AN INTERNATIONAL COMPARISON STUDY OF THE ALIGNMENT BETWEEN STANDARDS AND ASSESSMENT OF PRE-SERVICE ELEMENTARY MATHEMATICS TEACHER PREPARATION COURSES

by

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A thesis

submitted in partial fulfillment

of the requirements for the degree of

Master of Arts in Education, Curriculum and Instruction

Boise State University

December 2016

BOISE STATE UNIVERSITY GRADUATE COLLEGE

DEFENSE COMMITTEE AND FINAL READING APPROVALS

of the thesis submitted by

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Thesis Title: An International Comparison Study of the Alignment Between Standards and Assessment of Pre-Service Elementary Mathematics Teacher Preparation Courses.

Date of Final Oral Examination: 18 October 2016

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DEDICATION

To God, for His endless love, blessings and for giving me wisdom to face all the challenges.

To my mother, for her love, encouraging words, and for always supporting my dreams and goals.

To my father, family, and fiancé, for their love and patience.

To my friends, who are my second family and who during this journey have given me kind words of support.

ACKNOWLEDGEMENTS

First, I want to express my gratitude to my committee members. Dr. Joe Champion, my committee chair, for all the hours he spent helping me, his patience, valuable comments and suggestions, and specially for sharing his experience and interest in learning from my country's educational characteristics. Dr. Phil Kelly, member of my committee and academic advisor, for his help during the thesis process and my academic program. Dr. Sasha Wang, member of my committee, for her willingness to help and suggestions.

Second, I want to thank the instructors and leaders at the two research sites in the United States and El Salvador, who shared their program and course information for the study. Although I must omit their names for privacy, I am grateful for their willingness to help.

Third, I want to thank my professors during the master program, they changed my vision about the important role we play as teachers and how even across countries we share the same goal, improve our practice every day to help our students.

And finally, my special thanks to Joel Gongora, reviewer during the analysis process, for his valuable contribution, time and interest.

ABSTRACT

This study addresses the extent to which components of pre-service elementary teachers' mathematics programs are aligned. Specifically, it includes an analysis of national standards and assessments for elementary mathematics education courses at universities in two countries, the United States and El Salvador. Understanding that the quality of school education is closely linked to pre-service teacher education, the purpose of the study is to contribute much-needed information to assess and improve pre-service elementary mathematics curriculum in both countries. Using Webb's framework for standards-assessment alignment, data include the *Mathematical Education of Teachers II* (MET II) standards from the United States and *Study Plan for Teachers in Elementary Education* standards from El Salvador, as well as samples of exams from Mathematics for Elementary Teachers I & II courses at one university in each country. The findings include quantitative and qualitative alignment results suggesting potential ways to improve pre-service teacher education programs.

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LIST OF ABBREVIATIONS

C	Course
CAEP	Council for the Accreditation of Education Preparation
CBMS	Conference Board of the Mathematical Sciences
CCSSO	Council of Chief State School Officers
DOK	Depth of Knowledge
ECAP	Evaluación de Competencias Académicas y Pedagógicas (Academic and Pedagogic Skills Assessment)
ES	El Salvador
ESSA	Every Student Succeed Act
GDP	Gross Domestic Product
IN	Instructor
IT	Item
MET II	Mathematical Education of Teachers II
NCATE	National Council for Accreditation of Teacher Education
NCTM	National Council of Teachers of Mathematics
NCTQ	National Council of Teacher Quality
SEC	Surveys of Enacted Curriculum
ST	Standard
T	Test
US	United States
WAT	Webb Alignment Tool

CHAPTER ONE: INTRODUCTION

Statement of Problem

One of the most important efforts in society is the education of future generations. It is a great challenge for a country to provide education to all its citizens. Many people around the world work every day toward this goal, trying to make education more accessible, and working to improve the quality of teaching. In mathematics, student achievement depends highly on the quality of teachers, which in turn depends on the quality of pre-service teacher education programs (National Council for Accreditation of Teacher Education (NCATE), 2010-2014). Promoting and maintaining the high quality of these programs can improve the quality of teaching and learning for all children (Lee, Miller-Grandvaux, Allen, & Jessee, 2011).

Student achievement can be improved by having consistent systems of expectations and assessments (Webb, 1997). For instance, every day teachers make sure their lesson plans are in agreement with objectives, activities and assessment. By researching and improving the alignment between testing, curriculum standards, and instruction, teachers can better "deliver a consistent message about what should be taught and assessed" and "students will have the opportunity to learn and to truly demonstrate what they have achieved" (Martone & Sireci, 2009, p. 1333). Moreover, alignment research can extend beyond the school classroom, so that even teacher preparation programs can benefit from examining the correspondence of course objectives, instruction, and assessment.

This thesis addresses university teacher preparation programs across borders. The selected higher education institutions in the United States (US) and El Salvador (ES) share similar goals and vision for their elementary teacher preparation programs, but both programs need to be constantly updated and evaluated. An international comparison can offer insights to this process. The study compares alignment of Mathematics for Elementary Teaching course assessments with national standards at two universities, while also comparing the standards between the two countries.

The motivation for this study came from my experience teaching mathematics content and pedagogy classes for pre-service teachers in El Salvador, as well as my own experience as a student. That experience taught me that pre-service teachers depend on the quality of the programs in which they are immersed, and future generations of students will be in the hands of these future teachers. The universities have a compact with pre-service teachers, giving them what they need to assume their role as future teachers. As I have learned more about the goals of teacher preparation during my graduate education in the U.S., I see ways in which assessing the alignment between pre-service teachers' preparation program components can play an important role in the improvement of these programs.

The strategy for this study was to collect common information from multiple instructors of two courses at each research site, including course materials describing learning objectives and the major exams that served as primary methods of assessment in the courses. I used the Webb framework (Webb, 2007) to evaluate the alignment between the learning objectives and course assessments, and also compared national elementary mathematics teacher preparation standards (from *Mathematical Education of Teachers II*

(MET II) in the U.S. and from the Ministry of Education in E.S.) to better understand similarities and differences of the alignment between course objectives and assessments.

Two main advantages of alignment research are to provide policymakers and educators with common goals, and to identify their position according to those goals (Martone & Sireci, 2009). The alignment data reported in this thesis is meant to offer useful data for continuing to improve the respective preparation programs. The results may be useful for other universities in both countries by offering a frame for programs to consider how well their programs align to national standards. The formal national adoption of these guidelines is one of the principal differences from the United States, in which education is much less centralized. States and universities can make more decisions with respect to programs and curriculum. In brief, this study assists in understanding the quality of mathematics teacher education programs while providing potential avenues for improvement.

Research Questions

The following research questions guided the study:

1. To what extent do exams in Mathematics for Elementary Teaching courses align to national standards for elementary teacher preparation at selected universities in the United States and El Salvador?
2. To what extent do national standards for mathematics elementary teacher preparation programs in the United States align to those in El Salvador?

CHAPTER TWO: LITERATURE REVIEW

Teacher Preparation in the United States and El Salvador

United States

The United States is located in North America, bordering both the North Atlantic Ocean and the North Pacific Ocean, between Canada and Mexico. It is a large country, with a land area of 9 million square kilometers a July 2016 estimated population of 323,995,528 (U.S. Census, 2016). The U.S. government is a federal presidential republic and has no official language, although English has acquired official status in 31 of the 50 states. Education expenditures are 5.2% of Gross Domestic Product (GDP) (2011), and both male and female students continue education until an average of 17 years old (Central Intelligence Agency, 2016). Though the federal government supports some aspects of education, schools in the United States are decentralized, with state and local governments having primary responsibility for curriculum and instruction (Hatfield, 2015).

According to a 2014 review by the National Council of Teacher Quality (NCTQ), the United States has begun to place increased importance on improving teacher preparation program quality, which in turn supports having more teachers ready for classrooms (Greenberg, Walsh, McKee, & NCTQ, 2014). Some of the key findings of their review are (Greenberg et al., 2014):

- of the 1,668 programs (housed in 836 institutions) ranked in the Review, 26 elementary programs and 81 secondary programs make NCTQ's lists of Top Ranked programs
- elementary programs were ranked much weaker than their secondary counterparts, with 1.7 times as many elementary programs as secondary programs marked as failing
- mathematics preparation varies widely: 23 states had no program rated as providing strong mathematics preparation
- district superintendents reported that elementary teachers often do not know the core subjects of the elementary curriculum

According to that same NCTQ review, the U.S. University in this study occupies a position in the top 50 in the Undergraduate Elementary Teacher Prep Program: Bachelor of Arts in Elementary Education (K-8) category. Regionally the elementary program at the university was ranked in 13th place and the secondary program was ranked 5th. Elementary mathematics content courses were a primary component of the rankings, for which Math for Elementary Teachers I, Math for Elementary Teachers II, and Pedagogy for Elementary Math Teachers were evaluated in the review:

> Teacher candidates, even those who excel in math, generally require three semesters of coursework, complemented by adequate field practice in order to progress from a procedural to a conceptual understanding of the essential mathematics topics taught in the elementary grades. The program only partly meets this standard because it falls well short of providing the amount of

coursework necessary to ensure that all essential topics are adequately covered (Greenberg et al., 2014).

El Salvador

El Salvador (E.S.) is a small Central American country located by the Pacific Ocean, between Guatemala and Honduras. Though the smallest in the region by land area (just 21000 square kilometers), the country has an estimated 6,141,350 residents as of July, 2015. At least 20% of E.S. citizens live abroad, and there is a high population centered around the capital San Salvador. The government type is a presidential republic, and the official language is Spanish. The education expenditure is 3.4% of GDP (2011), and both male and female students continue education until an average of 13 years old (CIA, 2016). Schooling is centralized, with a liberal educative focus outlined in the Political Constitution of El Salvador (established 1939).

Teacher preparation programs in El Salvador are offered through both public and private institutions. Initially, programs were offered through teaching preparation centers at Ciudades Normales (Normal Cities, in the 1960s), although technical institutes subsequently delivered some programs. Now, universities administer teacher preparation programs (Guzmán, 1995). Article 64 of El Salvador's national Higher Education Law, approved by legislative decree No. 468 on October 14th, 2004, establishes that the Ministry of Education, with the advice of the Higher Education Council, develop uniform study plans to prepare teachers and Bachelor of Arts (BA) in Education Sciences, to teach in the levels of Pre-K, elementary, high school, and others. The Ministry of Education

determines the academic requirements of university teachers, the system for assessing candidates, entry and exit qualifications, and the minimum requirements the institutions must meet to implement the plans and programs (Ministry of Education of El Salvador, 2012).

El Salvador teachers' preparation program has been highlighted as part of a project for training renewal. The project's name is Academic and Pedagogic Skills Assessment (Evaluación de Competencias Académicas y Pedagógicas (ECAP)). The objective is to assess the training process with a test required of future teachers to graduate. The test has contributed to improve the training process in the universities and it has been reported to be an excellent predictor of teacher performance (Vaillant, D., 2007).

Characteristics of the Selected Teacher Preparation Programs

Table 1 summarizes the characteristics of the two programs. The programs are generally similar, although they differ in duration and relationship to national guidelines.

Table 1. Elementary Teacher Preparation Program Characteristics

Characteristics	**Program in the United States**	**Program in El Salvador**
Program design	Decentralized, developed by the University	Centralized, developed by the Ministry of Education
Degree	Bachelor of Arts in Elementary Education (K-8)	Bachelor of Arts in Elementary Education (1-9)
Entry and exit requirements	Entry • Submit application • Meet academic requirements • Successful interview Exit • Completed application • Official transcripts	Entry • Submit application • Meet admission requirements • Take psychological test Exit • Completed study plan

	• Complete Standard Performance Assessment for Teachers • Praxis II Assessment score For extended information see appendix A	• Approved Academic and Pedagogic Skills Assessment For extended information see appendix B
Time period in years and semesters	4 years	5 years
Semester credits*	120-122	172

Note. * Both programs use semester-based credits, although contact time per credit varies.

Guidelines for Teacher Preparation Programs

It is important to assess teacher preparation programs because they indirectly affect students' academic achievement. Among the most common factors associated with students' academic performance are their teachers' preparation, and teaching quality (Guzmán, 1995). Unless teachers are exposed to modern pedagogical techniques and understandings of content during their programs of study, teachers may not get to know effective ways to lead instruction. Moreover, many in-service teachers may not have access to ongoing high quality professional development. In other words, teacher preparation quality is related to better learning opportunities for children (NCATE, 2010-2014).

Teaching quality plays an important part in students' achievement. Effective strategies for teaching are different according to the subjects and grade, so that teachers should not use the same strategy for children in preschool as for students in high school, and vice versa (Lockheed, World Bank, W.D.C., 1990). According to Shulman (1987), the objective in preparing teachers is not to tell them to act in a rigid way, but to encourage them to think about how they teach and why they teach that way. Teachers

must comprehend the content, but also the pedagogical skills, to promote the ideas interchange. Pedagogical skills include management and class organization, appreciation of students' individual differences, formal and informal assessment, personal reflection, and critical self-reflection (Guzmán, 1995).

Moreover, the pre-service teacher education programs need to be aligned with different elements in the education system. Alignment with policies is one of these elements, that assures that actors in the education system work in coordinated ways (Lee et al., 2011). Pre-service teacher preparation program administrators might constantly be updating the various elements future teachers will need to know and be able to apply. And most importantly, these elements will necessarily need to be in alignment with current certification policies.

According to the U.S. Department of Education, the performance of each teacher preparation program must be reported annually to the federal government, including alternative certification programs. The annual report includes at least the following indicators: employment outcomes, teacher and employer feedback, student learning outcomes, and assurance of specialized accreditation. Table 2 describes these elements, which correspond to standards from the Council for the Accreditation of Education Preparation (CAEP) (U.S. Department of Education, n.d).

Table 2. Key indicators from U.S. Department of Education (ed.gov/teacherprep)

Priorities Aligned with the Field	Key provisions of proposed regulations and how they compare to the standards set by the Council for the Accreditation of Education Preparation (CAEP)
Student outcomes	Academic gains among K–12 students

Employment outcomes	Job placement and retention, including in high-need schools
Customer satisfaction	Surveys of program graduates and their principal
Program review and accreditation	Based on content/pedagogical knowledge, high quality clinical practice, and rigorous entry/exit requirements
Multiple performance levels	Resulting from review and accreditation
Flexibility to states and providers	In developing multiple measures of performance

It is especially important to highlight program review and accreditation, which describe the importance of some of the qualifications future teachers must demonstrate. Content and pedagogical knowledge are related with the specific teaching specialties, and are assessed at the beginning, during and at the end of the teacher preparation process. In addition, pre-service teacher preparation programs must be planned according to certain principles. One of those principles is, “effective pre-service teacher education should be aligned with professional standards for teachers” (Lee et al., 2011, p. 6). This means that the curriculum, pedagogy, and assessment procedures in the preservice preparation programs will be aligned with standards, often set at a national level. The professional standards represent statements about the knowledge and practical skills pre-service teachers should have before and after they become certified (Lee et al., 2011). This is not the only principle required to have successful pre-service teacher preparation programs, but it is highlighted here because alignment of course assessments to national standards is a primary focus of this study.

In the light of the information in this section, assessing and improving teacher preparation programs can be seen as a way to improve the education system. Some of the

measures states in the U.S. are taking in this area include: “increased screening for entry into teacher preparation, improved testing of content knowledge, ensuring that teachers know how to teach early reading, making the student teaching experience matter, and setting measurable expectations for programs” (Greenberg et al., 2014, p. 9).

Alignment

Background

The No Child Left Behind Act, in Title I Improving the Academic Achievement of the Disadvantaged, section 1001 states that:

> The purpose of this title is to ensure that all children have a fair, equal, and significant opportunity to obtain a high-quality education and reach, at a minimum, proficiency on challenging State academic achievement standards and state academic assessments. This purpose can be accomplished by —
>
> (1) ensuring that high-quality academic assessments, accountability systems, teacher preparation and training, curriculum, and instructional materials are aligned with challenging State academic standards so that students, teachers, parents, and administrators can measure progress against common expectations for student academic achievement (No Child Left Behind Act of 2001);

Essentially, the NCLB Act, and its recent reauthorization through ESSA (2015), is based on the policy belief that if student development and assessment are aligned with standards, and additionally with sanctions and incentives for accomplishing specified targets, this will positively influence the growth of student learning (Herman & Webb, 2007). “As defined by the NCLB Act, standards describe expectations for student

learning and achievement. Academic content standards specify what students are expected to know and be able to do, and student academic standards (also called performance standards) define what students must know and be able to do to demonstrate proficiency" (Herman & Webb, 2007, p. 2).

In the U.S., the NCLB and ESSA (2015) are intended to change school culture through closing the achievement gap, giving more flexibility, providing parents with more options, and supporting an efficient system to teach students. The accountability provisions will be evident when states illustrate how they will close the achievement gap and are able to provide all students, including those who are disadvantaged, with the necessary elements for them to gain academic proficiency. This process needs to be shared with parents and communities through annual state and school report cards (U.S Department of Education, n.d.).

The ESSA and other current U.S. regulations aimed at ensuring high-quality education include a number of explicit and implicit requirements that schooling elements be aligned with State standards. This is an advantage for the education community as the teaching and learning processes may become clearer than they have been in the past. For instance, parents can be sure that their children will be assessed on what they are being taught. At the same time, assessment results are expected to provide accurate information to the public, its policy makers, educators, parents and students themselves about how students are doing and to provide stakeholders with important feedback on which to base their improvement efforts (Webb, Herman, & Webb, 2007).

Defining Alignment

Alignment can have different meanings, although the basic concept is that, if two or more system elements are compatible or match with each other, they are aligned (Webb et al., 1997). Historically, the use of the term alignment in educational literature was to refer to the match between an assessment instrument and curriculum (Webb et al., 1997). This study uses the definition proposed by Webb et al. (1997): “Alignment is the degree to which expectations and assessments are in agreement and serve in conjunction with one another to guide the system toward students learning what they are expected to know and do” (Webb et al., 1997, p. 4).

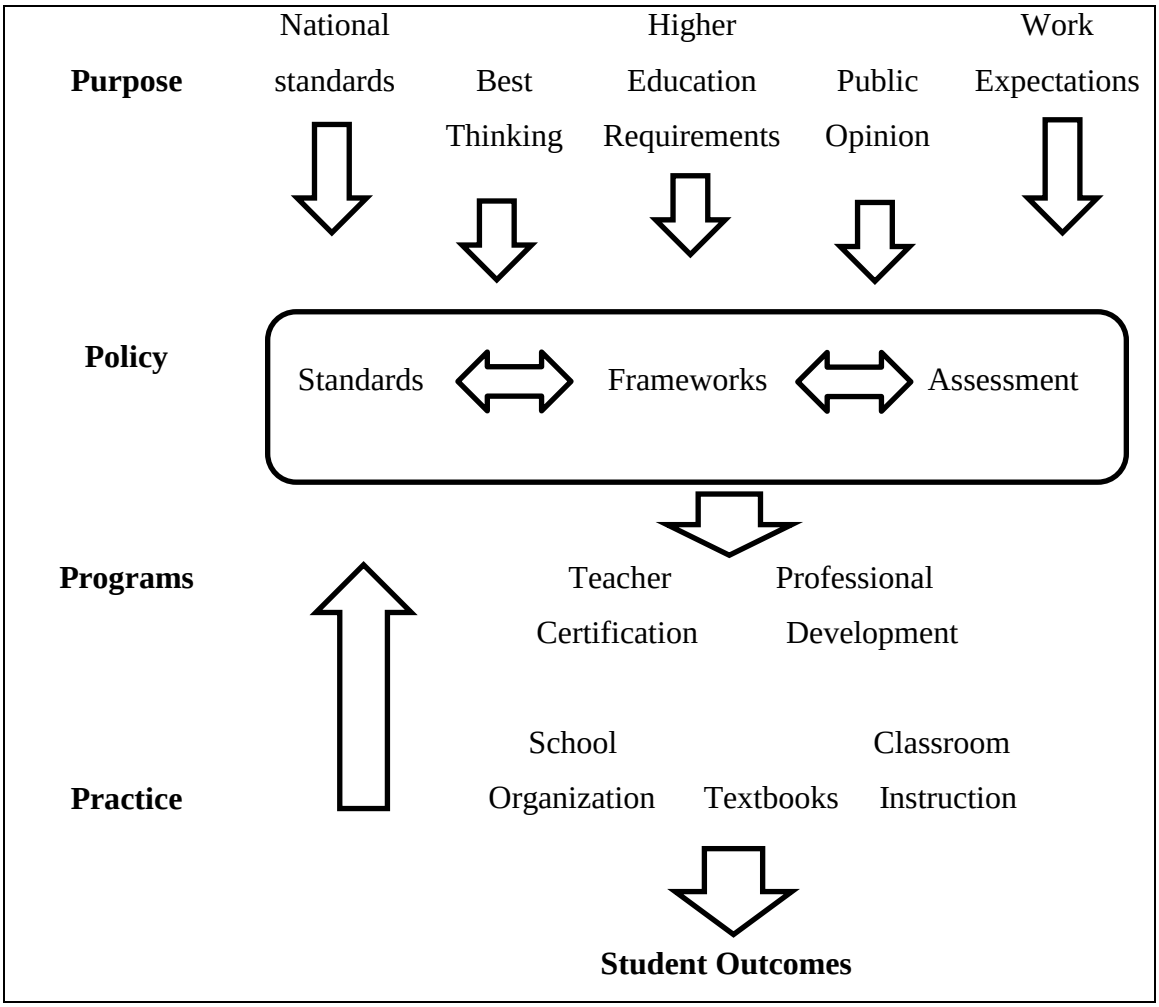


Figure 1. Vertical and horizontal alignment within education (Webb et al., 1997)

There exist different types of alignment models, although this study focuses on *horizontal alignment*. Webb et al. (1997) describes horizontal alignment as "the degree to which standards, frameworks, and assessments work together within an education system and mainly at the policy level" (Webb et al., 1997, p. 5). This differs from vertical alignment, which is "the degree to which the elements among the strata in an education system (e.g. textbook content, classroom instruction, professional development, and student outcomes) are aligned with each other and with outside forces (e.g. national

standards, public opinion, and work force needs)" (Webb et al., 1997, p. 5). Figure 1 explains better the relation between them.

The alignment process is about different elements combined together to describe the degree of match between the performance that states expect from students and the measure used to indicate whether or not students meet the expectations. The analysis process during alignment studies is based on knowledgeable educators who share their experience and knowledge, which is later applied to judge the criteria for measuring the alignment (Resnick, Rothman, Slattery, & Vranek, 2004).

Alignment between Curriculum, Assessment, and Standards

Preservice teacher preparation programs are designed according to certain standards or expectations. In the mathematics preparation area, these standards try to answer questions like: "What mathematics should future teachers study to prepare for their careers? What mathematics coursework and programs will prepare elementary teachers for teaching mathematics? What sorts of professional development experiences will develop and sustain high quality mathematics teaching in elementary school?" (Conference Board of the Mathematical Sciences, 2012, p. 23).

Sometimes standards are viewed as end products of learning, and the importance given to the assessment at the end of their preparation program affirm this fact (Hoewook & Hyunjin, 2010). The disadvantage of this view is that preservice teacher students do not see standards as a way to improve continuously, on the contrary, learning becomes a checklist they need to complete to determine whether or not they are ready to teach (Hoewook & Hyunjin, 2010). This is why it is important to consider the meaning of the word standard:

> Etymologically, the word *standard* comes from the Anglo-French *estaundart*, referring to a flag displayed on a battlefield to rally the troops (Oxford English Dictionary, n.d.). over time, the term evolved in two ways. First, instead of referring to a king's authority, it came to mean a consensus among experts. Second, it evolved to mean improved technical specifications that promote efficiency and make measures of that efficiency easier. Standards in education serve two similar purposes: they express a consensus among experts of what to teach and when to teach it, and they make measuring students' proficiency easier through assessments (Hirsch, Hirsch, Lappan, & Reys, 2012, p. 3)

This study emphasizes the concept of *content standards,* which is defined as: "content standards consist of a negotiated settlement among authorized experts concerning the specifications of what a person should know or be able to do, with consideration of how that is to be measured and/or documented, and as a means of modulating of effecting change within the system of education and restricting excessive variation" (Hirsch et al., 2012, p. 4). The standards in Table 3 and 4 include expectations of the mathematics courses for future elementary teachers in the United States and El Salvador, including areas such as: geometry, measurement, statistics, probability and arithmetic. Table 4 also include standards regarding pedagogic knowledge.

Table 3. MET II Essential Ideas (CBMS, 2012)

Number	List of Essential Ideas
1.	The intricacy of learning to count, including the distinction between counting as a list of numbers in order and counting to determine a number of objects.
2.	The different types of problems solved by addition, subtraction, multiplication, and division, and meanings of the operations illustrated by these problem types.
3.	Teaching–learning paths for single-digit addition and associated subtraction and single-digit multiplication and associated division, including the use of properties of operations (i.e., the field axioms).
4.	Recognizing the foundations of algebra in elementary mathematics, including understanding the equal sign as meaning "the same amount as" rather than a "calculate the answer" symbol.
5.	How the base-ten place value system relies on repeated bundling in groups of ten and how to use objects, drawings, layered place value cards, and numerical expressions to help reveal base-ten structure.
6.	How efficient base-ten computation methods for addition, subtraction, multiplication, and division rely on decomposing numbers represented in base ten according to the base-ten units represented by their digits and applying (often informally) properties of operations, including the commutative and associative properties of addition and the distributive property, to decompose the calculation into parts. How to use math drawings or manipulative materials to reveal, discuss, and explain the rationale behind computation methods.
7.	Extending the base-ten system to decimals and viewing decimals as address systems on number lines. Explaining the rationales for decimal computation methods. (This includes connections to grades 6–8 mathematics.)
8.	Understanding fractions as numbers which can be represented with lengths and on number lines. Using the CCSS development of fractions to define fractions a/b as a parts, each of size $1/b$. Attending closely to the whole (referent unit) while solving problems and explaining solutions.
9.	Recognizing that addition, subtraction, multiplication, and division problem types and associated meanings for the operations (e.g., CCSS, pp. 88–89) extend from whole numbers to fractions.

10.	Explaining the rationale behind equivalent fractions and procedures for adding, subtracting, multiplying, and dividing fractions.
11.	Understanding the connection between fractions and division, $a/b = a \div b$, and how fractions, ratios, and rates are connected via unit rates.
12.	The general principles of measurement, the process of iterations, and the central role of units: that measurement requires a choice of measureable attribute, that measurement is comparison with a unit and how the size of a unit affects measurements, and the iteration, additivity, and invariance used in determining measurements.
13.	How the number line connects measurement with number through length (see the Geometric Measurement Progression).
14.	Understanding what area and volume are and giving rationales for area and volume formulas that can be obtained by finitely many compositions and decompositions of unit squares or unit cubes, including formulas for the areas of rectangles, triangles, and parallelograms, and volumes of rectangular prisms.
15.	Using data displays to ask and answer questions about data. Understanding measures used to summarize data, including the mean, median, interquartile range, and mean absolute deviation, and using these measures to compare data sets.
16.	Understanding geometric concepts of angle, parallel, and perpendicular, and using them in describing and defining shapes; describing and reasoning about spatial locations (including the coordinate plane).
17.	Classifying shapes into categories and reasoning to explain relationships among the categories.
18.	Reason about proportional relationships in scaling shapes up and down.

Table 4. El Salvador Course Objectives (Ministerio de Educación, 1997)

Number	Objectives
1.	Analyze theories about geometric knowledge from the conceptual, cognitive, and phenomenological dimensions, in order to orient the teaching and learning procedures of geometry and measurement.
2.	Develop skills and competencies to handle contents referred to plane and spatial geometry, measurement, and statistics; contents which are included

	in primary and junior high (first to sixth grade) the first and second cycles of basic education (first to sixth grade).
3.	Develop the ability to use critically and constructively, results from research about the cognitive thinking process, in the teaching and learning procedures of geometry and measurement.
4.	Understand the necessary methodological foundation to guide the teaching and learning development of the geometry, measurement, and statistics.
5.	Develop skills for critical reflection and proposal actions about related problems in the teaching and learning procedures of geometry, measure, and statistics in the elementary education schools.
6.	Reflect critically and constructively about methods used in elementary schools to help students with difficulties in the development of geometric thinking.
7.	Acquire a deeper knowledge about numbers and the reasons which have led to its current form.
8.	Develop the ability to design methodological strategies to teach calculation algorithms in a comprehensive and progressive manner.
9.	Analyze theories about numeric knowledge from the conceptual, cognitive, and phenomenological dimensions, in order to orient the teaching and learning process at the school.
10.	Figure out the latest theoretical foundation, in order to give them the necessary skills to develop the arithmetic teaching and learning process.
11.	Develop skills to design instructional strategies which will allow them to a critical and constructive approach related to problems with the arithmetic teaching and learning process.
12.	Develop the ability to guide arithmetic teaching and learning processes of arithmetic.

Considering the standards' definition given, one of the most important outcomes regarding the alignment between standards and assessment is that they may address potential assessment or instructional deficiencies, which is done systematically when the different parts of the educational process are compared. It has been mentioned before that if the components in the educational system are not well aligned, the system is not giving

a consistent message of the most important aspects within the education process (Roach et al., 2008).

For a system to work most effectively, it is necessary for its elements to be in alignment. For instance, assessments must communicate and evaluate accurately what students are supposed to accomplish. Moreover, what students learn in the classroom must help them fulfill the standards (Herman & Webb, 2007). Coherence must exist between these elements, if not, it is difficult to deliver feedback to help students further develop.

The relationship between standards, assessments, and classroom instruction is a cycle. The three of them, as well as other elements that support the education process, do not have a linear relationship. As pointed out by Anderson (2002, p. 257) "Curriculum alignment requires a strong link between objectives and assessments, between objectives and instructional activities and materials, and between assessments and instructional activities and materials." Most surveys of teachers in individual states reveal that instructional alignment reporting is professionally useful (Polikoff, 2012). One of the teachers' roles is to provide their students with opportunities to learn. This can be supported by managing a coherent system in the classroom that is aligned not just with national standards and assessment but also with students' needs. The triangle presented in Figure 2 is a reminder that instructional activities are an important part of the process.

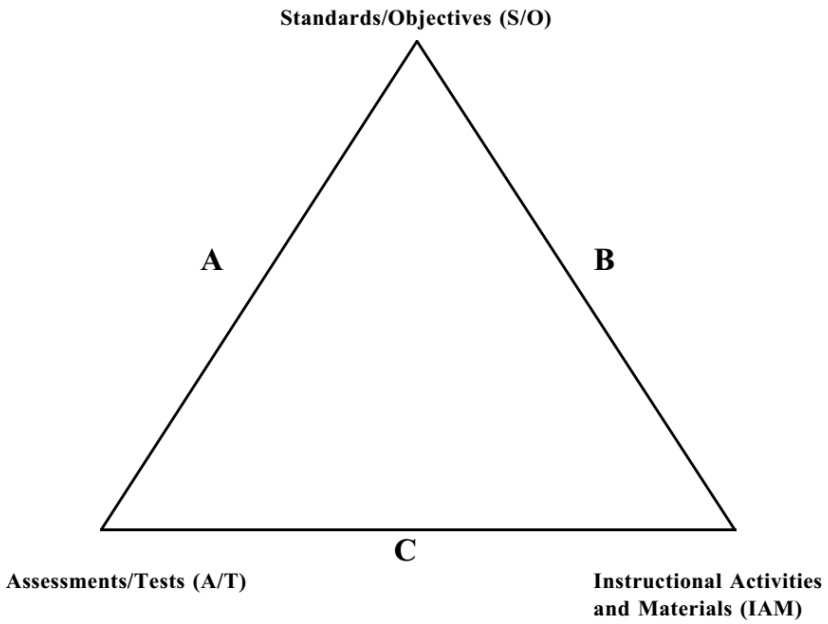


Figure 2. Relationships among standards, instructional activities and materials, and assessments (Anderson, 2002).

Methods to analyze the alignment between these elements vary. Bhola, Impara & Buckendahl (2003), through a rigorous analysis of characteristics, identified four existing models: Surveys of Enacted Curriculum (SEC), Webb Alignment Tool (WAT), Achieve Methodology, and Council for Basic Education (CBE) model (Bhola et al., 2003). Between the four models, the SEC and the WAT were highlighted in their study because of their availability and also because of their precise descriptions of the procedures used in the models (Newton & Kasten, 2013). These two models were also identified by the Council of Chief State School Officers (CCSSO) as two of the three preferred frameworks for use in the design and implementation of alignment studies (Roach et al., 2008). Table 5 provides a description of the major characteristics of the three models identified by CCSSO.

Table 5. Major alignment models (Roach et al., 2008)

	WAT	*SEC*	*Achieve*
Components Evaluated for Alignment	Assessments Standards	Assessments Standards and Curricular Materials Classroom Instruction	Assessments (Item and Item Sets) Standards
Raters of Evaluators	Alignment panel of 6 to 8 educators with subject area expertise	Individual teacher (Classroom Instruction); Alignment panel of 3 or more content area specialists	Alignment panel of 3 or more content area specialists
Alignment Evaluation Process	Panel members are trained to recognize and apply four depth-of-knowledge (DOK) levels. Panel reaches consensus on DOK level ratings for objectives from content standards. Panel members then independently rate the DOK level and corresponding objective from standards and assessment item.	Teachers complete Surveys of Enacted Curriculum ratings at the end of the year. Surveys includes ratings level of coverage for topics and subtopics taught and the level of cognitive demand for tasks in each topical area. Panel members rate the level of coverage for topics and subtopics and cognitive demand of tasks and activities for standards, curricular materials, and assessments.	Expert panels make consensus judgments regarding the quality of the content and performance match between individual test item and their respective standards. Each item is further evaluated regarding the source of its difficulty. Panels then judge whether entire item sets assess the respective standards with a comparable emphasis and range of expectations. Each set of items is further evaluated regarding the grade-level appropriateness for its span of difficulty.

Breadth Criteria	Categorical Concurrence Range of Knowledge Balance of Representation	Topic and subtopic categories Emphasis ratings within topics	Content Centrality (Items) Range (Item Sets) Balance (Item Sets)
Depth Criteria	DOK Consistency	Cognitive demand categories Emphasis ratings within cognitive demand	Performance Centrality (Items) Source of Challenge (Items) Level of Challenge (Item Sets)

It is important to note that, when conducting alignment studies, researchers do not evaluate the standards or assessments being studied; on the contrary, they help to specify the relationship between the two components (Newton & Kasten, 2013).

Alignment Studies

Thanks to the beginning of a systemic reform (1989), and the development of Curriculum and Evaluation Standards for School Mathematics (NCTM, 1989), an increasing number of alignment studies have helped describe the agreement or match between two or more documents or different elements of an educational system, typically at the state or district level (Webb et al., 1997). During the short period that standards-based reforms have taken place, there have been many attempts to methodically evaluate the extent of alignment (Porter & Smithson, 2002; Webb 1999). These attempts were proposed with the presumption that the usual method to evaluate the alignment between tests and standards is inefficient. For instance, usually states (or authorized agents) regularly bring a set of standards and ask developers to create a test based on those standards. At the end, test developers demonstrate the alignment through a matrix that describes how the items on the test match with the standards (Resnick et al., 2004).

There has been a recent focus on studying the alignment between student achievement tests and content standards (Newton & Kasten, 2013). There exist several new and rising procedures to define and measure alignment, with the most frequently used approach being the method developed by Norman Webb (1997, 2002). The Webb Alignment Tool (WAT) has been modified by many people (e.g., Herman, Webb & Zuniga, 2002; Impara, 2001; Plake, Buckendahl, & Impara, 2001; Porter, Smithson, Blank, & Zeidner, 2007). The most common factors measured by alignment studies are standards and tests, with the exception of the method developed by Porter et al., (2002), which aligns standards, assessments, and instruction, or in the case of Project 2061, that align textbooks and standards (Porter et al., 2007).

It is important to mention that even though both alignment studies and studies of the measurement of alignment have increased, there is still not a reliable metric for alignment. This has substantially decreased the ability of researchers to produce valid conclusions about the alignment value (Fulmer, 2011).

Last, the duration and cost of conducting the alignment process depends in large part on the number of courses or grades to be analyzed, the length and complexity of standards and assessments, and the number of assessments. Usually five to eight reviewers implement the analysis, and Webb has stated that the greater the number of reviewers, the more reliable the study will be (Webb, 2007).

CHAPTER THREE: METHODOLOGY

The Webb Alignment Model

The Webb Alignment Model is the framework used in this study to measure the alignment between standards and assessments. Besides its accessibility and detail in the process, it is one of the most highlighted methods (Roach et al., 2008) to evaluate the alignment between standards and assessments.

> In general, this process identifies four criteria that are used to compare the relation between standards and assessments. The process is conducted in two stages. In the first stage, reviewers code the depth-of-knowledge (DOK) levels of standards. In the second stage, reviewers code the DOK levels of assessment items and the corresponding curriculum standards or objectives. Reviewers code assessment items directly to the curriculum standards. Findings are reported for each of the four criteria, along with the attainment of specified acceptable levels. The reviewers' entry of coding and the analysis of data have been automated using a Web-based tool (http://www.wcer.wis.edu/WcAT)" (Webb, 2007, p. 8).

Webb Alignment Dimensions

The content focus dimension in the Webb's model has six subcategories for analysis: categorical concurrence, depth of knowledge, range of knowledge, balance of representation, structure of knowledge, and dispositional consonance. The first four of these are most often been applied in alignment studies (Roach et al., 2008), and are the primary focus of this study.

a. **Categorical concurrence** refers to whether the same or consistent categories of content appear in both standards and an assessment.

b. **Depth of knowledge** refers to a match between the cognitive demands of the standards and an assessment. The levels of depth of knowledge (DOK) assigned by reviewers are:

Level 1 (Recall) includes the recall of information such as a fact, definition, term, or a simple procedure, as well as performing a simple algorithm or applying a formula. Key words that signify Level 1 include "identify," "recall," "recognize," "use," and "measure."

Level 2 (Skill/Concept) includes the engagement of some mental processing beyond a habitual response. A Level 2 assessment item requires students to make some decisions as to how to approach the problem or activity. Keywords that generally distinguish a Level 2 item include "classify," "organize," "estimate," "make observations," "collect and display data," and "compare data."

Level 3 (Strategic Thinking) requires reasoning, planning, using evidence, and a higher level of thinking than the previous two levels. Level 3 activities include drawing conclusions from observations; citing evidence and developing a logical argument for concepts; explaining phenomena in terms of concepts; and using concepts to solve problems.

Level 4 (Extended Thinking) requires complex reasoning, planning, developing, and thinking, most likely over an extended period of time. Level 4 activities include developing and proving conjectures;

designing and conducting experiments; making connections between a finding and related concepts and phenomena; combining and synthesizing ideas into new concepts; and critiquing experimental designs.

c. **Range of knowledge** refers to the span of knowledge that students need in order to correctly answer the assessment item.

d. **Balance of representation** is used to indicate the degree to which one objective is given more emphasis on the assessment than another. This index only considers the objectives for a standard that have at least one related assessment item per objective.

Data Sources

An important preliminary step in this study was examining the national mathematics content standards for preparing elementary education teachers both the United States and El Salvador. In the U.S., there is no current national set of program standards for the mathematical preparation of elementary teachers (an effort by the Association of Mathematics Teacher Educators is currently under review). Instead, the U.S. program in this study, like many others, is designed according to the goals outlined in the *Mathematical Education of Teachers II*. MET II is widely adopted by mathematics content programs for elementary teachers and uses the Common Core State Standards as a framework to describe what elementary pre-service and in-service teachers should study and know (Conference Board of the Mathematical Sciences [CBMS], 2012). From El Salvador, the *Study Plan for Teachers in Elementary Education*, which is designed for first and second periods of teacher preparation (a period covers three years), is provided by the Ministry of Education of El Salvador. Tables 3 and 4 in the literature review list

the elementary mathematics teacher preparation standards in the U.S. and El Salvador, respectively.

The Mathematics for Elementary Teaching courses that were be part of the study are briefly described as following:

U.S. Program (according to the University's Undergraduate Catalog, 2015-2016)

- Course 1. Number systems from whole numbers through the reals: numeration, number operations, algorithms, and properties. Includes an integrated materials component which makes use of physical models and technology.
- Course 2. Probability, statistics, geometric concepts, principles, and measurement. Includes the use of physical materials and technology.

El Salvador (Ministerio de El Salvador, 1997)

- Course 1. Spatial thinking, plane and spatial geometry teaching process, geometric transformations, measurement teaching process, introduction to statistics, the language to represent information, introduction to probability.
- Course 2. Social and cultural aspects about numbers, numeric action in the classroom and its planning, fractions in the teaching process, decimals in the teaching process, teaching aspects about divisibility, teaching aspects of proportionality.

For the assessment items, instructors at the two research sites shared major exams (including final exams) in the past two years of teaching the two courses. In sum, 9 instructors shared a total of 30 exams, including 7 exams in Course 1 and 7 exams in Course 2 in the U.S. program, with a combined 205 items. In El Salvador, the sample

included 8 exams in Course 1 and 8 exams in Course 2, with a combined 182 items. Some of the instructors shared exams from both courses, so that there were exams from three instructors in each of the two courses and both countries.

Procedures

Alignment between Standards and Assessment

The Webb alignment framework was used to find the alignment degree between the Mathematics for Elementary Teaching courses and the standards for elementary teacher preparation. The steps were the following:

1. To measure categorical concurrence between exam items and national standards:
    a. Standards were coded by country prefix, followed by standard number (US-ST1 in the U.S., ES-ST1 in El Salvador), see table 8 for reference.
    b. Each instructor was assigned a number ("IN1" to "IN5" in the U.S, "IN1" to "IN4" in El Salvador).
    c. The items on exams were labeled according to the country, course, test, and instructor (e.g., "US-C1T2IN3-IT4" = fourth item on Instructor #3's second test in Course 1 at the U.S. program).
    d. Each coded item was matched to any of the respective national standards with substantial alignment. In most cases, items were aligned to a single matching national standard.
2. To measure Depth of Knowledge (DOK) of exam items:
    a. All items were assigned a DOK level on the ordinal scale 1 = recall, 2 = skill or concept, 3 = strategic thinking, and 4 = extended thinking as described in the literature review.

b. Separately, all national standards were rated using the same DOK scale.

c. A reviewer and the researcher independently rated the DOK of assessment items. Due to the limited scope of the study, there were just two reviewers, including the researcher. There was exact agreement on 57% of the 376 items, and nearly all others (41%) differing by one level. Cohen's Kappa measure of inter-rater reliability on the 376 rated items was measured at .32, which represents "fair" agreement (Landis & Koch, 1977).

d. Following Webb (2007), the quality of DOK alignment between items and standards was measured as the percentage of items rated greater than or equal to the DOK of the matched standard. The degree of alignment was rated "Proper" if the measured alignment was 50% or greater, "Weak" if the measured alignment was at least 40% but less than 50%, and "Poor" otherwise.

3. The range of knowledge of each exam for each instructor was measured as the list of standards identified as aligned to the items on the exam.
4. The balance of representation of each exam was measured as the relative proportions of items on the exam matched to each of the standards aligned to the respective course.
5. The analysis for the separate countries was compared qualitatively, this means the previous steps were done separately in each country, and then the results were compared with special emphasis on areas of commonality and consistent structural differences.

Standards Comparison

The standards for elementary teacher preparation programs between the United States and El Salvador were compared. This meant first listing all MET II essential ideas, and then listing the related ES standards, organized by whether the ES standard was a direct or partial match to the MET II Standard. ES standards that were not directly or partially related to any MET II standards were then listed separately. Finally, I summarized the alignment using a table and qualitative descriptions.

CHAPTER FOUR: RESULTS

Alignment between Standards and Assessment

This section summarizes the alignment of items in the 30 exams from Mathematics for Elementary Teaching courses at the two research sites with the respective national standards for the two respective programs according to the four criteria described in the methods.

Categorical Concurrence

Figure 3 shows the categorical concurrence between standards and items in the assessments through a bar plot showing the number of items matched to each of the standards in the respective programs. The degree of categorical concurrence can be considered acceptable for both programs. In total, the test items cover nearly all the standards. The specific counts can be found in the “Total” column in Table 6.

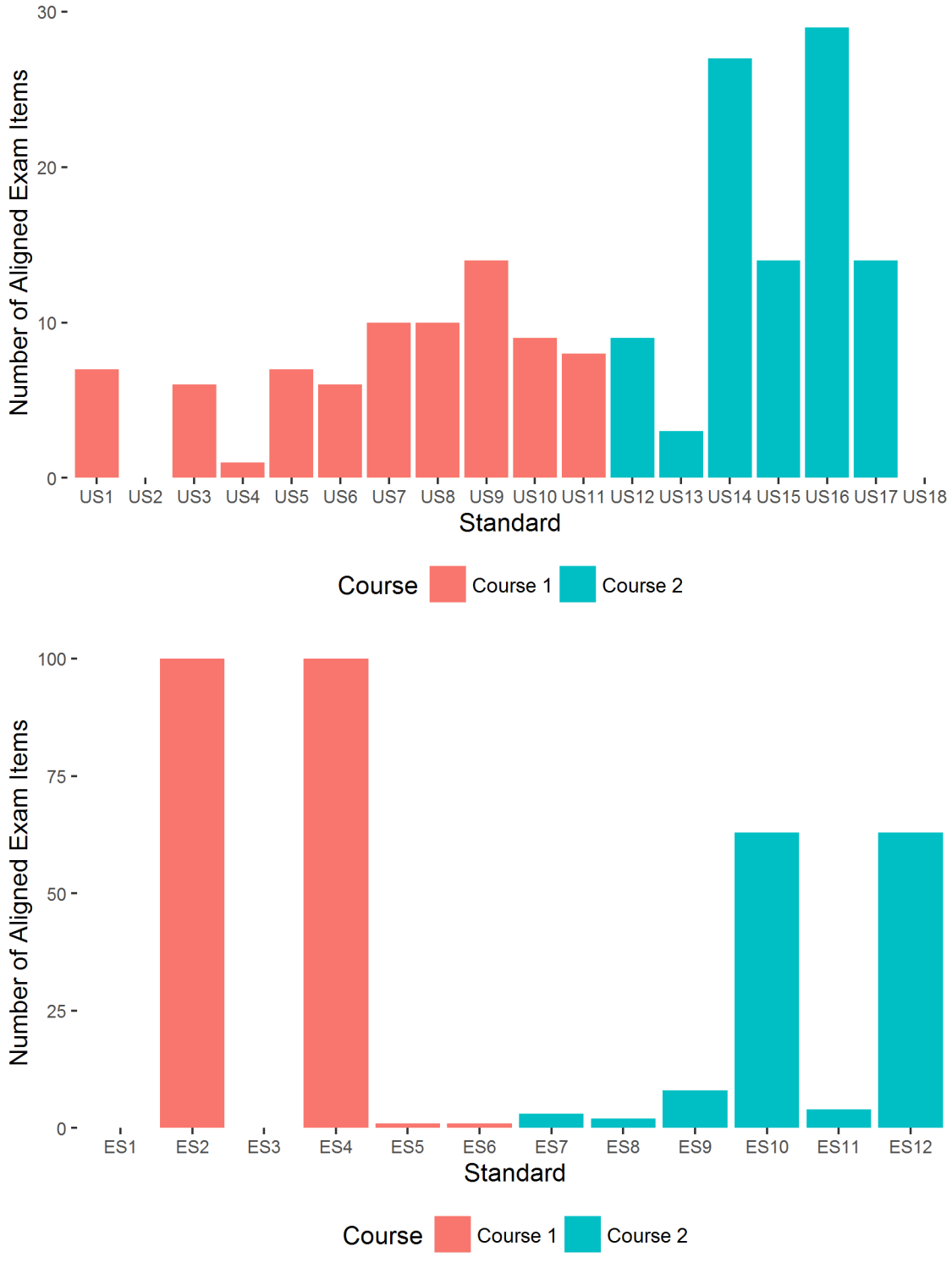


Figure 3. Categorical concurrence between national standards and exam items by course in the U.S. and E.S. programs.

Depth of Knowledge (DOK) between Standards and Assessments

The analysis of DOK alignment between standards and assessment suggests that the U.S. exam items were more properly aligned with the cognitive demand of the respective standards than in the El Salvador program. The items in the U.S. program met the criteria for "Proper" alignment for most of the standards (12 of 18), with the mean measured DOK alignment of 59%. Items in the El Salvador program met the criteria for "Proper" alignment for less than half of the standards (4 of 10), with the mean measured DOK alignment of 40%. About 88% of the items on the El Salvador exams were rated at DOK level 1 or 2, compared to 75% of the items in the U.S. exams.

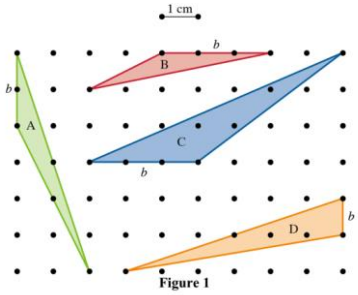
Table 6. DOK between standards and assessments

	DOK of Items								
Standards	1	2	3	4	NA	Total	DOK of Standard	% Aligned	Degree of Alignment [a]
El Salvador	**98**	**63**	**20**		**1**	**182**	**3**		
ES-ST1						0	3	0%	Poor
ES-ST2 & 4	54	41	5			100	3	5%	Poor
ES-ST3						0	3	0%	Poor
ES-ST5			1			1	4	0%	Poor
ES-ST6			1			1	3	100%	Proper
ES-ST7			3			3	2	100%	Proper
ES-ST8		1	1			2	3	50%	Proper
ES-ST9	2	3	3			8	3	38%	Poor
ES-ST10 & 12	42	17	3		1	63	2	32%	Poor
ES-ST11		1	3			4	3	75%	Proper
United States	**47**	**106**	**49**	**2**	**1**	**205**	**2**		
US-ST1	6		1			7	2	14%	Poor
US-ST2	12	10	9			31	2	61%	Proper
US-ST3	3	2	1			6	3	17%	Poor
US-ST4			1			1	2	100%	Proper
US-ST5	1	3	3			7	2	86%	Proper
US-ST6	2	1	3			6	3	50%	Proper
US-ST7	1	4	5			10	2	90%	Proper
US-ST8	2	4	3		1	10	3	20%	Poor
US-ST9	4	5	5			14	2	71%	Proper
US-ST10	4	2	3			9	2	56%	Proper
US-ST11		7	1			8	2	100%	Proper
US-ST12	2	5	2			9	2	78%	Proper
US-ST13		1	2			3	2	100%	Proper
US-ST14	1	24	2			27	2	96%	Proper
US-ST15	1	8	4	1		14	2	93%	Proper
US-ST16	5	21	3			29	3	10%	Poor
US-ST17	3	9	1	1		14	3	14%	Poor
US-ST18						0	2	0%	Poor
Grand Total	**241**	**227**	**77**	**2**	**3**	**550**	**3**		

Notes: [a] Degree of alignment classified according to Webb (2007) as described in procedures . NA = item did not include enough information to evaluate DOK.

In some cases, items were matched to more than one standard. Table 7 illustrates some of these examples and items exemplifying the DOK levels.

Table 7. U.S. and E.S. Item examples

DOK	Item example	Item code	Standard
1	A colleague approaches you and says that Suzie has shown evidence that she can subitize. Briefly explain what Suzie is able to do.	US-C1T1IN5-IT3	US-ST1
	The number which appears most often in a set of numbers. a. Range b. Median c. Mean d. Mode	ES-C1T3IN1-IT7	ES-ST2, ES-ST4
2	In figure 1 a. Construct the heights of the triangles that correspond to the bases that are labeled *b* b. Determine the areas of the triangles.  Figure 1	US-C2T3IN3-IT2	US-ST14 US-ST16
	Calculate the probabilities in each of the following events. You draw a card at random from a 52 deck (if it is necessary apply the formulas studied in class): a. a figure or a heart b. an ace c. a queen	ES-C1T3IN1-IT21	ES-ST2, ES-ST4
3	Use the definition of a fraction to determine which of 1/16 or 1/17 is greater. Explain your reasoning (do not use arithmetic or diagrams)	US-C1T3IN4-IT1	ST-8
	Create a question for the following problem and solve it: Santiago sells coconuts in the market $0.75 cents each; by the end of the day he brought $19.50 home	ES-C1T1IN4-IT5	ES-ST10 ES-ST12

DOK	Item example	Item code	Standard
4	Make an argument in support of the following conjecture. *Triangle ABC is isosceles with AB congruent to AC. If M is the midpoint of BC, then the segment AM is perpendicular to segment BC.*	US-C2T3IN2-IT10	US-ST17

Range of Knowledge

Range of knowledge alignment refers to the extent to which the breadth of the standards is similar to the breadth of assessment in the course. Webb's criteria for having sufficient alignment regarding the range of knowledge requires that at least 50% of the standards needs to be measured by at least one assessment item. Two different courses were analyzed for each country. The range of knowledge was analyzed for each course and instructor in the different countries.

Figures 4 and 5 illustrate the range of knowledge of the exams for each of the instructors in Courses 1 and 2 in the two programs. Each "dot" in the figure represents one item from the respective instructors' exams aligned to the respective standards. The presence of at least one dot (item) aligned to each standard indicates range of knowledge addressed by the assessments. In the U.S., the exams from all of the instructors met the criteria for sufficient range of knowledge alignment in each of the two courses, with the lowest alignment found in U.S. Instructor 3's Course 1 exams, which assessed just 7 of the 11 standards in the course. In El Salvador, one of the three instructors' exams met the criteria for sufficient range of knowledge alignment in Course 1, while two of the three instructors' exams met the criteria in Course 2. In both courses, El Salvador Instructor 3's exam items were aligned to just two of the standards for the course.

U.S. Course 1

Standard	USC1-IN3	USC1-IN4	USC1-IN5
US1	●	●●	●●●●
US2	●●●●●●●●●●	●●●●●●●●●●	●●●●●●●●●●●
US3	●	●●●	●●
US4	●		
US5	●	●●●	●●●
US6		●●●●	●●
US7		●●●●	●●●●●●
US8		●●●●●●●	●●●
US9	●	●●●●	●●●●●●●●
US10		●●●●●●●	●●
US11	●●●	●●●	●●
Other		●	

U.S. Course 2

Standard	USC2-IN1	USC2-IN2	USC2-IN3
US12	●●●●●	●●●●	
US13	●	●	●
US14	●●●●●●●●●●●●●	●●●●●●●	●●●●●●
US15	●●●●●●●●	●●●	●●●
US16	●●●●●●●●●●●●●●●	●●●●●●●●●●	●●●
US17	●●●●●	●●●	●●●●●
US18			

Figure 4. Range of knowledge as indicated by item alignment in U.S. courses

El Salvador Course 1

Standard	ESC1-IN1	ESC1-IN3	ESC1-IN4
ES1			
ES2/4	●●●●●●●●●●●●●●●● ●●●●●●●●●●●●●●●● ●●●●●●●●●●●	●●●●●●●●●●●●●●●● ●●	●●●●●●●●●●●●●●●● ●●●●
ES3			
ES5	●		
ES6	●		
Other			●●●●●●●●●

El Salvador Course 2

Standard	ESC2-IN1	ESC2-IN2	ESC2-IN3
ES7	●●●		
ES8	●		
ES9	●●●●●	●●●	
ES10/12	●●●●●●●●●●●●●●●● ●●●●●●●●●●	●●●●●●●●	●●●●●●●●●●●●●●●● ●●●●●
ES11	●●	●●	
Other		●●●●●●●●●●●●●●●● ●●	●

Figure 5. Range of knowledge as indicated by item alignment in El Salvador courses

Balance of Representation

Balance of representation refers to the relative emphasis of the alignment between items on the exams and the standards addressed by the courses in the programs. Figures 4 and 5 make it clear that items in the U.S. exams were more distributed across standards, although there was still a greater emphasis on standards US2 (operations), US14 (area and volume), and US16 (geometry concepts). In contrast, El Salvador exam items had more emphasis on clusters of standards, with standards 2 and 4 focused on geometry, measurement, and statistics and standards 10 and 12 focused on numbers of operations.

Figures 6 and 7 show the balance of representation of exams across instructors in the two programs, respectively.

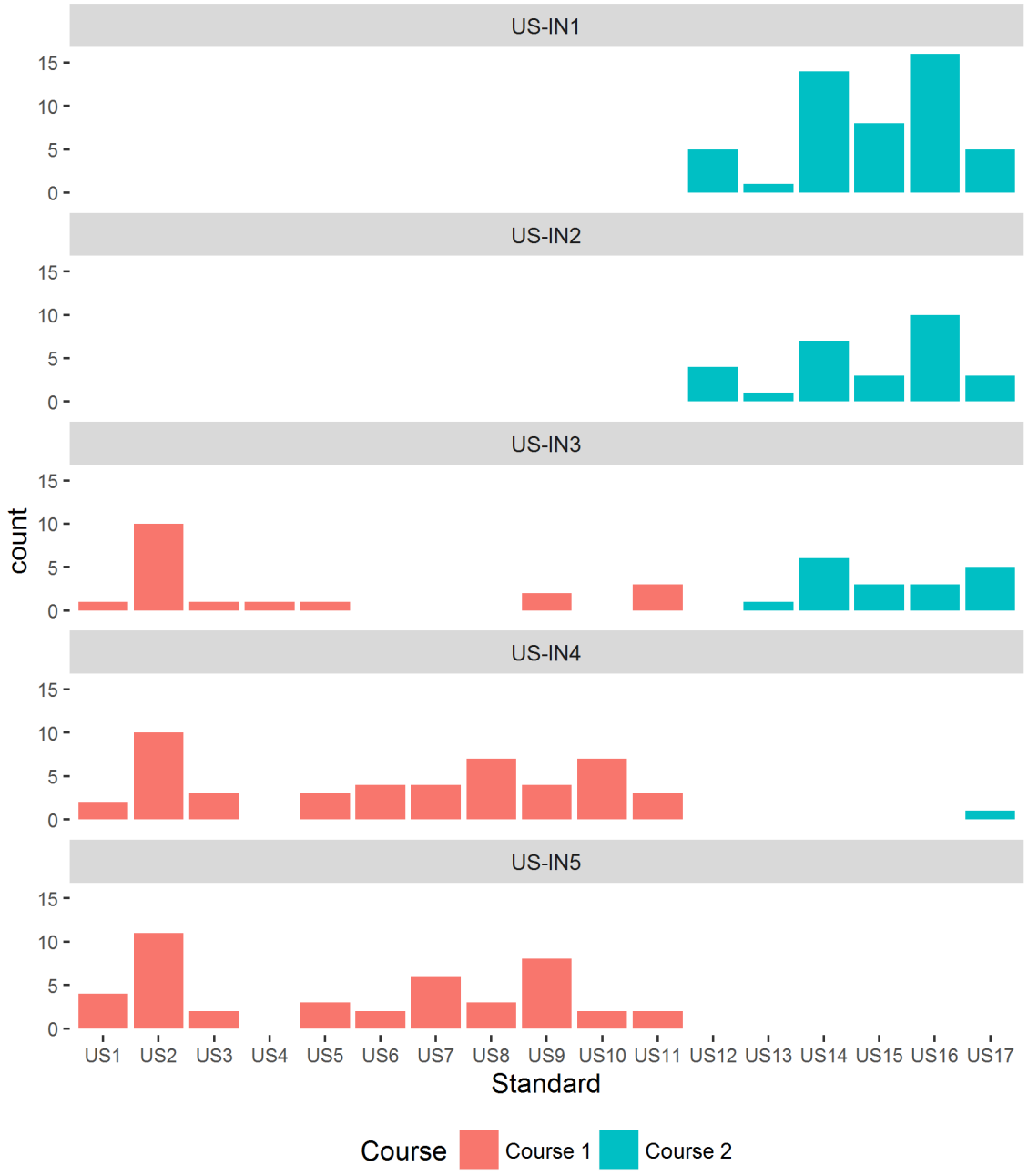


Figure 6. The United States balance of representation across instructors

In the case of the United States, Instructors 3, 4, and 5 taught Course 1. In addition to standard 2 which they all emphasized the most, Instructor 4 also placed relative emphasis on standards 8 and 10 (understanding fractions and rationale behind equivalent fractions), and Instructor 5 placed relative emphasis on standard 9 (operations

with fractions as extended from whole numbers). Instructors 1, 2, and 3 taught Course 2, with similar balance of representation. Standards 14 and 16, which are related to calculating areas and volumes and understanding geometric concepts, had more relative emphasis in these instructors' exam items. Also, Instructor 1 also emphasized standard 15 (statistics concepts), while instructor 2 also emphasized standard 12 (general principles of measurement), and, instructor 3 placed higher relative emphasis on standard 17 (classifying shapes into categories).

In the case of El Salvador, there was less variation across the instructors. Instructors 1, 3, and 4 taught Course 1, which is about geometry, measurement and statistics, emphasizing standards 2 and 4. Only Instructor 1 also included exam items addressing standards 5 and 6 (developing pedagogical skills about problems related to the teaching and learning process of geometry and reflecting about the methods used in elementary schools). Instructors 1, 2, and 3 taught Course 2, which is focused on arithmetic teaching and learning processes and included exam items emphasizing standards 10 and 12. Instructor 1 also included exam items aligned to standards 7 and 9 (getting a deeper knowledge about the numbers and analyzing theories about the numeric knowledge), and Instructor 4 included a small number of items aligned to standard 8 (developing the ability to design methodological strategies to teach algorithms).

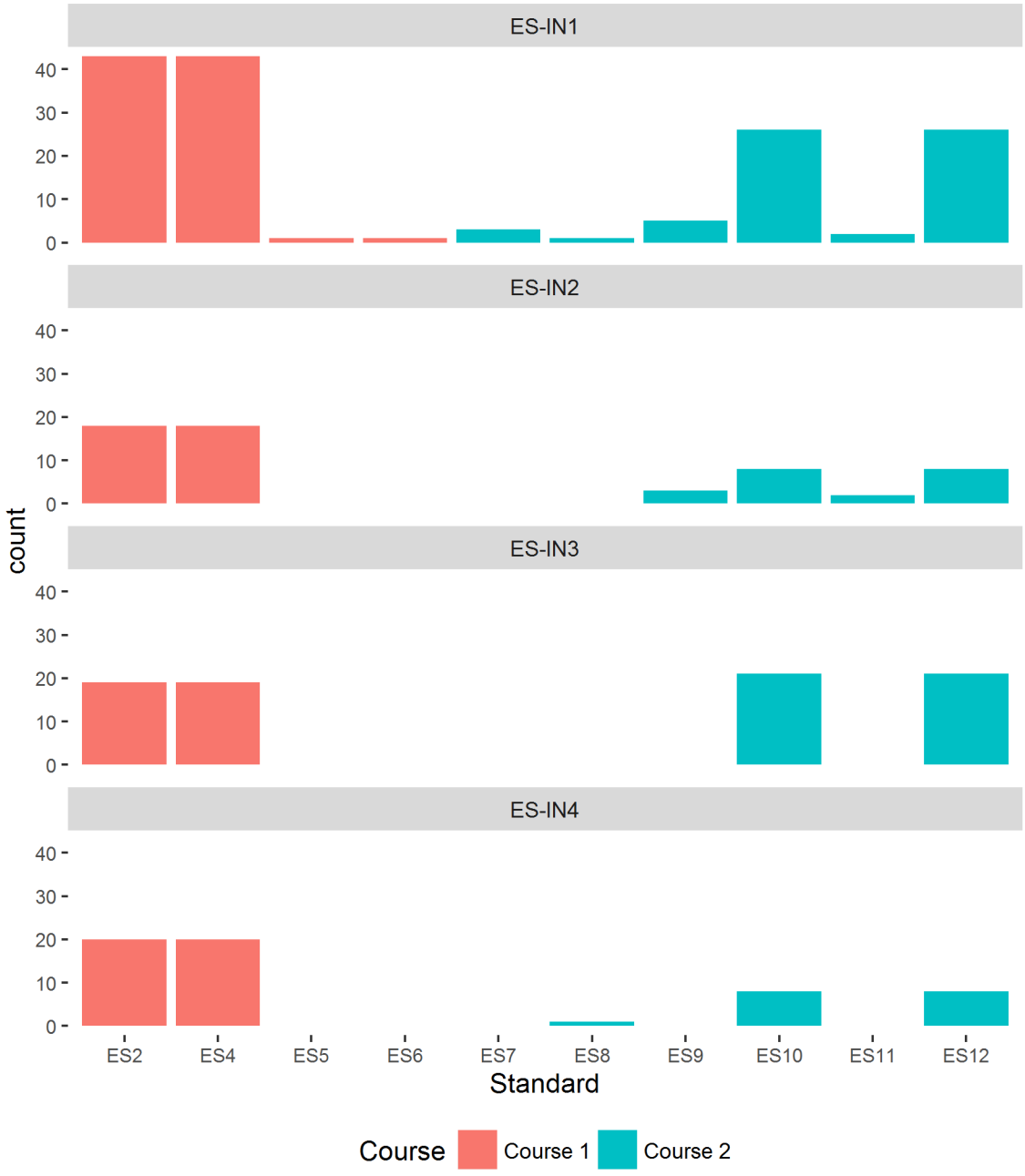


Figure 7. The El Salvador balance of representation across instructors

Standards Comparison

Table 8 shows that even though both courses in the different countries are working with the same content areas (numbers and operations, measurement, geometry, statistics, and probability), there were no direct matches between national mathematics standards in the two countries. The U.S. standards are more specific with regard to the content, with the El Salvador standards having a broader focus and including more pedagogical goals. There were, however, many partial matches, with the overall indications being that both countries' standards basically address the same content categories. However, there were four El Salvador standards (5, 6, 11, and 12) addressing pedagogic knowledge and skills which did not match with any particular standards from the United States.

Table 8. The United States and El Salvador standards comparison.

MET II Essential Ideas	El Salvador Direct Match	El Salvador Partial Match
US-ST1		ES-ST1
US-ST2		ES-ST8, ES-ST9
US-ST3		ES-ST8, ES-ST9
US-ST4		ES-ST7
US-ST5		ES-ST8, ES-ST10
US-ST6		ES-ST8, ES-ST9
US-ST7		ES-ST8, ES-ST9
US-ST8		ES-ST8, ES-ST9
US-ST9		ES-ST8, ES-ST9
US-ST10		ES-ST8, ES-ST9

US-ST11	ES-ST8, ES-ST9
US-ST12	ES-ST1, ES-ST2
US-ST13	ES-ST3
US-ST14	ES-ST4
US-ST15	ES-ST4
US-ST16	ES-ST1, ES-ST2
US-ST17	ES-ST1, ES-ST2
US-ST18	ES-ST1, ES-ST2
Others	ES-ST5, ES-ST6, ES-ST11, ES-ST12

CHAPTER FIVE: DISCUSSION

Limitations

The study addressed the extent to which national mathematics content standards are aligned to assessment in the pre-service elementary teacher preparation courses. The study took place at just two universities, one from each country, which is a small sample, but there is still reason to believe the data is representative of other programs in the respective countries, since the characteristics analyzed in this study (standards and assessments) guide the teaching and learning process and serves as an indicator of students' development, and these do not vary greatly across programs and instructors.

Regarding the participants of the study and the data collected from them (course assessments), there are three limitations. First, the quantity of participants. There were five instructors from the United States, and four instructors from El Salvador. In the case of El Salvador, it was representative since they were the ones who have been working with the courses. Second, there is a validity question regarding whether or not instructors wrote assessments designed to be aligned to standards. That is, even though the courses themselves were targeting national standards, instructors wrote their own items and may not have consciously addressed those standards. Usually tests are more aligned to content than to standards. Third, and one of my biggest concerns, is regarding the sampled assessments. They address summative learning in the courses, and may not provide much data about deeper content and pedagogy that cannot be assessed on in-class exams.

And finally, regarding the design of the study, it was also mentioned in the literature review that the greater the number of reviewers the more reliable the study will be. Since this was a small study comparing the alignment between two different courses with their respective standards it was consider appropriate to have two reviewers, but it could be seen as a limitation.

Recommendations

The Webb alignment method (Webb, 2007) was designed to compare the alignment between standards and assessment. Research in this area has often used the formal web-based WAT instrument, but this study highlights potential benefits of applying the framework in other ways. The four criteria used in this study gave important information regarding the alignment between standards and assessment and it is not difficult to implement. The finer grained analysis allowed for thinking beyond whether items matched with standards, to also include the degree of that alignment, and the depth of knowledge of items. I would highly recommend following similar steps in alignment studies of program standards and course assessments.

One of the main purposes of making a comparison study was getting to know, share, and learn from each country's approach to preparing teachers. One of the strengths of the United States is the way standards are written; they are clearer regarding the content knowledge required of well-prepared elementary teachers. El Salvador may benefit by rewriting the standards to be more specific according to the different areas (geometry, statistics, etc.). For instance, one of the standards states that students will develop skills and competencies to handle contents referred to plane and spatial geometry, measurement, and statistics. This standard can be broken into different parts,

regarding the areas, plane and spatial geometry, measurement and statistics. As well, the United States can take ideas from El Salvador. In the United States' set of standards, pedagogical knowledge and skills is not directly addressed. These ideas should not be implicit; they have to be explicit as this is an important feature in the teachers' development process. Teachers need to learn more than content appropriate for their potential instruction - they also need to learn how to teach it, how to solve students' problems, the best way a specific concept can be studied, and so on.

In addition, the results suggested a very large number of exam items in both programs are designed at level 1 or 2 (recall, and skill/concept) depth of knowledge, and less are designed to meet levels 3 and 4 (strategic thinking, and extended thinking). This information is valuable for instructors and also for courses at the universities related to assessment in teaching and learning. For instructors, it can assist revision of items for more balanced assessment of knowledge; both to identify if they are thinking about the levels when planning assessments, and also to evaluate how much they are challenging students cognitively. For instructors teaching courses about assessment in teaching and learning, it is a way to improve the skills future teachers will have regarding designing tests or any form of assessment.

As a final recommendation, and taking account that the education of future generations is a shared endeavor for all members in society, all programs preparing future elementary teachers in the area of mathematics should have some degree of consistency (about what the future teacher needs to know and be able to do when they finish their programs) and constantly improved. Alignment between standards and assessment is just one of the many important aspects institutions need to consider. Students' achievement

highly depends on the teachers' preparation (Lockheed, World Bank, & et al., 1990), and other programs can take this study as a starting point to make decisions about how to improve.

Conclusions

The first question of this study was about measuring the extent to which exams in Mathematics for Elementary Teaching courses align to national standards for elementary teacher preparation at selected universities in the United States and El Salvador. One important high-level difference is that courses in the United States and El Salvador have a different teaching and learning sequence. In the United States, future teachers first study arithmetic (number and operations) and then, geometry, measure, statistics and probability. In El Salvador, content is studied in essentially the opposite order, with geometry, measure, statistics and probability first, followed by arithmetic (number and operations).

During analysis, matching El Salvador assessment' items with standards was challenging because in addition to content knowledge, most standards are written to develop deeper pedagogy knowledge and skills. Aligning exam items in the U.S. program with standards was typically much easier, since standards are more specific and written to develop content knowledge. As a next step, future studies may use the results of this study while accounting the two structural differences in the research design, by for example parsing the more general El Salvador standards into sub-standards during alignment.

Broadly, in terms of Webb's four categories of alignment, the results support claims that (1) the categorical concurrence of test items was acceptable for both

programs, (2) the depth of knowledge of exam items tended to be higher in the U.S. program, with better alignment of cognitive demand to standards, (3) the range of knowledge was fully met by instructors in the U.S. program and partially met by instructors in the El Salvador program, and (4) both programs' instructors gave more emphasis to some of the standards than others.

Regarding the second question, the extent to which national standards for elementary teacher preparation programs in the United States and El Salvador align. It was found that both programs are targeting similar content knowledge. The main difference was that El Salvador program also includes standards that address pedagogic knowledge and skills and these are not present in the United States set of standards.

Finally, despite the potentially valuable results from this study and associated follow-up steps the universities may take in order to improve based on those results, due to the small sample and limited duration of this study, I recommend replicating this study with a larger sample of institutions, and over a greater span of assessments.

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APPENDIX A

Admission to Elementary Teacher Education (according to the University's Undergraduate Catalog, 2015-2016)

Admission to elementary teacher education is required before a student may enroll in certain upper-division teacher education courses.

Application is available online

The admission requirements are:

1. Application Package
2. Deadline:
    - First Friday in February for fall semester admission
    - Third Friday in September for spring semester admission
3. Academic Requirements:
    - Minimum cumulative Grade Point Average (GPA) of 3.0.
    - English Composition. Six credits of English composition must be completed with a minimum grade of C in each course. (Students who score in the 80th percentile or above on the ACT or SAT may be exempted from ENGL 101.)
    - Mathematics with a minimum grade of C. Neither class can be taken by correspondence.
    - Science. Eight credits of laboratory science in two areas with a grade of C or better.

- Teacher Education Pre-Professional Courses with a minimum grade of C in each course and an average GPA of at least 3.0 for all teacher education courses.
- Passing scores on the PRAXIS Core Academic Skills for Educators in mathematics (150) and writing (162). For information, access the PRAXIS website at www.ets.org/praxis/. Passing score on the exams must be on file in the Office of Teacher Education prior to acceptance into the program.
- Successful interview with TE interview panel.

Exit requirements

1. Completed application for Teaching Credential.
2. Official transcripts from ALL colleges and/or universities attended.
3. Successful completion of Standard Performance Assessment for Teachers.
4. Individual Professional Learning Plan, and Professional Year Assessment.
5. Completed Institutional Recommendation from Office of Teacher Education.
6. Official PRAXIS II assessment score sheet or notarized copy for all PRAXIS II assessments.
7. Comprehensive Literacy Assessment Certificate.

APPENDIX B

Entry requirements to new applicants in any of the specialties (Ministerio de Educación de El Salvador, 2012)

1. Admission grade
    - The global grade for the Learning and Aptitude Test for High School Students (Prueba de Aprendizaje y Aptitudes para Egresados de Educación Media (PAES)) must be equal or higher to the national average officially given by the Ministry of Education of El Salvador.
    - Have a global average of 7.0 contemplating the final grades from high school in the four basic subjects: Mathematics, Literature, Science and Social Studies. The average will be calculated adding the final grades from both years of high school and dividing the total between eight.
    - High school students which result in the PAES is higher than 7.0 can be admitted without taking on account the calculus indicated in the previous item.
    - For high school students who graduated before 1997 (without PAES), the entry requirement will be the average of the grades obtained in the four basic subjects of the two first years of high school. The applicant will qualify with a grade equal or higher than 7.0.

- For other cases the higher education institution will have to present the application to the National Direction of Higher Education (Dirección Nacional de Educación Superior (DNES)).

2. Psychological test
    - The higher education institution in which the applicant is requiring to be admitted will have to apply to all candidates two psychological tests: General Intelligence and Personality. The application of additional tests will be optional for the higher education institutions, as well as interviews or other resources.

Exit requirements

1. Have completed the study plan.
2. Approve with a minimum grade of 7.0 and minimum GPA of 7.0 in every subject.
3. Approve Academic and Pedagogic Skills Assessment (Evaluación de Competencias Académicas y Pedagógicas (ECAP)) with a minimum grade of 7.0
4. The GPA will have a 30% percentage of the global score in the ECAP.