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## Mathematics and Spanish: A Comparative Approach of Teaching Methods

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MATHEMATICS AND SPANISH:  
A COMPARATIVE APPROACH OF TEACHING METHODS

A Thesis  
Submitted  
in Partial Fulfillment  
of the Requirements for the Designation  
University Honors with Distinction

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University of Northern Iowa  
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Running Head: MATHEMATICS AND SPANISH

Mathematics and Spanish: A Comparative Approach of Teaching Methods

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### Abstract

Teaching methods in various academic disciplines are all connected. Whether one looks at various content areas, grade levels, or ability levels, teaching methods all share important similarities, as well as sharp contrasts. The meta-analysis and case study address the comparisons between teaching mathematics and Spanish at the secondary education level. In the study, a review of literature is conducted and case studies are analyzed in order to see the role of written and oral communication in mathematics and Spanish education. Throughout the study, written and oral communication, through teacher-student and student-student communication methods, show a strong overlap and supporting role of one another. Throughout the study, various instructional strategies and implications as related to written and oral communication are discussed. In conclusion, the study shows that when used effectively with students, when varied and transitioned with other instructional strategies, and when supplemented by appropriate questioning techniques, written and oral communication promote critical thinking, problem-solving, explanation, and creativity in both the foreign language and mathematics classroom. The study explores in more detail how both disciplines benefit from these two areas of communication.

Teaching, as with any professional area of study, requires adaptability, flexibility, constant learning, and willingness to grow. All teachers must not only continually reflect on their teaching styles, but they must also explore new and traditional teaching strategies to understand the best combination to implement into their classrooms in order to maximize student learning. Along with generally exploring new up-and-coming teaching trends in the general education field, it is important to explore specifically in one's own content area. This research aims to explore examples of teachers' practices in the foreign language and mathematics fields. By evaluating the general trends of educators in both content areas and by exploring research in educational journals, I hope to learn what the best teaching practices are that promote student learning. Moreover, it is possible through the research to find valuable information and methods that will not only benefit me by informing my personal teaching philosophy, but will also serve the profession by providing a clear, fresh look at current developments and benefits of the role of written and oral communication in education.

#### *Reason for Project*

As partial fulfillment of my Honors with Distinction designation at the University of Northern Iowa (UNI), I am completing this thesis project. While at UNI I had a double major in secondary mathematics teaching and Spanish teaching. As a pre-service educator, I had the opportunity to take several methods courses and to attend conferences in both content areas; through these experiences, I noticed that communication plays a central role in teaching and learning in both content areas. In mathematics and Spanish classrooms alike, the roles of communication orally and through the written form are both very important. By completing this study, I hope to better understand the role of communication in mathematics and Spanish

classrooms, as well as to inform my teaching philosophy to serve me well in mathematics and Spanish teaching.

In order to convey the information from this study, the paper will be organized in a progressive manner. Initially, I will explain the research questions and describe the project. As outlined in the methodology, I will analyze literature related to mathematics and Spanish teaching methods and view case studies of mathematics and foreign language teachers in order to compare and contrast teaching in the different content areas using what was learned from the review of literature. The middle portion of the paper will contain the literature review, the analysis from the case studies, and a synthesis of the material. Then, in the conclusion of the study I will explain how this research informs responses to the research questions, and I will describe other areas that should still be explored in order to benefit the profession even more.

#### *Project Description*

To complete this project, I will be doing a qualitative, meta-analysis of related literature in teaching methods for the foreign language and mathematics classrooms. First, I will complete a literature review that encompasses reading from classroom methods textbooks in both fields, educational journals, and other professional journals. I will identify ‘big ideas’ from the literature review to use when analyzing the case studies. For the purpose of this study I will focus on communication through the role of writing and the role of oral communication in mathematics and Spanish classrooms.

In this study, written communication will be defined as students or teachers giving or exchanging information through writing. Similarly, the idea of oral communication will be defined as students or teachers using any method to give or exchange information orally or through discussion. Other necessary terminology will be explained throughout the study.

After the literature review, I will watch case study videos while focusing on the ‘big ideas’ from the literature review. While watching videos of classrooms in these two content areas, I hope to extrapolate some knowledge of what methods work well in supporting communication. Many of these case study videos also include teacher commentary afterwards, which allows me to gain more insight into the teachers’ methods and plans. I will be viewing three videos from each content area, and each of these videos are from fifth to twelfth grade classrooms. I carefully chose the videos I am going to analyze because they include a variety of teaching styles, from teacher-directed teaching to student-led instruction. I believe that these videos will allow for variety in exploring communication in mathematics and Spanish teaching.

As aforementioned, as a mathematics teaching and Spanish teaching major at the University of Northern Iowa, I am very interested in studying the language and culture surrounding both mathematics and Spanish teaching. Through this meta-analysis of related literature, I will research Spanish and mathematics teaching methods and the roles of communication in these classrooms. By comparing and contrasting the uses and successfulness of these methods as related to communication, it is possible to learn more about each content area, as well as about the teaching methods applicable to each content area. As focus areas for the meta-analysis, I chose to research the two areas previously mentioned—the role of writing and the role of oral communication; I plan to look at these two areas as well with their correlation and connection to different styles of communication, such as teacher-student and student-student communication. Through this project, I aim to compare various case studies and texts in order to learn more about the teaching profession and inform a teaching philosophy to serve me in both mathematics and Spanish, which will allow me to be a more effective educator, maximizing student learning.



My research question for the study is, how do oral and written communication inform the teaching and learning of mathematics and Spanish? From that overarching research question, I broke the question down into two more specific research questions. The first of these two questions is, how is written communication used in the teaching of mathematics and Spanish? Similarly, the second research question is, how is oral communication used in the teaching of mathematics and Spanish? These research questions will be further addressed at the conclusion of the study.

### Methodology

To begin the study, I explored the purpose for the project and then narrowed the focus down to the research questions previously mentioned. At this point, I used a meta-analysis of literature to draw main areas of focus for the rest of the study. The review of literature looked at current research in mathematics and Spanish teaching methods, focusing on the role of written and oral communication. The research for the study was drawn from educational journals, professional journals, valid online resources, and teaching methods textbooks in both fields. Within the literature review I also looked into the role of teacher-student and student-student communication in the classroom. At the conclusion of the review of literature, I analyzed the material using a comparative technique from qualitative research.

In both of these areas, with mathematics and foreign language, it is important to use observational protocol to be able to learn about teaching methods. Case studies show insight into student reactions and provide me more data to use in answering my research questions. Oftentimes, research and studies use a quantitative approach to summarizing teaching results. However, viewing case studies allows the viewer to see a more first-hand look into student responses and expressions, which are impossible to quantify; therefore, qualitative methods will

be used to analyze the videos. The observational protocol of these case studies allows me the chance to view these six segments with a focus on the research questions and the main ideas drawn from the literature review. The case studies also elicit a better understanding of student responses to the teaching methods used. The case study analysis was an essential component to my study.

To conclude the study, I analyzed the review of literature and the case study analysis again using a comparative method. I concluded the study with responses to the research questions and an explanation of further areas to be studied and explored. This study of teacher-research will benefit both content areas in education, as well as inform my personal teaching philosophy.

#### Review of Literature

##### *Mathematics Education*

Recently, mathematics has been at the forefront of current research in teaching. Current research indicates that to “know math” is to understand it, as opposed to simply completing the required numerical tasks or problems based on memorized routines. In an example of this, from the *Educational Studies in Mathematics* publication, the authors of the study say that it is as if “knowing and understanding were something stored in peoples' minds independent of the situation that they find themselves in” (Roth, 2004). This source explains how students learn a concept in a certain setting and then act as though that setting, such as a math concept, have no overlap or interaction with other contexts; the only situation that a concept is known and used in is the context where the concept was originally learned. For this reason, teachers are trying to use mathematical communication, problem-solving, and applications to be able to help students really know math, independent of context.

Also, as a result of current research, the philosophy of teaching mathematics is changing, forcing curriculum and teaching methods to change as well. Much of the research in mathematics education has focused on communication, supporting my focus for this study. From a philosophical point of view, the content from this section supports the need to integrate written and oral communication in the mathematics classroom.

### *The Role of Writing*

“Mathematical literacy” is a term that has been recently popularized in the mathematics teaching field. This term means being able to readily apply and understand mathematics concepts through language. According to a meta-analysis conducted by Ballheim, et. al. (n.d.), mathematical literacy is made up of the following abilities:

Connecting mathematics to the real world; using mathematics appropriately in a variety of contexts; communicating using the richness of the language of mathematics; synthesizing, analyzing, and evaluating the mathematical thinking of others; appreciating the utility and the elegance of mathematics; and understanding and being conscious of what has been learned mathematically.

In the Standards 2000 Project, the National Council of Teachers of Mathematics (NCTM) introduced a new set of principles and standards for mathematics teaching at all grade levels. These principles and standards are divided into categories that are focal points for teaching mathematics. A 2007 article by Thompson reads, “The process standards of communication and representation in the ‘Principles and Standards for School Mathematics’ are critical tools to help students develop mathematical literacy. In the mathematics classroom, students need to be encouraged to use speaking, listening, reading, and writing to communicate their understanding of mathematics words, symbols, and concepts.” The communication process standard aligns

directly with all forms of oral, written, and technological communication in the mathematics classroom. Similarly, the idea of representation in the mathematics classroom addresses using a variety of representations to be able to have fluency in moving between written, numerical, and representational forms of the data and numerical concepts.

In mathematics, written communication is an essential component of learning. Students are required to be able to effectively write responses and explanations to mathematical problems, as well as construct their own problems. Writing plays a critical role in teaching students to understand mathematics. Adams (2007) suggests that “Students ‘doing’ mathematics ultimately results in students reading mathematics.” This idea of reading mathematics shows one aspect of the role of communication in mathematics; students often read and write mathematics simultaneously, as they read their own writing.

In a 2007 article, Rothstein elaborates on how integrating writing into the mathematics classroom naturally guides teachers to an instructional strategy that integrates the curriculum. Students are required to pull information from multiple areas of mathematics they have studied in order to create a full, correct response. Writing in mathematics is oftentimes used to master algorithms, solve word problems, and apply mathematical concepts, all of which can make students who otherwise do not like writing to see a practicality and enjoyment to writing. “Combining mathematics with writing promotes students' abilities to analyze, compare facts, and synthesize information. Integrating writing and mathematics also increases student engagement while building student knowledge” (Rothstein, 2007). For these practical reasons, writing in mathematics is at the forefront of the reform in mathematics teaching strategies.

One method that teachers have been using to implement more writing in the mathematics classroom is adding a journaling requirement. Teachers may ask students to journal daily or

weekly as a method of assessing student understanding, guiding future instruction, and eliciting mathematical written communication from the students. L. Nickerson II (2007) completed a study about high school Algebra students in grades ten through twelve and how journaling in mathematics and the quality of their responses affected their test scores. Nickerson found that students who had completed journal entries with their original wording and by applying the mathematical wording that had been talked about orally in class the students had a much higher level of achievement on their tests. Conversely, students who had simply copied down problems in their journals from the textbook and not reinforced the vocabulary that was used in class in their writing struggled more and had much lower scores on their tests. From his study, Nickerson (2007) suggests that “An assignment involving several such explanatory examples could perform a same or similar function as the longer journal assignment examined in this study.” Using both explanatory examples on a regular basis in class work and the longer journal assignments are valuable tools for educators to utilize.

These results have also been paralleled in several studies with middle school mathematics students as well. Students in the middle grades need just as much opportunity to be able to construct and explain their knowledge as high school students. In a teaching experiment conducted in a seventh-grade classroom, Steele (2007) cites that “writing gave students the opportunity to create their own detailed problem-solving knowledge by constructing it for themselves, not by having the teacher tell them the procedures.” Steele (2007) looked into how students used four different types of problem-solving strategies through writing their responses to basic algebraic problems. Another study looks into the importance of implementing writing in group settings in first-year university mathematics courses. In this observational study, “group work and mathematical communication skills, especially writing skills, are used as a tool to

develop non-routine problem solving skills” (Taylor, 2007). The author continues to discuss how students developed behaviors that were more thoughtful and skilled in problem solving, which was beneficial in not only mathematics but also in other areas of their lives. The research suggests that writing is a beneficial method in the mathematics classroom.

### *The Role of Oral Communication*

In conjunction with written communication, oral communication is an area in mathematics that many educators and students overlook. As with any content area, teaching students to communicate orally about their knowledge on a subject matter is essential. Students in mathematics classrooms need to speak mathematically, using the accurate terminology. This area of study will also look into teacher-student (TS) and student-student (SS) communication and the role these two forms of oral communication have in the classroom.

Oral communication can be effective in many ways. One of these ways is through student to student communication (SS), which can be through group work or one student presenting to the-entire class. The book *Mathematical Understanding 5-11: A Practical Guide to Creative Communication in Maths* by Anne Cockburn (2007) presents many strategies for oral communication, focusing on SS communication. Some of these strategies include: speaking and presenting, listening activities, role play, drawing, and visual methods such as posters and presentations. All of these ideas aim to help the students learn about mathematics and communicate their ideas more correctly. However, another important benefit of oral communication in the mathematics classroom is uniting the students with each other, as well as uniting the teacher and the students together. Nearly any strand of mathematics can be supplemented by presentational communication, group work, and SS communication.

Another mode of oral communication in the classroom is teacher to student communication (TS). This instructional strategy is oftentimes called teacher-directed instruction, where the teacher directs all of the instruction in a manner of talking to the students as opposed to interacting with them as much. Although some may argue that direct instruction is an outdated instructional strategy for teaching mathematics, direct instruction is a structured, clear method for students to follow and clearly understand. Cockburn (2007) also suggests that the oral communication in this method is a beneficial method for students who are considered at-risk and who are low performers. These students find it easier to have the information directly explained to them as opposed to having to conceptualize and discover it for themselves. The teacher can also use TS communication to facilitate small groups as he or she moves around the classroom prompting discussion with the students.

Oral communication of all types serves the students well in a mathematics classroom. By teaching students to focus on more precision in their language, mathematics classrooms are ideal places for students to develop confidence and better communication skills. Moreover, the written communication and the oral communication are highly intertwined in this area as well. In an article by Csongor (2005), it is explained that because students in mathematics classrooms are “enthusiastically engaged in lively discussions during every phase of the activity, striving to outsmart their partners, by continually correcting each other, and they are steadily improving both their oral and written communication skills.” The enthusiasm and conversation about mathematics is exactly what mathematics educators strive for in their classrooms, in a subject matter that is oftentimes challenging for students.

As previously mentioned, oral and written communication are both very important in the mathematics classroom and are highly intertwined with each other. According to a study by

Pugalee (2004), when students verbally express the results to a problem versus using writing to express a solution, they try fewer problem-solving strategies and successes. The authors of the study explain that students are less experimental with problem-solving strategies when they are using oral communication to respond to a problem, while writing allows the students more freedom and successes as they find multiple methods of solving problems. This being said, it was evident that the students had the knowledge to be able to construct these various strategies and solutions, but they were not as confident, used to, and relaxed enough to be able to use these same tools orally. Current research in mathematics is looking at the most beneficial ways to help students communicate orally in the classroom. With a combination of these two modes of communication, one important benefit is that students begin to construct thoughts and organize structure, and “students who construct global plans are more successful problem solvers” (Pugalee, 2004). In summary, oral communication of all forms, implemented correctly, elicits positive student learning in the mathematics class.

### *Spanish Education*

Similarly, teaching and learning foreign languages have also been at the forefront of research as the world becomes more globalized. Moreover, in many parts of the United States, the Spanish language is becoming an important part of daily life. In order to effectively apply the skill of a foreign language and effectively communicate, it is essential to be able to both write and speak the language. This basic concept directly correlates with my thesis study. Current research in foreign language has been focusing on trends in technological applications for teaching, learning, and using languages across all grades and locations.

Similar to the recent shift in mathematics, in foreign language learning, the idea of “knowing” the content is being redefined. Currently the idea of knowing a language is being



able to use the language effectively in any given context, non-dependent on dialect, region, or context. This shift causes instruction in second language (L2) classrooms to be more varied, focusing on a larger variety of cultural, contextual, and situation differences through oral dialogue activities and written assessments or projects.

### *The Role of Writing*

Teachers of foreign languages also have a critical responsibility of teaching students how to write in the L2. Foreign language educators teach the students skills that benefit writing in both the first (L1) and second languages. Through exploring the role of writing in the foreign language classroom, it is evident that this writing instruction not only benefits the foreign language learning but also establishes many benefits to other disciplines and areas of the students' lives.

Teaching students writing skills in the target language is an essential aspect of foreign language teaching. By teaching the students how to write in the L2, students will have a stronger grasp of the target language, as well as a more confident and varied approach of ways to communicate in the second language. A study by Shang (2007) suggests that a variety of skills and formats of teaching writing to foreign language learners “helped improve students' foreign language learning and attitudes towards English.” However, for teachers using a mostly writing-dominated approach, some students may also struggle, especially if they are not strong with the writing style of learning. Even if students struggle with learning a foreign language through writing, it is important that all types of learners are exposed to and involved with all types of learning.

When students are able to improve their writing in the target language, they are also able to improve their reading and comprehension skills in both the L2 and L1. When students learn to

write in the L2, they also immediately improve their ability to read short stories, poems, phrases, and literature. However, when teaching students to write in the L2, some may suffer from anxiety or be very protective of their writing (Macleod, 2007). To help minimize the anxiety in the classroom, it is important that teachers show the relationship between L1 and L2 writing. In the same study mentioned above, recorded in a collection of journal articles from ACTFL, says that “for foreign language teachers, fostering students’ positive and realistic perception of their writing competence is as important as developing students’ writing skills” (American, 2002). Writing can be a sensitive subject for many students, and it needs to be treated carefully and in a manner that reduces anxiety to the lowest possible level for each student.

Another important benefit for learners in the L2 classroom through writing is the improvement of grammar in both the L1 and L2. When students are asked to write out grammatical constructs and use them in sentences and phrases, they are more likely to remember them and acquire a working knowledge of them. Mulroy (2004) explores the results of immersion schools and their connection to grammar. Immersion schools can be defined as “an approach to foreign language instruction in which the usual curricular activities are conducted in a foreign language. This means that the new language is the medium of instruction as well as the object of instruction” (Bostwick, 2005). Immersion schools provide students a variety of situations in the L2. Mulroy looks at the sociolinguistic and communicative competence, which is the “practical ability to get one’s message across” (Mulroy, 2004). In his study, Mulroy found that although students in immersion programs are able to speak in the target language, the students struggle immensely with using correct grammar. Writing can help students visualize the connection of the correct grammar to the speaking and reading aspects of L2 learning.

Also, in foreign language writing, peer editing is another extremely effective method. Students learn from the peer interaction and editing. Peer editing not only allows students to help another student with his or her writing, but it more importantly allows them to see variety in writing from students who are at or near their L2 level, which causes them to notice patterns of mistakes, reflect, and grow in their own writing. Some students may not be mature or old enough to handle this task on their own, so teachers may need to show students how to correctly edit writing and guide them through the reflecting afterwards; by doing this, the foreign language teacher will receive the most benefit from the activity (Macleod, 2007).

Semones (2001) discusses a case study about collaborative writing in the classroom and the teacher's role in facilitation. In this case study, students in a French classroom were able to peer edit, use computer mediated materials to access and work on writing assignments, and eventually collaborate on larger writing projects. Semones (2001) discusses how asynchronous collaborative communication is a very beneficial idea for foreign language writing. The students enjoyed this setup and said that it was more fun than writing alone. Moreover, the educators who used this method found that when this writing activity was used in "the computer-mediated environment, peer interaction mimics the social context of initial language acquisition, wherein the student can continuously learn about a written text, the writer's ideas, the writing process, and the target language" (Semones, 2001, p. 4). Students will have various learning and working styles, as well as personality types, which are all reasons that flexibility and spontaneity are required on the teacher's part when enacting a benefit such as this.

Learning foreign language writing skills also has many benefits to students in other academic disciplines and areas of their lives. One large benefit of teaching writing in any area is the self confidence that writing builds. In Mulroy's 2004 study, he said that writing is an area

which causes immersion students to excel through “the positive attitudes they develop toward themselves as language learners” (Mulroy, 2004, p. 55). Also, writing causes students to feel more comfortable using humor in their L2 and their everyday lives. In the three-year InterActive Education Project, funded by the Economic and Social Research Council, students and teachers reported that a better grasp of humor was reached (Taylor, Lazarus, & Cole, 2005). Humor in the L2 and in daily life shows that students have a strong grasp of the vocabulary, as well as that students are reaching a level of communication fluency.

Also, through learning foreign language writing, students are better able to use and correctly express themselves in their own language. Students will learn or be reinforced of the terms for the parts of speech, which will help them to better understand and connect the reasons why grammar functions the way that it does in the L1. For example, students may not have an understanding of the term “indirect object pronoun” or the subjunctive tense in English. However, when these concepts are presented in an L2 classroom, students are able to be more cognizant of these grammatical constructs and tenses in their own language. This is beneficial because students are able to better express themselves in their L1, as well as be more professional and correct in their speaking and writing.

Another benefit of writing in an L2 classroom is the possibility of building relationships through writing correspondence by e-mail, keypals, or traditional letter writing. Students find a practical use for writing in the target language while at the same time forming relationships that would otherwise not exist. These relationships that are built can serve as lifelong correspondences, practice in the target language, or someone to visit in another country or area as a class or individually. In the in-depth study on the topic of e-mail exchanges by O’Dowd (2003), he discusses that the role of teachers in facilitating this activity are highly important.

O'Dowd (2003) also notes examples of correspondence which show that students are “able to construct a more empathetic view of the target culture by gaining insight into how members of the foreign culture view themselves and their own culture” (p. 137). These relationships and perspectives that are established and corrected are an essential part of foreign language learning and of life.

Moreover, studying a foreign language also improves students' cognitive abilities which will benefit them in all other academic disciplines. Also, the writing skills will help them after high school or college because writing is an essential part of any person's entire life. Students who write in any language improve their ability to write overall. The more writing experience a person has, the more confidence and readiness he or she has for post-high school courses or for basic everyday functions, such as writing letters, personal statements, job applications, or messages. Writing in a foreign language establishes strong cognitive skills and more cultural awareness, which are both important in daily life as well. L2 writing clearly has immense benefits in all aspects of one's life.

Writing in the foreign language classroom, especially collaboratively, will also develop a stronger bond and level of comfort between the students and their peers. This is important because it will also help to alleviate the anxiety from speaking with the students' peers. Anytime that a learning environment can be created that will be more healthy for all students, that would be beneficial; using writing to create a more cohesive learning environment is a great way to begin as a foreign language teacher. This method also implements the SS communication skills as related to oral communication. The benefits for the foreign language learning through teaching writing are endless.

After examining the role of writing in the foreign language classroom, it is evident that writing instruction not only benefits the foreign language learner in the L2 content but also establishes many benefits to other disciplines and areas of the students' lives. These benefits reach far beyond the classroom. Foreign language teachers, and educators of any type, are responsible for emphasizing all types of writing, which will in turn benefit the students cognitively and socially. Moreover, better writing skills will improve students' overall communication skills and effectiveness as productive members of society. With all of the evidence and the clear reasons to emphasize writing in a foreign language classroom, it is impossible to dispute that it is right to write.

### *The Role of Oral Communication*

Communication is a core objective of foreign language learning. In Spanish teaching, it is essential for the students to effectively see an educator model correct speaking skills (TS), as well as to have the opportunity to interact orally with students at their own ability levels (SS). The balance of these communication styles and the value of each allow for a class with positive, beneficial oral communication.

Oral communication is becoming an essential component in foreign language education that many secondary schools and universities are requiring oral proficiency exams to pass to higher levels of the foreign language courses (Van Moere, 2006). Although some schools are still hesitant to use this method, proponents of the idea have implemented the exams and used the research about oral communication to defend their reasoning. Because the idea of oral testing is a relatively new development in the L2 discipline, long-term results of the implementation are *not readily available*.

Moreover, SS communication in foreign language is essential, as previously mentioned, especially with the dialogue setting and group work settings. In order to really “know” the language, students need to be able to practice the speaking in various contexts, involving their peers and much SS communication. Also, direct instruction in foreign language classrooms is a beneficial tool. Teachers oftentimes need to use direct instruction through TS communication, in the target language, to explain and model grammar points.

Research also shows that L2 students need to be able to ask questions directly to the teacher and have the teacher give direct responses. A study by Ohta and Nakaone (2004) looks at the benefits to L2 learners of teachers answering questions directly, as opposed to the negative affects to the students when counter-questions are used. The research explains that when students were able to work in groups, the students’ questions were answered by peers before needing to ask the teacher, and these questions received correct answers from the peers. The students who asked the teachers questions oftentimes received counter-questions that eventually narrowed down to direct responses from the teacher. The research suggests that “Direct answers are effective in both ESL and FL classes and that counter-questions are useful as an intermediate step prior to a direct answer” (Ohta & Nakaone, 2004).

Oral communication and written communication are both instrumental components of Spanish teaching, and they can be intertwined together to supplement each other in an ideal way. The research supports the importance for using each method, through TS communication, SS communication, or other methods. Continuing to unite foreign language research, education, and learning with these two important areas will benefit the discipline and the globalization process in society.

### *Comparison of Mathematics and Spanish Teaching Methods*

While some people argue that mathematics and foreign language are completely separate disciplines, these two content areas are linked in many ways, as evidenced in the literature review. In comparing and contrasting the disciplines overall, both of the disciplines require a sense of structure and order, and as with any content areas, teaching and learning mathematics and foreign language both require motivational strategies, problem solving and critical thinking, instructional decision-making, and a myriad of other educational components. In the literature review for both of these subjects, it is oftentimes difficult to see where the distinction is between the role of written communication and oral communication, as these two areas supplement and support each other well. Although these forms of communication align well, they also have some distinguishing factors and different benefits. After reviewing the current research and literature in both mathematics and Spanish education, it is possible to explore both of the supporting similarities and the distinguishing differences.

#### *The Role of Writing*

Through the literature review of both content areas, the idea that writing is essential in both mathematics and Spanish is evident. Research in both disciplines show much benefit from written communication. In mathematics and foreign language learning, writing allows students another mode of expressing themselves and using critical thinking. Moreover, in both content areas, written communication is a way to assess if students “know” the content through their ability to show understanding and apply the material in a written context. In these disciplines, the written communication trend is more based on teacher-directed teaching and specified assignments or projects. Also, in both disciplines, students have the opportunity in their oral



communication to be creative and expand on the question, all-the-while using their working knowledge of the content vocabulary.

In mathematics, the role of writing in the classroom is oftentimes to clarify and express a solution to a problem in more detail. In Spanish, written communication is also utilized as a form of clarification and explanation. The research shows that both disciplines use writing as a way to respond to communication, problem-solving, and vocabulary in the content area, which is important as writing and speaking are all so closely intertwined and supplement these areas.

### *The Role of Oral Communication*

Similarly, the literature review in these two subject areas shows many similarities and differences in mathematics and Spanish education in the area of oral communication. Both disciplines use oral communication as an important resource in the classroom. In both cases, it is shown to be beneficial if the teacher communicates in the language of the discipline and conveys that expectation to the students. For example, the students show more learning when the teacher speaking in the target language in a foreign language classroom and when the teacher speaking mathematically in the math classroom. Both of these cases allow students to show their understanding of the material by synthesizing it and responding with correctly articulated, mathematical questions or responses. For this purpose, educators need to be well versed in their content area, as well as to have knowledge of how to teach the skill of oral communication to the students.

Group work and differing communication styles are important in each discipline as well. The research showed that TS and SS communication styles were used in both mathematics and Spanish areas. SS communication through group work was shown to be equally as beneficial in both content areas, even though foreign language classes appear to currently use this style of

communication more frequently. In contrast, mathematics educators appear to use the TS communication style of direct instruction more often than Spanish educators. In foreign language classrooms, educators use direct instruction mainly to introduce a core grammar concept. In mathematics, TS communication is used for many concepts as well, including teacher counter-questions in response to students' question, even with the trend of teaching mathematics from a discovery context growing around the nation.

Overall, the literature review shows that written and oral communication are highly overlapping and essential into the classroom in both content areas. TS and SS communication are an asset to both types of communication, with the research focus being on their role in oral communication. The review of literature benefits the study by giving a clear, detailed look at communication in mathematics and Spanish teaching.

#### Findings of Classroom Practices through Case Studies

As previously mentioned, the next step in the thesis is looking into case studies involving a variety of classrooms in mathematics and foreign language from around the country. Case studies lend a unique opportunity for seeing how the research and the classroom practice are synthesized together. Also, these studies allow the chance to see the current research applied in the classroom and observe the results and student responses. In each content area, I have chosen three different case studies, ranging from the fifth grade to the twelfth grade. Each of these case studies is from different school systems, with different classroom teachers. These six total case studies will be analyzed using the roles of written and oral communication within each content area. At the conclusion of the case study research, I will be able to summarize the findings and compare and contrast the observations.

*Mathematics Teaching Case Studies*

I selected three different case studies related to mathematics to view. The three mathematics case studies were all chosen from the *Powerful Practices in Mathematics and Science* (2004) resource of two CD-ROMs documenting research-based teaching. This resource is published by the National Center for Improving Student Learning and Achievement in Mathematics and Science through the University of Wisconsin-Madison.

*Mathematics Case Study 1*

The first case study I chose is called “Generalizing from a Pattern to Create a Formula.” This case study documented a seventh grade classroom taught by a teacher named “Ms. A.” Prior to this lesson, students had been working on a series of problems involving the number of rods in a beam of a given length (the beams were modeled using toothpicks representing the steel girders that would make up the structure). Throughout this lesson, the goal of Ms. A. was to have the students use deductive reasoning and create a table to be able to generalize a formula for the total number of rods in beams of a given length. To begin, the students worked in groups to create tables using data of the figures that are created. Then the students used small group discussion to explore patterns in the tables that they created. After the students have discussed the patterns, Ms. A. prompted them to look for creating the general formula that is stated in the objective of the lesson; once they have found a formula, each group was asked to present their results to the class. While the two groups presented, Ms. A. asked questions requiring them to defend their reasoning behind their formulas.

*The role of writing.* In this case study, Ms. A. did a good job of transitioning the students from words to formulas. For example, she helped the students transition the idea of “next term equals the current term plus four” into a formula. To better explain the example, part of the

dialogue of this case study as the teacher tried to transition students to writing and describing the formula orally went as follows:

Ms. A.: What's the next current formula?

Student 1: We go up by 4.

Ms. A.: To get the next one, it's the current one plus 4. But we don't want to know every single one to get down—we don't want to have to go through 49 to get down to 50. What I'm going to have you do in pairs is, on the construction paper, build length 6. And what I want you to try to do when you build length 6 is come up with a way to figure out the length without having to know the length right before it, without having to know the number of rods in length 5.

Then, the students looked at their tables and patterns that they had discussed in groups, and the teacher used TS communication and questioning techniques to lead a class discussion.

Ms. A.: Can you read your formula, student 2?

Student 2:  $4L - 1$  equals the total.

Ms. A.: Very short,  $4L - 1$ . Where does that come from? That's what we want to know. ... Where do you get the 4 from, and what do you mean about minusing one rod? How come it's 4?

This is a difficult idea for students to understand of moving from clearly stated words to algebraic expressions, but it is an essential skill and necessary for students to be able to also think critically to move from number sentences to words. Ms. A. did a good job of easing her seventh grade students into this idea in this lesson and asking them critical thinking questions that asked them to defend and explain their responses. Although it is oftentimes overlooked, this skill is a core component of effective written communication in mathematics.

*The role of oral communication.* In this study, Ms. A. used effective oral communication methods as well. She asked the students to work in groups, using SS communication, to have the students discover a pattern for the formula previously stated. Once the students had found the formula they were expected to present their formulas to the class by explaining and defending their formulas and connecting them with versions presented by other groups.

Ms. A. had the students read aloud out of the textbook, having the students practice orally communicating and using the mathematical vocabulary. She asked the students leading questions, and they raised their hands and responded. However, the questions that she asked initially were not very open-ended; thus, the students were not required to elaborate and critically think on her initial classroom questions. Later in the lesson she began to initiate more classroom discussion (TS) using questioning. At the end of the lesson, the students seemed to respond very well when they are presenting their formulas and Ms. A. asked them questions that required them to explain themselves.

Also, in Ms. A.'s class, the SS communication through group work was very positive; the students created good class discussion. However, the video did not show the teacher moving around the room during the discussion to make sure that the students were all getting to participate in the discussion, as opposed to having certain students dominate the discussion. The students were then able to come to the board to show and draw examples, using a SS method of oral communication where they presented their work to the whole class.

### *Mathematics Case Study 2*

Secondly, I chose to view a case study entitled "Introducing Students to Causal Modeling." This episode incorporated both mathematics and science together in a technique that is beneficial to both disciplines. This case study looked at a ninth grade class. The teacher in

this class is not named, so I will call him Mr. Doe. Over multiple class sessions the students were working in groups to explore the phenomenon of the “black box.” The black box was a box construction with some internal mechanism inside. The students were unable to see inside to find what is inside the box, but through trials using water being poured into the box, the students proposed mechanisms or models for whatever their group thought was inside of the black box explaining these data patterns. The students were learning the technique of using mathematics and science to show causal reasoning and also to explore scientific methods. During this class period, the students were being asked to test the black box and explain the pattern of water inputs and outputs throughout. Then, they tested a range of inputs, measured outputs, recorded their results, and looked for patterns in the data. Students were working collaboratively, with the same group, throughout the multiple-day lesson, and presented their results at the conclusion of the lesson. The students presented at the end of the lesson describing their ideas about the internal mechanism of the black box. During the presentations, students were also asked to support their results and models using their data and reasoning. To conclude the lesson, the students of other groups were able to ask questions and critique the other groups’ results.

*The role of writing.* In this study, in Mr. Doe’s class, during this lesson students were not asked to complete much written communication. However, the students were asked to present their findings by writing their tables and patterns on a large poster form. In the first two case studies the main format of writing occurred when students wrote numerically and in table form, which still required students to effectively communicate through writing.

*The role of oral communication.* Throughout this case study, Mr. Doe used oral communication effectively. Mr. Doe used humor throughout his TS communication style to keep the students engaged in the lesson. He asked a lot of factual questions that checked for

students' basic understanding and following along with the lessons. When Mr. Doe used humor, his students seemed to see him more on a personal basis and have better conversational interactions with him while communicating with him in a more conversational tone.

While students worked in groups, Mr. Doe walked around the class asking questions of the students, allowing them to defend their reasoning, and pushing them to stay on task. This is a great example of TS communication on an individual basis. Aside from SS communication with the students in their group work, the students also had another great experience of SS communication when they presented to their classmates.

### *Mathematics Case Study 3*

The final case study that I chose to view is from a fifth grade classroom. In order to cover the range of all grade levels of my teaching certification, I decided to conclude my mathematics case studies with a fifth grade example entitled "Constructing Descriptive Models of Growth." In this segment, the instructor, who I will call Mr. Jones, had the students conduct an investigation into height and growth of tobacco hornworms fed one of two different diets: green pepper or a recipe. The students looked for growth patterns in their worms and learned to create an S-shaped curve graph based on their data. The students were required to make data tables, created graphs, and calculated growth rates. Also, the students learned about how to use frequency displays and how to determine and explain changes within each experimental group over time. This hands-on lesson of mathematics addressed a variety of instructional strategies.

*The role of writing.* In this lesson, Mr. Jones had his students present their findings in groups to the class. As in the other two cases, the students were required to draw their results and graphs on large posters to show the class. These posters had some charts and graphs on them, as well as some written sentences about conclusions from the data. When the students

created their posters, the written communication on them required that students knew how to correctly use the vocabulary that they have been learning in this lesson.

*The role of oral communication.* In Mr. Jones' class, he asked students questions that required them to explain themselves as well. Oftentimes when a student responds to an answer, he replied by asking them "why?". Because the students were younger, Mr. Jones used clear TS communication through direct instruction to be able to keep the students on task, informed, and following along. He asked students to compare this study to prior knowledge from other class projects. Mr. Jones also had his students present the results and their graphs to the class using SS oral communication.

#### *Mathematics Teaching Case Study Analysis*

*The role of writing.* Writing served a beneficial role in these mathematics classrooms, as the research suggests. Written communication of mathematics can be in many forms. Aside from the traditional form of writing paragraphs and representing solutions in sentence and paragraph form; mathematics can also be communicated through data and charts. Although recent research suggests that writing in sentences using full vocabulary words is more beneficial, any form of written communication is beneficial for student learning; these three mathematics case studies all have a greater focus on numerical and graphical written communication than written communication using vocabulary. However, written communication played an important role in all three of these mathematics lessons.

*The role of oral communication.* Oral communication was very prominent in all of these hands-on lessons. The students used oral communication through TS and SS communication in class instruction, group work, and class presentations in each of these cases. In each of these studies, the teacher effectively transitioned the students orally as well from an initial concept into



a more conceptual and critical-thinking format, such as the words to formulas example. Critical thinking, defending responses orally, and making connections by relating their findings to other students' work are all a core part of using oral communication in the classroom. Furthermore, when the students read aloud from the textbook, they were able to gain practice using the terminology in the correct mathematical context. These three case studies all lend some insight into the instructional strategies and student learning in mathematics classrooms. These studies illustrate the literature review research well and are beneficial tools to use for the thesis study.

### *Spanish Teaching Case Studies*

I chose three case studies that include a range of ages and a variety of teaching style and methods. Also, the three chosen case studies all showed varying types of communication techniques in the classroom, including written and oral communication. The same process, outlined above, was followed for the foreign language case study research. I selected three different case studies related to Spanish teaching, all from the "Teaching Foreign Languages K-12: A Library of Classroom Practices" (2005) resource online. This library of classroom practices is the companion website for the textbook *Teacher's Handbook: Contextualized Language Instruction* by Shrum and Glisan (2005). The case studies were chosen after observing many from the variety in the online library. Each of these three case studies did a good job of incorporating multiple forms of communication into the content of the lesson, and each of these case studies will be looked at in more detail in the roles of the two areas of communication that are being studied.

#### *Spanish Case Study 1*

The first case study is a segment called "Hearing Authentic Voices." In this video, Davita Alston taught a Spanish I class of eighth grade students in Newark, Delaware. She had

her class engage in mock telephone conversations and had a focus on how leisure time is spent in Mexico in this lesson. For this portion of the lesson, she had the class brainstorm about how they think American teenagers occupy their time. Then the class reviewed a video that included Spanish-speaking youths talking about their leisure time activities. The students were allowed to compare and discuss these, and finally, Ms. Alston had two students native to Mexico come to visit the class and answer questions about how they spend their leisure time in Mexico. This lesson used a wide variety of communication tools in the classroom.

*The role of writing.* In the first case study, Ms. Alston never had the students explicitly write out anything as part of the lesson. However, the students oftentimes wrote down brief notes, especially when they were planning for their short oral activities. The students were encouraged to write questions out in the L2 as well in preparation for and during the presentation about leisure time given by the two speakers from Mexico.

*The role of oral communication.* In the first case study, Ms. Alston set out one of the objectives for the day for her students to be able to correctly ask and respond to questions of native speakers about their leisure time. The students began with an oral exercise in pairs. The students were each assigned to be either student A or student B and were given papers with new vocabulary, and the students were required to make a scenario about things that they usually do using these new vocabulary words. The entire class period, from the initial greetings as the students came into class, the teacher spoke completely in Spanish. The students followed this pattern and spoke in Spanish as well. During their brief presentation of their scenarios, the teacher asked them questions in the L2 about what they said, requiring the students to think more critically about their vocabulary and their meaning.

*Spanish Case Study 2*

The second case study that was studied was entitled “Routes to Culture.” This case study looked at a Spanish II class involving students in ninth and tenth grade, taught by Mr. Pablo Muirhead. Most of the students in his classes have taken Spanish since the Elementary Spanish program was initiated when these students were in grade five. This lesson is full of cultural learning and falls part way through a thematic unit about the African presence in the Latin American culture. The goal for the day was for the students to practice and gain comfort with their oral skills while also elaborating on some aspect of the African presence in Latin America. In this lesson, the students identified cultural aspects of stories about an enslaved African girl in Panama. They then practiced SS communication by working in small groups to prepare skits. The skits incorporated cultural aspects and were performed for the rest of the class. To conclude the lesson, the class practiced playing an musical instrument called los cajones, which is a set of box drums with joint origins from both Africa and Latin America.

*The role of writing.* In this study, Mr. Muirhead had the students work with index cards to form words into sentences, with each student having one word on an index card and they had to arrange themselves so their cards formed a sentence. This exercise allowed students to think critically as they were required to put the words in order logically after repeating them aloud as a class. When a student was interviewed after this activity, he explained how Mr. Muirhead used this activity often to engage the students and how it was a good activity that allowed the students to practice their vocabulary. This exercise of forming sentences was a way of having students work together using writing. This lesson by Mr. Muirhead focused more on oral communication, however.

*The role of oral communication.* Mr. Muirhead had his students spend 30 seconds with a partner answering a question he posed. Then he had the students stop talking when the 30 seconds were up and change partners, then asking the students another question. This activity continued for a while, as long as necessary for the teacher to reach the objective. The logic that Mr. Muirhead used was to elicit new vocabulary from the students, starting out with simple questions and developing into questions that were more related to the topic of the lesson and more cultural topics. The teacher walked around the room listening to the responses to informally assess their comfort level. The students seemed to respond very well to this oral communication strategy for the most part, but some students had difficulty staying on task when they would rotate to be partners with certain peers. Also, when some of the students were interviewed, Mr. Muirhead's students said that the most beneficial teaching tactic that he used is his ability to transition the peer questioning from vague to detailed, applicable to the lesson, and culture-specific.

### *Spanish Case Study 3*

Lastly, I also studied the segment entitled "Interpreting Literature." This video showed eleventh graders in a Spanish III classroom taught by Ms. Barbara Pope Bennett. The lesson in the video focused on the story *Dos Caras* (1989) by Sabine Ulibarri of New Mexico. In this segment, the students were instructed through TS communication and direct instruction as they summarized and discussed the interpretation of the story. Also, students were asked to discuss the message and morals in the story, while speaking in the target language throughout the class session. At the end of the class period, the students used oral communication to act out segments of the story as an entire class and then used SS communication through group work to create alternative endings to the story.

*The role of writing.* In the third case study, Ms. Bennett used literature to elicit written communication, which was a beneficial instructional strategy and helped students in all content areas. As the literature review showed, written communication and literature are closely linked together, and incorporating one of the two strategies in the classroom also benefited the other strategy. The students in this case study were required to think of, and write down, an alternative ending to the story, which used critical thinking applied to the written communication context.

*The role of oral communication.* In this segment, the students used oral communication to work in groups and act out segments of the story that they had read. The students used SS communication effectively to be able to debate and agree on alternative endings to the story. Throughout this process, the students asked each other questions, leading to more discussion in the L2. The students seemed very engaged and motivated by having the chance to discuss, critically think, and then write in the target language.

#### *Spanish Teaching Case Study Analysis*

*The role of writing.* Written communication was evident in each of these foreign language case studies. The students were required to use critical thinking in the writing activities in each of these case studies. For example, students were asked to critically think to use new vocabulary and form sentences, as well as to critically think in order to create alternate endings to a story. In each of the three case studies, students used writing to be able to take informal notes of the TS communication and about the information discussed in their group work. These three studies gave a good balance and variety of teaching strategies, applications of written communication, and student responses, which supplement my thesis study well.

*The role of oral communication.* Also, oral communication was evident in each of these three case studies. For example, in two of the case studies (case study 1 and 2), the instructor

sets out with objectives related to oral communication. Furthermore, an overarching theme in all of the Spanish case studies was the concept of the teachers speaking Spanish the entire time to the students and the students being expected to speak Spanish for everything, including questions, as well. Also, all of the case studies involved a balance of TS communication and SS communication styles. In each of the cases, the teacher spent some time with TS direct instruction asking questions and eliciting more critical thinking and application questions of the students. This strategy seemed to engage the students well.

In each of the three case studies, the teacher used some form of SS communication as well. In the first two case studies, students mainly worked in partners, but the teacher had the students rotate partners throughout the activity. Also, in the last two case studies, students worked in small groups ranging from three to four students to create skits and discussion. Both the use of the TS and SS communication seemed to engage the students. In all three of these case studies, the concept that seemed to most benefit the students were the smooth transitions and the variety of activities and types of communication. The students responded well to the variety of modes of communication, as long as the transitions were smooth and the activities were well-organized without free time to allow students the opportunity to be off task. These three case studies all lend a unique look into Spanish teaching methods and the students' initial responses; these are beneficial tools to use as observational protocol in my thesis study.

### *Comparison of Mathematics and Spanish Teaching Case Studies*

#### *The Role of Writing*

Writing was evident in all six case studies I viewed for the study. In the case studies, it was evident that writing was most beneficial in classrooms when it was balanced with and combined with oral communication activities as well. When students were interviewed

throughout the case studies, several students responded that the teacher created an interest in the material because of their varying styles of activities, including writing, presentations and dialogues, and note-taking. The teachers of these case studies supported this idea as well in their comments, saying that students showed better overall performance when a variety of these instructional methods was implemented. In both disciplines, the teachers were most effective when they balanced the two forms of communication, varied instruction styles within these methods, and used smooth transitions from activity to activity. In many cases, when the teacher used clear connections with purposeful activities that were well-organized, the students learned the best. This is supported by several student comments included with the case studies.

In both content areas, students were asked to write in the appropriate language. These activities where the students wrote mathematically or wrote in Spanish formed a basis for the oral presentations and discussions later in the lesson. Also, students used writing in all cases to be able to take notes and effectively keep structure to the direct instruction from the teacher. Writing serves an important structural and communicative role in both mathematics and Spanish classrooms. The students used writing in a structural role to formulate charts and tables of data in the mathematics classrooms, and the students in the foreign language classroom used writing in a structural role to make notes of the grammar points and questions from the teachers. Moreover, the same charts and tables that were written in the mathematics classroom were expanded upon and presented to the class in a communicative role. In the Spanish case studies, students used the written communication to write responses as assessments for the teacher, communicating their knowledge to the teacher. For example, the students in the third Spanish case study were asked to write alternate endings to the story, which served a communicative role

to both their peers and the teacher. Each of these two roles of written communication was an evident practice throughout the case studies.

### *The Role of Oral Communication*

Oral communication was also found to be evident in both content areas. The teachers in all six classrooms did an exceptional job of balancing and combining TS and SS communication in each lesson. By using a healthy balance of these two methods, teachers were also able to use a strong balance of questioning techniques. The questions that the teachers asked oftentimes transitioned from factual to more conceptual questions, which allowed students to be comfortable in the lesson and setting prior to critical thinking questions. The teachers in the case studies also showed teachers using SS and TS questioning techniques to narrow the focus of the discussion and have students discover the goal and objectives of the lesson.

One of the key ideas shown in all of these videos was that the teacher spoke in the target language of the classroom the entire time, giving that same expectation to the students as well. In the Spanish classrooms, the teachers used Spanish the entire time, and the students were aware of that expectation on their part as well. The research in the review of literature also supports this essential teaching practice. Similarly, in the mathematics classrooms, the teachers used clear, specific mathematical terminology in their lessons.

In all six of these cases, students also benefited from using SS presentation communication and discussions in the classroom. When the students presented, written communication was also oftentimes supporting the oral activity. During the presentations students were also asked to defend their reasoning in the language of the discipline. This style of SS or TS questioning elicits critical thinking from the student. As mentioned in the review of literature, Ohta and Nakaone (2004) suggest large benefits to L2 learners when teachers answer



questions directly, using the target language. Moreover, teachers using language as a means for teaching and using critical thinking has been evident throughout the study. Overall, the case studies support the research by showing the importance and benefits of written and oral communication in the classroom.

### Conclusions and Recommendations

After completing the meta-analysis and case study analysis, it is clear that written communication and oral communication are core and progressive methods in mathematics and Spanish classrooms. With the recent change in the call to teach mathematics for understanding and the situational nature of foreign language, students and teachers around the world are now seeing a practicality and emphasis on the written focus of both mathematics and Spanish. Educators have seen the benefits of incorporating and increasing the amount of focus and attention placed on vocabulary and writing. The overwhelming benefits of writing in mathematics and foreign language show that it is essential for educators to prepare students to be problem solvers with a basis of communication in all disciplines. Also, as with any subject, a healthy balance of teacher-student (TS) and student-student (SS) communication aides in an effective classroom instructional strategy.

Throughout the study, answers to my research questions began to emerge. Recall the overarching research question was: how do oral and written communication inform the teaching and learning of mathematics and Spanish? Because I broke the question down into two more specific research questions, the responses to those two questions will answer the overarching research question. The first of these two, more specific research questions is, how is written communication used in the teaching of mathematics and Spanish? Throughout the study, this idea has also been answered in the comparison sections of the review of literature and the

case studies. Written communication serves both disciplines through allowing students the opportunity to clarify, explain, and elaborate on the content. Also, written communication allows students to express themselves, to solve problems or encounter situations in different ways, and to show different ways of problem solving. Critical thinking was another important theme of written communication throughout the study. In both content areas, writing requires students to critically think, to problem-solve and explain their rationale, to be creative, and to defend and explain their thinking. These benefits, as with oral communication, will serve the students well in all areas of their academics and their lives.

Furthermore, the second research question is, how is oral communication used in the teaching of mathematics and Spanish? Throughout the study, this idea has been answered in the comparison sections of the review of literature and the case studies. Oral communication is used in each of these content areas to elicit critical thinking, to effectively communicate and clarify solutions or situations, and to present findings to peers. Moreover, oral communication is seen as a way for students to problem solve, to defend responses, and to learn and utilize effective questioning techniques. All of these skills will serve the students in other disciplines and as lifelong learners.

Overall, it is difficult to distinguish the line between written and oral communication as the two overlap and support each other well. Throughout both disciplines and both forms of communication, several themes were evident. First, critical thinking and problem solving was a recurring theme. Communication elicits students' critical thinking and problem-solving skills, as well as requiring them to explain and clarify concepts. Also, effective questioning techniques were an important core part throughout the study. If the teacher effectively implements questioning, through TS and SS communication as well, students will benefit in all of these

content areas and communication styles. As with any instructional strategy, the research cautioned against the overuse of any of the communication strategies. If this happens, students will possibly turn away from not only that overused strategy but also all other communication-centered teaching strategies. Lastly, research stressed the importance of the teacher having the ability to teach these communication skills to the students and to effectively model them in the classroom. Students will learn from examples, but they also need to have honest, clear instruction on how to be more effective in these communication areas in order to maximize their learning in return. The research and information through the study will well serve both content areas and the teaching profession as a whole.

Also, this study informs my personal teaching philosophy as well. Throughout this study I have learned even more the importance of including written and oral communication in my teaching philosophy. I have gained a larger repertoire of instructional strategies that can be used in both areas as well, especially strategies that promote critical thinking. Along with realizing the importance of incorporating oral and written communication in my classroom, I have realized the importance of teaching the two forms of communication as related and supplemental ideas. Oftentimes these two methods are taught in isolated cases, so in my teaching philosophy I plan to balance and supplement the communication methods together. Lastly, I have learned the importance of taking time and teaching the students the skills of written and oral communication in the content areas. This study has been very beneficial to my personal teaching philosophy as it will serve my teaching and the learning of my future students well.

In the future, this area of educational methods has many more veins for research. Some areas that still need to be further explored are the varying types of questioning methods. Also, as technology is at the forefront of developments in teaching methods, technological implications

and instructional strategies driven by technology and communication is another area of study; written and oral communication both have a strong connection with technology. Finally, nonverbal communication is another area to be studied, as nonverbal communication plays a large role in education and all other types of communication. Also, throughout the study, few biases and limitations existed. However, one bias that was present was my bias and interest in the material. Because of my interest in the material, I saw a benefit to the content.

After this study, through the research, it has been possible to find valuable information and methods that will not only inform my personal teaching philosophy, but will also serve the profession by providing a clear, fresh look at current developments and benefits of the role of written and oral communication in education. Written and oral communication are important components of education and of life. Through continual research and growth, teachers can explore and learn about these instructional strategies that will best benefit their students and maximize student learning. This reflection and growth for students and teachers alike encourages adaptability, flexibility, problem-solving skills, and lifelong learning, which benefits all professions and facets of society.

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