ATTITUDES TOWARDS MATHEMATICS IN PRE-SERVICE TEACHER TRAINING: A COMPARATIVE STUDY BETWEEN SPAIN AND PORTUGAL FOCUSING ON ANXIETY

ATITUDES PARA COM A MATEMÁTICA NA FORMAÇÃO INICIAL DE PROFESSORES: UM ESTUDO COMPARATIVO ENTRE PORTUGAL E ESPANHA COM FOCO NA ANSIEDADE

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ABSTRACT
This article is part of a larger project - *Attitudes towards Sciences and Mathematics* - involving several Ibero-American countries. In this paper, we analyze attitudes related to anxiety towards mathematics in two studies with Spanish and Portuguese pre-service teachers. The participants of the first study (N = 186) are Spanish pre-service teachers at the beginning of the mathematics curricular units of their courses, and Portuguese pre-service teachers at the beginning of professional master's degree courses; the participants of the second study (N = 229) are the same Spanish pre-service teachers and Portuguese pre-service teachers at entry into higher education. The Modified Auzmendi Questionnaire was used to research the association between anxiety and gender, stage of education and country. An association between anxiety and country was found in the first study, Spanish pre-service teachers showing greater anxiety. At entry into higher education (second study), no significant difference in level of anxiety was found across the two countries. We concluded that further cross-country comparative research is needed to examine the stability of those findings, and whether

the pedagogies used throughout teacher training contribute to the increase or decrease of anxiety towards mathematics.

Key words: Attitudes, anxiety, mathematics, pre-service teacher training, comparative study.

RESUMO
Este artigo enquadra-se no projeto *Atitudes em relação às Ciências e à Matemática* que envolve diversos países ibero-americanos. Analisamos as atitudes relacionadas com a ansiedade para com a matemática em dois estudos envolvendo estudantes portugueses e espanhóis, em formação inicial de professores. Os participantes no primeiro estudo (N = 186) são alunos espanhóis no início dos seus cursos, estando a começar unidades curriculares de matemática, e alunos portugueses que estão a iniciar os mestrados profissionais necessários para serem professores; os participantes no segundo estudo (N = 229) são os mesmos alunos espanhóis que entram no primeiro estudo e alunos portugueses à entrada no ensino superior. Utilizou-se o Questionário Modificado de Auzmendi para pesquisar uma eventual associação entre ansiedade e fatores como o género, nível de educação e o país. Os resultados do primeiro estudo mostraram que havia uma associação entre ansiedade e país, experienciando os alunos espanhóis maior ansiedade. No segundo estudo, não foram encontradas diferenças significativas no nível de ansiedade em função do país. Conclui-se que são necessários mais estudos comparativos para examinar a estabilidade dos resultados encontrados e se as pedagogias usadas durante a formação inicial de professores contribuem para o aumento ou para o decréscimo da ansiedade para com a matemática.

Palavras-chave: Atitudes, ansiedade, matemática, formação inicial de professores, estudo comparativo.

1. Introduction

Clarke and Hollingsworth (2002) proposed a model of professional development of in-service teachers, recognizing the complexity of teachers' learning processes. We think that this model is also useful to analyze the learning processes of prospective teachers. According to the authors, professional development stems from the reflection that teachers make in the several domains: (i) *personal* domain comprising of knowledge, beliefs and attitudes; (ii) *external* domain (external source of information or stimulus); (iii) domain of *consequence* (salient outcomes*);* (iv) and domain of *practice* (professional experimentation). Professional development also stems from the experimentation of new forms of actuation. This article focus on the personal domain, specifically on anxiety, considered as a negative attitude. We assume the definition of mathematics anxiety as “a feeling of tension, apprehension, or fear that interferes with math performance” (Ashcraft, 2002, p. 181).

The relevance of attitudes is widely recognized in mathematics education. Chacón (2000, p. 23) defines these attitudes as an "evaluative predisposition of conduct that determines the personal intentions and influences the behaviour". Attitudes towards mathematics of pre-service teachers influence the teaching in this disciplinary area. Prospective teachers have attitudes towards mathematics that were acquired over the previous years of schooling as students (Bekdemir, 2010; Philippou & Christou, 1998).

Those attitudes may be obstacles to the development of new competencies, and it is of utmost importance to develop research on them (Maaß & Schlöglmann, 2009) since studies on higher education students have focused on domains of knowledge and professional development and not so much on the affective domain. The latter studies have been developed more in the educational stages before entering higher education. Students' mathematics learning are influenced by the quality of training of prospective teachers, their motivations, attitudes, expectations and visions about their future profession (Mendías, Alex, & Espigares, 2011). Specifically, attitudes towards mathematics are reflected in teaching practices and those practices influence students' learning (Jong, Hodges, Royal, & Welder, 2015; NCTM, 2014). Affective factors are very relevant in mathematics education and anxiety is certainly the one with the highest influence on achievement (Picos, Alonso, Saez, & Del Rincón, 2013; Ramirez, Gunderson, Levine, & Beilock, 2013; Wu, Willcutt, Escovar, & Menon, 2014).

According to Márquez (2004), the closed questionnaire of Auzmendi (Escribano, 1992) is the most widely used in Spanish studies focusing on attitudes towards mathematics. This questionnaire uses multidimensional definition of attitude, including items relative to the usefulness of mathematics, liking - disliking mathematics, and anxiety. Its psychometric properties were researched by Escribano (1992) resulting in a model with five factors. Later, López (cited in Márquez, 2004), identified four factors explaining 53.6% of the variance, and Méndez and Macía (2007) also coincide in these four factors. Cézar, Pinto, Rizzo, Camino, Albarrán, & Espinosa (2016), proposed a model of a single factor for anxiety. This is called the Modified Auzmendi Questionnaire (MAQ), and is the one used in the present studies.

This article is integrated into a larger project, *Attitudes towards Sciences and Mathematics*, involving the Universidade de Castilla-La Mancha (UCLM), the Escola Superior de Educação de Lisboa (ESELx) and other Ibero-American institutions. The project aims to: (i) identify attitudes towards mathematics and natural sciences in in-service teachers and pre-service teachers of the first years (age 3-12) and in children/students of the various educational stages (age 3-18); (ii) analyze possible relationships between different factors (gender, educational stage, number of years of teaching practice, teaching practices implemented) and attitudes; and (iii) carry out a comparative study among Ibero-American participating countries.

The goal of the present article is to analyze data collected through the MAQ, delivered to elementary prospective teachers in UCLM and ESELx, in order to identify which factors may be associated to anxiety.

2. Theoretical framework

In the field of psychology, the concept of attitude includes a behavioral component, being recognized as a motivational force of human behavior. According to Goldin, Rösken, and Törner (2009), attitudes are defined as propensities towards certain kinds of emotional feelings or patterns of behavior in particular domains. So, attitudes are affective responses including positive or negative feelings of moderate stability and intensity (Kislenko, 2009). This definition leads us to the need of clarifying the notion of affect. Philipp (2007) defines affect as "a disposition or tendency or an emotion or feeling attached to an idea or object" (p. 259) relating to emotions, attitudes and beliefs.

Emotions are "feelings or states of consciousness, distinguished from cognition" (Philipp, 2007, p. 259). Beliefs are defined by Törner and Pehkonen (1999, p. 1) as "one's subjective knowledge (which also includes affective loadings) of a certain object or concern for which indisputable grounds may not necessarily be found in objective considerations" and can be conscious or unconscious. Philipp (2007) describes beliefs as psychologically held premises, understandings or propositions about the world that are thought to be true, having several degrees of conviction. Stability is one of the criteria to distinguish across elements that constitute affect. Emotions change more rapidly than attitudes and beliefs.

In mathematics education, a growing interest on affect has been observed, namely on the issue of attitudes, since the second half of the 20th century. According to Zan and Di Martino (2008), there is a lack of theoretical framework in research on attitudes towards mathematics insofar as many studies about attitudes do not provide a clear definition of the construct itself which "tends rather to be defined implicitly and a posteriori through the instruments used to measure it" (p. 158). Several authors present different definitions of attitudes towards mathematics, since a simple one described as the positive or negative degree of affect associated with mathematics (McLeod, 1992) to a multidimensional definition (Di Martino & Zan, 2011; Hart, 1989; Ma & Kishor, 1997; Zan & Di Martino, 2008). McLeod (1992) proposed a first model about the affective domain in the learning of mathematics, considering, as Philipp (2007), that it is composed of attitudes, beliefs and emotions. According to him, attitudes towards mathematics can have two types of sources: (i) result from the automation of an emotional reaction to mathematics that occurs repeatedly, which turns into an attitude by being stable; (ii) result from the association of an existing attitude with a new situation related to the previous one. Aiken (1970), reviewing the work about attitudes in mathematics education of that decade, recognizes that although there is no definition for attitudes in mathematics education, there is a consensus that "it refers to a learned predisposition or tendency on the part of an individual to respond positively or negatively to some object, situation, concept or another person" (Aiken, 1970, p. 551).

Later, other researchers proposed multidimensional perspectives of attitude not centered on the behavioral aspect. Hart (1989) argues that there was, at the time, no definition agreed by experts of what is meant by attitudes in mathematics education. For him, the notion of attitude combines three components: (1) positive or negative emotional response towards mathematics; (2) beliefs regarding mathematics, and (3) behavioral tendency in relation to mathematics. From this point of view, attitudes towards mathematics is defined by the emotions associated with mathematics, the beliefs towards mathematics and the behavior. A sketch of the model of attitudes in mathematics education in the Ibero-American context is presented in Sallán (1991). While McLeod (1992) and Philipp (2007) place the components of beliefs and emotions, together with attitudes, in the definition of affect, Hart (1989) places them in the notion of attitude. Also Zan and Di Martino (2008) and Di Martino and Zan (2011) proposed a three-dimensional model of attitudes towards mathematics: (1) emotional disposition (I like/dislike mathematics); (2) perception of competence (I can/can't do it); (3) vision of mathematics (mathematics is...). According to Di Martino and Zan (2011), there is a close relation between emotional disposition and perception of competence. Concerning the vision of mathematics, which results from the ideas that students express about mathematics, the authors stress the importance of valuing significant thought processes rather than products, which are often associated with the emphasis of

obtaining correct answers. In this perspective, attitudes are defined in a complex way, which is distinct of considering them as predispositions to certain patterns of behavior, according to a simple definition. Ma and Kishor (1997) also proposed a broader definition of attitudes towards mathematics including different elements, such as the conception about the usefulness of mathematics, the liking or not of mathematics, the tendency to engage or not in mathematical activity, and the conception about personal aptitude for mathematics.

Positive attitudes integrate the mathematical proficiency as defined by Kilpatrick, Swafford and Findell (2001). These authors see learning of mathematics as including the development of five interconnected strands that, together, constitute mathematical proficiency: (i) conceptual understanding; (ii) procedural fluency; (iii) strategic competence; (iv) adaptive reasoning; and (v) productive disposition. The last one is the inclination to see sense in mathematics, to regard it as useful and worthwhile, coupled with a belief in diligence and one's own efficacy. Therefore, productive disposition resonates with positive attitudes, in the sense of the broader definition of attitude of Ma and Kishor (1997).

Picos et al. (2013), using structural equations analysis, found that the most relevant factor for feeling negative attitudes towards mathematics is anxiety. Other authors have also reported that many people have extremely negative attitudes to mathematics, sometimes amounting to severe anxiety (Hembree, 1990; Ashcraft, 2002; Maloney & Beilock, 2012). Anxiety, coming from the latin word "anxietas", appears frequently associated to the feeling of anguish (coming from the latin "angustiae"), meaning *extremely narrow* and the feeling of being compressed. Mathematics anxiety has been defined by Richardson and Suinn (1972, p. 551) as "feelings of tension …that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations". According to this definition, anxiety relates to perception of competence, in the model proposed by Zan and Di Martino (2008) and Di Martino and Zan (2011), and also to the tendency to engage or not in mathematical activity, in the model of Ma and Kishor (1997), in the sense that the higher the anxiety, the lower the self-confidence to engage in mathematical activity.

Núñez et al. (2005) report several studies (Utsumi & Mendes, 2000; Watt, 2005) that show that as students move up the educational stage, the level of negative attitudes, including anxiety, increases. Students with 16 years of age or older, express more negative attitudes than students aged 11 or 12. The study conducted by Núñez et al. (2005) with 5926 Brazilian and Spanish students aged 9 to 16 led to the same conclusion: as students progress in the educational stage, attitudes towards mathematics became more negative, students becoming more anxious throughout their schooling. Kislenko (2009) reported several studies dealing with gender differences that show a higher level of anxiety in mathematics for females than for males. This author presents a study involving a sample of 580 students from grades 7, 9 and 11. The results, concerning anxiety, confirm that females tend to be more insecure in mathematics lessons than males, and that 11th graders were more text-anxious.

Regarding pre-service teachers' mathematics anxiety, the study developed by Bekdemir (2010) revealed that mathematics anxiety was persistent in numerous pre-service teachers, and it was substantially caused by teaching approaches undergone in their past. In addition, Philippou and Christou (1998) showed that (i) prospective teachers brought

negative attitudes towards mathematics from their past, and (ii) a mathematics preparatory program designed and implemented over a period of three years influenced attitudes positively. Specifically, anxiety decreased at the end of the mathematics preparatory program. The findings of Newstead (1998) also showed the influence of teaching approach in anxiety level. This study focused on mathematics anxiety in nine- to eleven-year-old children and found that pupils who were exposed to a traditional approach revealed more mathematics anxiety than those who were exposed to a teaching approach, including a process-oriented teaching method, emphasizing understanding rather than drill and practice, as well as social and public aspects of doing mathematics, particularly with regard to the work with peers in small co-operative groups and to the problem solving and discussion of several strategies for solving these problems.

Ma and Kishor (1997) did not find a significant association between attitudes and academic achievement. However, other recent studies with Spanish prospective teachers (Blanco, Barona & Carrasco, 2013; Blanco, Guerrero, Caballero, Brígido, & Mellado, 20102010; Jiménez, Nieto, Cortés, & Lizarazo, 2012) pointed to a correlation between cognitive and affective dimensions. Nordlander and Nordlander (2009), in a study with 244 Swedish students (age 13 to19), also showed the big influence of students' attitudes on the ability of solving mathematical problems, revealing a strong positive correlation between the students' achievement in problem-solving and their attitudes. They stress that, having a negative attitude towards mathematics can block students' performance. On the other hand, having a positive attitude towards mathematics can motivate students to engage in mathematical activity, influencing their learning (Reinup, 2009). According to the NCTM (2014, p. 8), "interest and curiosity evoked throughout the study of mathematics can spark a lifetime of positive attitudes toward the subject". Goldin (2002) even mentions that the affective system plays a central role in the cognitive dimension of mathematics learning. Focusing specifically on anxiety, also Ramirez et al. (2013) stress the influence of mathematics anxiety on mathematics achievement of middle school and high school students. Several authors (Ashcraft, 2002; Newstead, 1998; Ramirez et al., 2013) state that mathematics anxiety interferes with memory processes because anxious students devote attention to their intrusive worries (such as one's fear of mathematics, one's low self-confidence) rather than to the mathematical task.

To summarize, these findings suggest an association between anxiety and diverse factors, such as gender, stage of education, teaching approach and mathematics achievement.

3. Methodology

The two cross-sectional quantitative studies that we report now aim at examining anxiety towards mathematics in pre-service teachers of UCLM and ESELx.

3.1. Participants

Study 1. The participants were 186 pre-service teachers, 142 Spanish and 44 Portuguese, who answered the MAQ completely.

The Spanish sub-sample is composed by pre-service teachers that were initiating curricular units of mathematics in their courses. They were in the 1st year of "Grado de Maestro en Educación Primaria" (elementary education teacher degree) and in the 2nd year of "Grado de Maestro en Educación Infantil" (preschool education teacher degree).

The Portuguese sub-sample is made of 1st-year pre-service teachers of professional master's degree courses: "Mestrado em Educação Pré-escolar" (master's degree in preschool education), "Curso de Mestrado em Ensino do 1.º Ciclo do Ensino Básico e de Português e História e Geografia de Portugal no 2.º Ciclo do Ensino Básico" (master's degree in the teaching at the 1st cycle and in the teaching of language, history and geography at the 2nd cycle of elementary education), and "Curso de Mestrado em Ensino do 1.º Ciclo do Ensino Básico e de Matemática e Ciências Naturais no 2.º Ciclo do Ensino Básico" (master's degree in the teaching at the 1st cycle and in the teaching of mathematics and natural sciences at the 2nd cycle of elementary education). All Portuguese pre-service teachers who were in 1st year of the professional master's degree courses (92) were invited to respond to the questionnaire but only 44 completed it. They had already gone through three years of training experience in a higher education institution corresponding to the completion of a degree in basic education ("Licenciatura em Educação Básica" - LEB).

There were 165 females and 21 males. They attended preschool teacher courses (N=99) and elementary education teacher courses (N=87). All pre-service teachers responded to the questionnaire at the beginning of the school-year of 2015-16.

The different ways to reach a job position as in-service teacher in the two countries have been described in the work of Nieto and Jiménez (1995), but before the implementation of the Bologna Agreement. Currently, this path in Spain involves a 4-year degree called "Grado de Maestro en Educación Infantil" (preschool education teacher degree) or "Grado de Maestro en Educación Primaria" (elementary education teacher degree), which corresponds to 12 and 18 compulsory European credits on didactics of mathematics, respectively. The electronic syllabus per subject is public and incorporates the contents, the competences to be acquired, the tentative timetable, and the assessment, and is approved by the Ministry of Education through ANECA (Quality National Agency). In Portugal, pre-service teachers access the teacher profession after completing a master's degree preceded by the completion of a 3-year LEB degree. They can choose among three options: "Curso de Mestrado em Ensino do 1.º Ciclo do Ensino Básico e de Português e História e Geografia de Portugal no 2.º Ciclo do Ensino Básico" (Portuguese language, history and geography); "Curso de Mestrado em Ensino do 1.º Ciclo do Ensino Básico e de Matemática e Ciências Naturais no 2.º Ciclo do Ensino Básico" (mathematics and natural sciences); or "Mestrado em Educação Pré-escolar " (preschool education). The syllabi of contents and competences are not fixed by the Ministry of Education. They depend on each university or polytechnic institution that offers them.

Study 2. The participants were 229 prospective teachers, 142 Spanish (as in the first study) and 87 Portuguese. They completed the MAQ just before the beginning of the first mathematics content course. Among them, 208 are females.

The Portuguese sub-sample comprises pre-service teachers from the 1st year of LEB who responded to the questionnaire at the beginning of the school-year of 2016-17.

3.2. The questionnaire

In order to measure anxiety, psychologists have mostly used questionnaires, while educators have no unique way of quantifying it. As in the case of attitudes, several authors (Blanco, Barona & Carrasco, 2013; Blanco et al., 2010; Jiménez et al., 2012; Di Martino & Zan, 2010; 2011) consider that it should be approached through essays or open-ended questions, as they argue that respondents to closed questionnaires are not sincere but are influenced by what they think they are expected to answer (Zan & Di Martino, 2008). On the other hand, studies with closed questionnaires are abundant (Arrebola & Lara, 2010; Cézar & Pérez, 2010; Palacios, Arias, & Arias, 2013; Seco & García, 1999). Among the instruments used to measure anxiety towards mathematics, the most widely used are the Fennema–Sherman Mathematics Attitude Scales (Fennema & Sherman, 1976) and the Mathematics Anxiety Research Scale (MARS) by Richardson and Suinn (1972). MARS is a test whose psychometric properties have been most frequently assessed, as well as its modified versions, such as Suinn and Winston (2003) that was found consistent and highly reliable. In the Spanish context, there are several ad-hoc questionnaires to measure anxiety towards mathematics, but the most widely used is the Attitude towards Mathematics Scale of Auzmendi (Escribano, 1992). In this scale, the author considers anxiety as one among five factors in the original study performed with pre-university students. Cézar et al. (2016) performed an exploratory and confirmatory factor analysis on this questionnaire involving the answers of 200 Iberian primary education teachers and pre-service teachers. They concluded that this instrument clearly discriminated one factor: anxiety. This is why this Modified Auzmendi Questionnaire is used in our two studies. The anxiety scale is composed by seven items (Annex 1), and pre-service teachers answered through a five-point Likert scale. To the exception of 3 items, that are formulated negatively and therefore were reverted for statistical analysis, the remaining are positively formulated. Thus, the higher the score, the higher is level of anxiety. The maximum possible score is 35.

3.3. Statistical analysis

In the interpretation of the results we consider the higher the anxiety the more negative the attitude towards mathematics. Statistical analyses were performed through IBM Statistical Package for the Social Sciences, V. 22. The total for anxiety was examined for its distribution. To carry out the mean contrasts, the normality of total anxiety distribution was checked with Kolmogorov-Smirnoff's test (K-S) for N> 50 subsamples, and Shapiro-Wilk (S-W) for N<50 subsamples, by using the significance correction of Lilliefors's. For the cases in which the distribution is normal, a parametric hypothesis contrast was used. A non-parametric hypothesis contrast was used otherwise.

4. Results

4.1. Study 1

Table 1 shows that the mean of total anxiety is slightly above the median.

Table 1: Total anxiety descriptive statistics (study 1)

Min.	Max.	Mean	Standard Deviation	Median
7	35	19.80	6.902	19

*Maximum possible score = 35.

N=186

The table suggests that nearly 50% of pre-service teachers do feel an anxiety smaller than 19. In previous studies with elementary education degree students (Checa & Artero, 2013; Mendías, 2013) a higher value of anxiety was found, but it is not what we have found here.

After exploration of total anxiety, 3 factors have been identified as meaningful factors for total anxiety: gender, stage of education, and country (see Table 2). The correlation between each factor and anxiety through Spearman coefficient was studied and was found significant only for country (*p =.731* for gender; *p =.701* for stage of education; *p=.000* for country). The value of .398, makes country a relevant factor depicting total anxiety.

Table 2: Descriptive statistics of total anxiety for each factor (study 1)

Gender	Female	Mean	19.81
		Median	20.00
		Standard Deviation	6.905
	Male	Mean	19.71
		Median	17
		Standard Deviation	7.051
Education Stage	Preschool	Mean	19.88
		Median	20.00
		Standard Deviation	6.446
	Elementary	Mean	19.71
		Median	19.00
		Standard Deviation	7.424
Country	Portugal	Mean	14.84
		Median	14.00
		Standard Deviation	5.823
	Spain	Mean	21.34
		Median	21.00
		Standard Deviation	6.489

To confirm the association or lack of it between total anxiety and these three factors, inferential statistics on the means were used. To know the kind of contrast to be used, the normality of total anxiety distribution respecting each factor was analyzed. We found a normal distribution for country (*p=.051* Portugal; *p=.004* Spain) and educational stage (*p= .200* preschool; *p=.005* elementary) and not normal for gender (*p=.020* females; *p=.012* males). Therefore, a parametric contrast for means (t-student) was used in the two first cases and a nonparametric contrast (U-Mann-Whitney) in the third one.

For gender, the mean obtained is 19.81 for females and 19.71 for males, smaller in the last case by just one tenth. The U Mann-Whitney hypothesis contrast (*p=.730*) impedes discarding the equivalence of means, concluding that gender is a factor not associated to total anxiety, contrary to what is observed in other studies performed with similar samples (Artero & Checa, 2014). This information reinforces the lack of correlation achieved, which means that there is not any influence of gender on anxiety for this sample.

As for education stage, the mean is almost the same for preschool and for elementary education, 19.88 and 19.71, respectively. The hypothesis contrast make us not to discard the equivalence of means (*p=.870*). Besides the results on the lack of correlation between total anxiety and education stage, we can conclude that the education stage at which pre-service teachers would work in the future as teachers does not influence their total anxiety.

Regarding country, the total anxiety in Portuguese pre-service teachers is lower than the one of Spanish pre-service teachers (see Table 2), with the total sample mean between the two values. The range (see Table 1) goes from 7 to 35, and the median lies closer to the lower end, meaning that the lower total anxiety values are more abundant than the higher ones. An independent samples t-test was performed in order to test the significant of mean differences of anxiety by country. A significant difference was found ($t_{(184)}$ = -5.90, p < .001), experiencing the Portuguese pre-service teachers a significantly lower level of anxiety (M = 14.84) than the Spanish pre-service teachers (M= 21.34).

4.2. Study 2

Table 3 displays the descriptive statistics of total anxiety in study 2.

Table 3: Total anxiety descriptive statistics (study 2)

Min.	Max.	Mean*	Standard Deviation	Median
7	35	21.34	6.59	21.00

*Maximum possible score = 35.

N=229

The means are slightly higher than in study 1 and within the median scores.

The individual scores of anxiety were analyzed for their distribution (Howitt & Cramer, 1997). We found that the scores were normally distributed (Skewness = 0.078; Standard error of skewness = 0.161; z= 0.48) and therefore parametric tests were used to test the significance of mean differences across gender and country.

Table 4 displays descriptive statistics of total anxiety by gender and country in study 2.

Table 4: Descriptive statistics of total anxiety by gender and country (study 2)

Gender	Female	Mean	21.50
		Median	21.50
		Standard Deviation	6.54
	Male	Mean	19.71
		Median	17.00
		Standard Deviation	7.05
Country	Portugal	Mean	21.34
		Median	22.00
		Standard Deviation	6.80
	Spain	Mean	21.34
		Median	21.00
		Standard Deviation	6.49

The means suggest that male pre-service teachers experience a lower level of anxiety than females and that anxiety does not appear to differ across countries. In order to test the significance of those mean differences, independent samples *t-tests* were conducted. They revealed that there were no significant differences on level of anxiety by gender ($t_{(227)}$ =1.19, p. > .05) and on level of anxiety by country ($t_{(227)}$ = 0.008, p. > .05). It is concluded that neither gender nor country provided a significant contribution for total anxiety in this study.

5. Discussion

In study 1, the Portuguese prospective teachers show a lower value of anxiety. The discussion on this last issue which is the only difference observed, can be related to the different moments at which the questionnaires have been delivered to Spanish and Portuguese pre-service teachers: in Spain, just after ending the mathematics pre-university courses and before starting the mathematics courses at university (1st-year course in elementary education and 2nd-year course in preschool education degree), and in Portugal at the beginning of the professional master courses, after a 3-year degree in basic education (LEB) completed at higher education stage.

The lower value of anxiety observed in Portugal can be related to the fact that in LEB there are 30 European Credits - ECTS - of mathematics, that is to say, the number of

credits of mathematics amounts to a ¼ of the total number of credits. In fact, Portuguese language and mathematics are the two major blocks of the contents in LEB. This fact may make pre-service teachers feel more confident, and therefore, less anxious. On the other hand, it can be related to the type of learning experiences in mathematics undergone in the three years of LEB, already in higher education. In this course, there is a focus on the mathematics that future teachers need to teach, and from this point of view, content is far from formal mathematics used in secondary education. Also, the teaching methodologies used in LEB mathematics classes may be a factor to consider, since active methodologies that involve pre-service teachers in investigative and argumentative processes may contribute to the reduction of anxiety level, as indicated by Newstead (1998) in her study with children.

The Portuguese pre-service teachers entering LEB do have varied educational mathematical inputs, and also different motivations and attitudes towards mathematics. Some of them enter LEB without any mathematics course at the secondary education because it is not a compulsory but elective subject in some courses. However, at the end of LEB course, they seem to feel capable of affording mathematics in a higher extent than Spanish pre-service teachers. In Spain, the higher value of anxiety may be due to the fact that the pre-service teachers just have finished their secondary education stage (Bekdemir, 2010; Maaß & Schlöglmann, 2009; Núñez et al., 2005; Philippou & Christou, 1998). In this educational period, most of them come from high school (aged 16 to 18) modalities where mathematics is a compulsory subject (Cézar & Pérez, 2010), but the way it is taught does not involve any investigative or argumentative approach, because the teaching of mathematics is rather traditional and based on teacher's exposition. The pre-service teachers entering university after 15 years of school mathematics still feel anxious when dealing with this subject. This is a drawback for their ulterior teaching of mathematics, unless it is modified through their university studies. Therefore, this is an issue that needs further consideration.

The hypothesis about the influence of nature of mathematics content and pedagogy implemented in LEB course in Portugal, as an explanation for the lower level of anxiety in Portuguese pre-service teachers, led us to a new study (study 2) in order to compare the pre-service teachers of both countries in similar moments at entry into higher education. In study 2, we found the same amount of mean anxiety for Spanish and Portuguese prospective teachers and no association with other factors.

In this study, the questionnaires have been delivered to Spanish and Portuguese pre-service teachers in a similar moment, just after ending the pre-university courses and before starting the mathematics curricular units in their courses at higher education stage. This suggests that previous educational stages account for a similar effect on anxiety level (Bekdemir, 2010; Maaß & Schlöglmann, 2009; Núñez et al., 2005; Philippou & Christou, 1999).

The mean total anxiety in Portuguese pre-service teachers when entering LEB is 21.34, reducing to 14.84 after completion of LEB. This reinforces the hypothesis that there may be a significant influence of the type of pedagogy followed in mathematics LEB classes on the reduction of anxiety. Although the Portuguese subjects are not the same in the two studies, we anticipate no reason for disclaiming such hypothesis on future research.

We consider that it is important to design longitudinal studies examining how anxiety develops or reduces in the two countries throughout the teacher training process. Going into that direction, we will try to examine in a next study how anxiety has evolved, when participants of study 2 reach the end of their training as teachers.

6. Conclusion

We found no association between anxiety and gender or educational stage, but a significant difference with country, Portuguese pre-service teachers scoring lower. Attitudes are forged in the life period as students (Maaß & Schlöglmann, 2009), which includes the higher education stage as the last one. Our results suggest that the mathematical experience in this stage may lead to a reduction of anxiety level. This contradicts the results of studies (Núñez et al., 2005) involving students of different educational stages, from elementary to high school stage, which presented evidence that, as students advance in the educational stage, negative attitudes, including anxiety towards mathematics, also increase. Our findings suggest the contrary: as Portuguese prospective teachers progress throughout the higher education stage, a decrease in the level of anxiety towards mathematics is observed. Similar results were found in the study of Philippou and Christou (1998), who reported a decrease of anxiety in prospective teachers, at the end of a mathematics program implemented over a period of three years. Nevertheless, our results regard only to the population of UCLM and ESELx. As we did not use representative samples of Spanish and Portuguese prospective teachers, these results cannot be generalized.

In Spain, teacher education university degrees do have compulsory mathematics courses, which means we cannot give figures on how many pre-service teachers would choose them if elective. In the case of Portugal, just 34% of the total of incoming pre-service teachers chose a master's course on mathematics and natural sciences. Thus, it is possible that those who chose this route do no experience as much anxiety towards mathematics as those who chose other courses. As we have found a decrease in level of anxiety after a 3-year LEB course, this also raises additional interesting issues related to the nature of teaching characteristics and pedagogies used throughout training, and comparisons across countries may be especially informative.

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Annex 1. Items from the Modified Auzmendi Questionnaire, used to assess anxiety

ATTITUDES TOWARDS MATHEMATICS

Mark your opinion on these statements following the next convention:

1: Totally disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Totally agree

7. Mathematics is the subject I fear the most.

1 2 3 4 5

8. I feel confident when I tackle a mathematical problem.

1 2 3 4 5

12. When I face a mathematical problem, I feel myself incapable of thinking clearly.

1 2 3 4 5

13. I am calm and quiet when I deal with a math problem.

1 2 3 4 5

17. Working with mathematics makes me feel very nervous.

1 2 3 4 5

18. I don't get stressed when I have to solve mathematical problems.

1 2 3 4 5

22. Mathematics makes me feel uncomfortable and nervous.

1 2 3 4 5