers and two student teachers; (3) pilot study 1 [n = 295]; (4) revision and modifications of pilot study 1 in order to improve psychometric scale properties; (5) pilot study 2 [n = 277]; (6) additional revisions and completion of pilot study 2 with the aim of further improving the instruments' psychometric properties, specifically internal consistency; and (7) the pilot study 3 reported here [n = 263].

In the first stage of the item generation process, the research team drew on their own experiences as teachers and teacher trainers. In the second stage, the expert panel, consisting

[2] Catalan is the habitual language of instruction in undergraduate university classes in Catalonia. Items were translated into English by the authors for the purposes of this publication.

of active primary teachers involved in research and a small group of fourth year students was consulted on the content and structure of the items, including their wording and suitability, which led to some changes in item wording. The instrument that was proposed at this stage was rated on a 5-point Likert-type scale and consisted of 20 items. This version of the instrument was tested on 295 participants. On the basis of an exploratory factor analysis of the initial test, four items were removed, 6 were slightly modified, and 2 were changed substantially. A second version, which was also rated on a 5-point Likert scale, consisted of 18 items and was tested on 277 participants. The final pilot stage [n = 263], reported here, consisted of an assessment of the psychometric properties of the questionnaire which were much improved compared to the results of the two initial pilot runs.

Results

In the third pilot study of the proposed survey, participants indicated their degree of agreement with 16 statements on competencies, on a 5-point Likert scale, from 1 – *strongly agree* to 5 – *strongly disagree*. The analysis sought to validate the measurement model for the theoretical variables proposed and described above.

Factorial structure and item retention

All items were subjected to a principal component analysis with direct oblimin rotation. As in the first pilot study, two item-retention criteria were used: (a) item loading on the main factor should exceed .60 and (b) the loading on the remaining factors should not exceed .30 for the pattern matrix or .40 for the structure matrix. These criterion were met by all items (see Table 1).

The Kaiser–Meyer–Oklin (KMO) value was 0.814, over the recommended 0.6. Bartlett's test of sphericity indicated the necessary communality present to justify a factor analysis (χ^2 = 1437.568, df = 120, $p \leq .001$). Hence, it was deemed appropriate to factorize the

Table 1. Rotated factor and Structure Matrices for the proposed items.

Item	F1 Opinion of reform		F2 Specific self-evaluation: Ability to assess		F3 Comprehension of interdisciplinarity		F4 Application of preconceptualization		F5 General self-evaluation	
	P	S	P	S	P	S	P	S	P	S
Teaching practices focused on key competencies allows for a more quality education for students.	.854	.844								
The future of primary education should be based on competencies.	.845	.838								
Good teachers are those who focus on competencies when they teach.	.766	.785								
All teachers should keep competencies in the forefront of their mind when they teach classes.	.743	.785								
If I follow a key-competency-based teaching curriculum I will be a better teacher than if I don't follow one.	.726	.690								
I do not understand why so much importance placed on key competencies in schools.[R]	-.657	-.704								
I have received sufficient training to be able to competencially evaluate my students in my future student teaching experiences.			.847	.864						
I know how to evaluate primary students with a key-competency focus.			.844	.865						
During my initial student teaching experience I was able to competencially evaluate my students.			.831	.844						
Social and cultural aspects can be integrated when teaching all disciplines.					.861	.856				
Social and cultural aspects can be taught at the same time as mathematics.					.832	.848				
There are specific competencies relevant to each subject.							-.830	-.834		
Some specific competencies correspond to certain disciplines.							-.797	-.803		
When I plan a teaching unit for an undergraduate degree subject, I am familiar enough with the key competencies so that I don't have to look them up.									.826	.837
I have interiorized the key competencies.									.751	.817
I am familiar with all the key competencies.									.687	.747

Note. Principal axis factor analysis with oblique rotation (direct oblimin) was carried out. P = pattern coefficients; S = structure coefficients. Items have been translated from the original version in Catalan. [R] Reversed item. Only pattern and structure coefficients with values of .400 or greater are shown.

variables. The factor analysis revealed a structure comprising five factors instead of the four that were hypothesized (see Table 1).

These factors explained 68.2% of total variability. The factorial structure is shown in Table 1. The first factor, identified as Opinion of key competency-based educational reform (Opinion of reform), is comprised of 6 items (e.g. "Teaching practices focused on key competencies allows for a more quality education for students.") and explains 27.6% of the variance. The second factor, Specific self-evaluation of ability to assess students within a key competency framework (Specific self-evaluation: Ability to assess) consists of 3 items (e.g. "I have received sufficient training to be able to evaluate my students in my future student teaching experiences.") and explains 15.8% of the variance. The third factor, Comprehension of the possibility of an interdisciplinary-focused approach (Comprehension of interdisciplinarity), consisting of two items (e.g. "Social and cultural aspects can be integrated when teaching all disciplines."), explains 10.7% of the variance. The fourth factor, we identified as Application of a preconceptualization of previous educational policies (Application of preconceptualization), also consists of 2 items (e.g. "Some specific competencies correspond to certain disciplines") and explains 7.8% of the variance. A final firth factor General self-evaluation of the key competency-based teaching understanding (General self-evaluation) accounts for 6.3% of variance. As is common, we only considered factors that obtained an eigenvalue above 1. All the eigenvalues were above this value: 4.42 for Factor 1, 2.53 for Factor 2, 1.72 for Factor 3, 1.25 for Factor 4, and 1.01 for Factor 5.

Scale reliability

To determine the reliability of the five factors regarding the retained items, we calculated Cronbach's alpha for each Factor consisting of 3 or more items. For the 6-item Factor Opinion of key competency-based educational reform (Opinion of reform, F1), Cronbach's alpha was .867. The alpha value for the 3-item Factor Specific self-evaluation of ability to

assess students within a key competency framework (Specific self-evaluation: Ability to assess, F2) was .794. For the additional 3-item factor General self-evaluation of the key competency-based teaching understanding (General self-evaluation, F5) it was .751. While not ideal, the Spearman-Brown coefficient can be used to estimate reliability in two-item scales (Eisinga, te Grotenhuis, and Pelzer 2013). Therefore, two-item factor internal consistency was estimated through the Spearman-Brown Coefficient as well as for the other three factors (see Table 2).

Table 2. Number of items (N), mean (M), range, and internal consistency (Cronbach's alpha and Spearman-Brown Coefficient).

Factors (scales)		N_{items}	M	SD	Range	α	Spearman-Brown Coefficient
F1	Opinion of key competency-based educational reform (*Opinion of reform*)	6	3.505	.710	.533	.867	.892
F2	Specific self-evaluation of ability to assess students within a key competency framework (*Specific self-evaluation: Ability to assess*)	3	2.601	.784	.506	.823	.794
F3	Comprehension of the possibility of an interdisciplinary-focused approach (*Compre-hension of interdisciplinarity*)	2	4.555	.427	.011	-	.521
F4	Application of a preconceptualization of previous educational policies (*Application of preconceptualization*)	2	3.881	.573	.162	-	.646
F5	General self-evaluation of the key competency-based teaching understanding (*General self-evaluation*)	3	2.511	.769	.099	.751	.692

Table 3 shows the correlation coefficients for each of the scales resulting from the factor analysis. Non-redundant and non-significant correlations were confirmed between factors, confirming that there were no redundancy issues. Not surprisingly, higher, albeit non-redundant correlations were observed between the two self-evaluation factors F2 (Specific self-evaluation: Ability to assess) and F5 (General self-evaluation), as predicted, as well as

the two factors (originally hypothesized as one) aimed at measuring an understanding of the educational policy F3 (Comprehension of interdisciplinarity) and F4 (Application of preconceptualization).

Table 3. Correlations between the five dimensions items of part one (5-point scale) of the questionnaire.

	F1	F2	F3	F4	F5
F1. Opinion of key competency-based educational reform (*Opinion of reform*)	-				
F2. Specific self-evaluation of ability to assess students within a key competency framework (*Specific self-evaluation: Ability to assess*)	.148*	-			
F3. Comprehension of the possibility of an interdisciplinary-focused approach (*Comprehension of interdisciplinarity*)	.135	.061	-		
F4. Application of a preconceptualization of previous educational policies (*Application of preconceptualization*)	.195	.133*	.498**	-	
F5. General self-evaluation of the key competency-based teaching understanding (*General self-evaluation*)	.326**	.467**	.003	-.006	-

Note. *$p \leq .05$, **$p \leq .01$.

Potential floor and ceiling effects were examined by observing the proportion of respondents who scored the lowest or highest possible score on any of the five scales. There were no concerning ceiling or floor effects detected, with ≤11% of respondents scoring the highest or lowest scale scores (average 3.1% across scales).

Discussion and Conclusions

Recently, mandates on standards in education policy, such as key competencies in the EU, or Common Core in the USA, have included intentions to radically change the education practice of millions of professionals. There exists an urgent need to develop appropriate instruments to measure the extent to which teachers and teaches in training agree with these education policy mandates and understand why they are implemented as education policy, as they

are designed by policy-makers. It is also beneficial for university lecturers who train future teachers to have access to valid, reliable tools for use with their students. Nevertheless, there is a dearth of valid and reliable instruments available to these ends. Those responsible for teacher training should determine whether their students are familiar with education policy reports, consider them to be useful, understand the concept cognitively, and feel able to apply it practically in the classroom. Our aim was to develop, test, and validate an instrument for its future implementation as a research tool in longitudinal and multilevel studies, in a wide range of educational contexts and used on a smaller scale as a way for professors and Departments at universities in EU countries to assess their own teacher training.

Initially, it was expected that the proposed variables, based on the theoretical principles presented in the Introduction section, would be similarly reflected in the factor analysis. For the most part, this was true. Indeed, the analysis revealed that three hypothesized variables, Opinion of key competency-based educational reform (Opinion of reform, F1), Specific self-evaluation of ability to assess students within a key competency framework (Specific self-evaluation: Ability to assess, F2), and General self-evaluation of the key competency-based teaching understanding (General self-evaluation, F5) clearly corresponded to three of the proposed variables. However, the expected loading for the third proposed variable Cognitive understanding of education reform, was not coherent with the factor analysis. In addition, the two resulting factors are worthy of further study. As established at the start of the paper, it is very difficult to change existing knowledge structures, as understanding is based on what we already know. This could contribute to difficulties in accepting new information (see, for example, Calderhead and Robson 1991; Beck, Czerniak, and Lumpe 2000; Chinn and Brewer 1993; Smith, diSessa, and Roschelle 1994; Spillane 2000). Therefore, given the data presented here, we believe that separate consideration of a variable Application of a preconceptualization of previous educational policies (Application

of preconceptualization) from Comprehension of the possibility of an interdisciplinary-focused approach (Comprehension of interdisciplinarity) is warranted. However, an expansion focused on the differences between these two concepts could increase the internal consistency of these two scales; a limitation of the current instrument. One additional limitation of the study is that instrument development has taken place in a specific university context. Future studies should assess instrument validity and reliability in other university and national contexts.

Longitudinal application could help to evaluate current and future teachers on the concept of competencies, beliefs in their ability to apply competencies in their future classroom experiences, and beliefs in the usefulness of the concept through changes over time. Longitudinal studies could identify potential changes over time in the five variables proposed here and during the various stages of formal and informal training. As indicated by Feiman-Nemser (2001), trainee teachers' initial perspectives should be examined critically before alternatives are presented, as teachers' beliefs and theoretical knowledge shape their understanding of concepts (see also Buehl and Beck 2015, Ertmer et al. 2015, Korthagen and Vasalos 2005). Future studies could also compare the opinions of different faculties of education with those of students at different universities to explore potential correlations and include students' assessments of their university lecturers' ability to transmit the concept. The tools should be combined with other more qualitative, practical evaluations that are also used longitudinally, to achieve their potential.

It would be particularly interesting to apply this instrument in a multilevel study comparing contexts and networks of communities. Multilevel models (also known as hierarchical linear models, among other names) can control many variables at the same time while they consider different levels of organizational groupings, for example, the individual, formal training, and the professional environment (see Bickel 2007; Raudenbush and Bryk

2002). It has been observed that social aspects of the community and the input of colleagues play an important role in understanding and shaping attitudes on how to improve teaching practices (e.g. Hofman and Dijkstra 2010) as well as in understanding new education policies (see Brown and Poortman 2018). These influences could come from different contextual levels simultaneously (e.g. Jurasaite-Harbison and Rex 2010). The context, organization, and community in which a teacher is placed influence the learning goals and collaboration (Brown and Poortman 2018). By applying the scales proposed here and studying other variables, multilevel analyses could reveal best practices relating to the implementation of education reforms, considering the differences between universities providing formal teacher training and schools in terms of working in professional teams, tutoring, and other organizational structures.

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