

Evaluating the Effects of Mother Tongue on Math and Science Instruction

By
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Edited by
Dr. Ismail Sahin
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Table of Contents

CHAPTER 1: THE CONTEXT OF THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION.....	1
Introduction to the Problem.....	1
Background, Context, and Theoretical Framework.....	2
Statement of the Problem	3
Purpose of the Study.....	3
Research Questions.....	4
Rationale, Relevance, and Significance	4
Nature of the Study.....	5
Definition of Terms	6
Assumptions, Limitations, and Delimitations	8
Organization of the Remainder of the Study	9
CHAPTER 2: THE LITERATURE REVIEW OF THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION.....	11
Introduction to the Literature Review	11
Theoretical Framework.....	15
Site Analysis Based on Language and Its Effects on Learning.....	15
Site Analysis Based on Systems Theory	16
Site Analysis Based on Action Science.....	17
Site Analysis Based on Change Theory	18
Review of Research Literature	19
History of Language in Haiti.....	19
Political and Economic Impact	19
Educational Impact.....	22
Research on Mother Tongue as an Effective Learning Tool.....	23
Use of Mother Tongue Yields Superior Academic Achievement.....	24

Achievement in Second Language is Comparable to that in First Language24

Use of Mother Tongue Increases Student Participation in the Learning Progression26

Necessity for Research on Mother Tongue Instruction26

Educational Impact of Second Language as Instructional Tool.....27

Economic Effect of Second Language as Instructional Tool27

Obstacles to Implementation of Models That Have Worked in Other Countries27

Governmental and Community Support28

Chapter 2 Summary29

CHAPTER 3: MEASURING THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION33

Purpose of the Proposed Study33

Research Questions and Hypotheses34

Research Design35

Target Population, Sampling Method, and Related Procedures36

 Target Population36

 Sampling Method36

 Sample Size37

 Setting.....38

 Recruitment38

Instrumentation38

 Quantitative Data.....39

 Qualitative Data.....39

Description of Intervention.....40

Field Test41

Operationalization of Variables42

Data Analysis Procedures42

 Quantitative Data.....42

Qualitative Data.....	43
Limitations of the Research Design.....	43
Internal Validity.....	44
External Validity.....	45
Expected Findings	46
Ethical Issues	47
Conflict of Interest Assessment.....	47
Position Statement.....	47
Chapter 3 Summary	49
CHAPTER 4: RESEARCH FINDINGS FOR THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION.....	51
Description of the Sample	52
Summary of the Quantitative Results.....	52
Results of Dispersive Tendency of Pre-Test Scores	53
Results of t-Test between Means of Pre-Test Scores per Grade Level.....	55
Results of ANCOVA between Means of Math Post-Test Scores per Grade Level	56
Results of ANCOVA between Means of Science Post-Test Scores per Grade Level	58
Detailed Analysis of Quantitative Data	60
Dispersive Tendency of Pre-Test Scores	60
t-Test of Pre-test Scores	60
ANCOVA of Post-Test Scores for Both Groups	62
Summary of the Qualitative Results.....	64
Student Group Interview Results	64
Student Perception Questionnaire Results	66
Chapter 4 Summary	67
CHAPTER 5: IMPLICATIONS FOR THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION.....	69

Summary of the Results.....	69
Discussion of the Results.....	70
Discussion of the Results in Relation to the Literature	71
Limitations.....	72
Implication of the Results for Practice	72
Recommendations for Further Research	73
Conclusion.....	73
REFERENCES	75
APPENDIXES	79
Appendix A. Student Perception Questionnaire.....	79
Appendix B. Participant Interview Questions	82
Appendix C. Student Perception Questionnaire Results	83

CHAPTER 1: THE CONTEXT OF THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION

Introduction to the Problem

French is currently used as the language for instruction in Haitian classrooms. However, most Haitian students do not have a solid grasp of this language. As a result, the students are unable to effectively understand and assimilate concepts. This leads to an ineffective education system, which renders tens of thousands of students graduating yearly without basic skills.

The totalitarian French educational system that requires students to acquire basic skills in a foreign language endures in lieu of an alternative system in which students are actively engaged and learn using their native tongue (DeGraff & Ruggles, 2014). This situation further explains why students are unable to find employment upon graduation further adding to problems with Haiti's economy. "There are several reasons to think, however, that the maintenance of French in fact acts as a handicap on Haiti's economy. To begin with, economic development is negatively influenced by low educational participation" (Hebblethwaite, 2012, p. 275).

Kreyol, on the other hand, is spoken by nearly 100 % of the population. "Creole is the native language of every citizen in Haiti, and for some 85% of the population the only language" (Byrne & Holm, 1993, p. 291). Therefore, using this language for instruction would possibly ensure that students grasp concepts presented. Students would then be able to transfer knowledge to another language whether French or any other. This can be done by making Kreyol the language of instruction in classrooms. This does not mean that French would be replaced by Kreyol. It simply means that Haitian students could finally be given the opportunity to acquire a solid grasp of concepts using the only language they know and understand. Then they may transfer their knowledge to any other language of their choosing.

Background, Context, and Theoretical Framework

The issue of choosing which language to use as a medium of instruction in Haitian classrooms is a controversial one. French is currently used as the language for instruction. However, this poses two issues: first, it is considered Haiti's second language. Second, it is not accessible to the population as a whole. Gibson's (2011) article on Haiti's educational system found that:

Many questions and issues are raised including which language should be used as a medium of instruction, the issue of teaching literacy in a language that is not the child's vernacular language, questions of which language the teachers are most literate and most orally proficient in, and issues of social mobility and linguistic capital surrounding language for certain social classes. (p. 26).

Kreyol is a language spoken by virtually all Haitians. However, Kreyol is seen as the language of the poor in Haiti. Because of the power that French has and the elitist characteristics that are attached to it, without mastery of it, social advancement can be difficult (Gibson, 2011). It has been used as a means to keep a portion of the population illiterate and under tight political control. Degraff (2007) contended that the Haitian school system has played the most important role in defaming and degrading the Kreyol language. He further asserted that the omission of Kreyol in Haitian schools serves as a means of marginalizing monolingual Kreyol speakers, making them feel as if they are worth less than French speakers.

At the research site, like in many schools in Haiti, the use of Kreyol in the classroom is not encouraged in the secondary grades and forbidden in the primary grades. The administration of the research site requires that courses be taught exclusively in French. This affects the track that students choose to follow during their high school career.

In high school, students choose between three sections. Section A/B, the literature path, is very heavy on French and has the lowest enrollment because of students' lack of knowledge of the French language. Section C has a math and physics focus and relies less on language than number sense and therefore has the second highest enrollment. Section D has the most students as it encompasses the sciences (biology, geology, low level physics and math). The reason students pick this section is the primary skill it requires for success is rote

memorization. Although students may not be able to grasp French and therefore the concepts presented in that language they may strive to make this section manageable and score a passing grade by memorizing the information from their books, they may still not acquire the skills to be successful. According to USAID, the language issue in Haitian classrooms along with traditional pedagogical methods such as rote memorization, lead to low level readers that in turn go through life as ineffective learners (DeGraff, 2013).

Statement of the Problem

The problem was that although French is the language of instruction in Haitian classrooms, only a small percentage of the population speaks and understands this language well enough to comprehend concepts presented using this medium. “While Haiti is considered a bilingual country with French and Creole being the two official languages, researchers have found that only seven percent of Haitians are truly French/Creole bilingual” (Gibson, 2011, p. 19). Kreyol, on the other hand, is a language spoken by all Haitians. The use of Kreyol in Haitian schools could support the statement that, “ Years of research have shown that children who begin their education in their mother tongue make a better start, and continue to perform better, than those for whom school starts with a new language” (Daniel, 2003, p. 1).

However, Kreyol is not currently the language used for instruction in the majority of schools including research site:

Research has shown repeatedly that students acquire literacy most efficiently in their native language, that which they have spoken since infancy or early childhood. To expect them to acquire literacy in a language foreign to them is to unnecessarily hamper their academic achievement (Spears, 2010, p. 4).

It could be assumed this would also include their achievement in math and science.

Purpose of the Study

The purpose of this action research study was to implement math and science instruction for Haitian students in their native language, *Kreyol*, to improve Haitian students’ academic achievement. As the debate about which language to use as a medium for instruction continues one thing is certain, students are failing. This study was directed toward finding a possible solution to improve student success in Haitian classroom.

Research on linguistic theories such as that from Degraff's (2014) MIT-Haiti Initiative and Dejean (2010) has highlighted the importance of language in the processing of new information, thus the choice of language as the main variable in this study. It was therefore hypothesized that the use of student's mother tongue will increase the efficiency of understanding and processing technical information presented in classes. The results of the study may provide useful information as to improvements necessary to increase student success.

Research Questions

1. What are the effects of teaching Haitian students in their native language of Kreyol on their academic achievement in Math?

H1: Teaching Haitian students in their native language of Kreyol will have a positive effect on their academic achievement in Math.

H0: Teaching Haitian students in their native language of Kreyol will have no effect on their academic achievement in Math.

2. What are the effects of teaching Haitian students in their native language of Kreyol on their academic achievement in Science?

H1: Teaching Haitian students in their native language of Kreyol will have a positive effect on their academic achievement in Science.

H0: Teaching Haitian students in their native language of Kreyol will have no effect on their academic achievement in Science

3. How will the use of Kreyol affect students' perception of the use of language in their education?

4. How will the use of Kreyol affect students' perception of their identity as Haitians?

Rationale, Relevance, and Significance

The proposed change in practice involved using Kreyol as the language for math and science instruction in designated classrooms as opposed to the current use of French as the medium of instruction. The current practice could lead to an ineffective classroom in which students do not grasp concepts presented by instructors. This could also cause failing students and a failing educational system. As per a 2012 Haitian government report, the majority of students

have low literacy level due to the practice of rote memorization and the lack of understanding of concepts due to language barrier (DeGraff & Ruggles, 2014).

By not making the change in language used as a medium for instruction, students could continue to struggle to learn in a language that is unfamiliar to them. As a result, opportunities for learning a variety of skills and concepts would be limited. This research would be appreciated by the other members of the project team as it will provide concrete data on effective teaching methods for the students engaged in the MIT-initiative.

This research also may have more important and lasting impact as it may provide more evidence as to the importance of changing the primary language used in Haitian classrooms from French to Kreyol. Numerous research studies such as that from Bühmann and Trudell (2008) have addressed the importance of the use of one's native language in acquiring academic concepts. However, the question of which language to use in Haitian classrooms still remains. This current research project will contribute to the body of knowledge concerning the importance of implementing Kreyol as the language of instruction in the Haitian classroom.

Nature of the Study

The intervention was designed to gather data on the role of language in the classroom, specifically within the acquisition of math and science concepts at the research site. This study was a quasi-experimental research, which used the nonequivalent control group design with pre-test and post-test for an experimental and control group. The target population consisted of 246 girls enrolled at Institution X, a private school located in Haiti.

Students were divided into two groups using a non-random sampling method; specifically, consecutive sampling to determine the study sample. This method was chosen because consecutive sampling allows for the use of the entire available population and was the best choice of nonprobability sampling methods as it provides a good portrayal of the entire population being studied in a short period of time (Lundsford, 195). As switching replication method was also applied to address the fact that in nonequivalent groupings participant individualities may not be equivalent within Kreyol condition and French condition groups. This method addresses these possible differences by allowing participants that figure in the

French condition group to also be part of the Kreyol condition group during consecutive interventions thereby increasing validity of the study (Trochim & Donnelly, 2001).

Once groups were formed using sampling methods referred to above, one group received math and science instruction in their native language of Kreyol rather than traditional French, while the other group received instruction on the same concepts in French. It has been noted that “language is the key to communication and understanding in the classroom” (Benson, 2004, p. 1). The researcher gathered data from assessment of both groups. After analysis of data using repeated measures Analysis of Covariance, ANCOVA, the researcher compared differences in performance.

The researcher also provided students with a questionnaire about their experience learning in French and Kreyol. Data from this questionnaire was compiled in an Excel spreadsheet and coded to decipher themes and patterns in responses. Data was presented in graphs and tables and analyzed to note differences in how students identified with and felt about learning in each respective language.

Definition of Terms

The following terms are directly related and will be used throughout this research study. They are represented as the researcher intends for the reader to comprehend them.

Antiphon. (In traditional Western Christian liturgy) a short sentence sung or recited before or after a psalm or canticle (Oxford English Dictionary Online). For the purpose of this study the term refers to the rebuttal of the previous point.

Creole. A mother tongue formed from the contact of a European language (especially English, French, Spanish, or Portuguese) with local languages (especially African languages spoken by slaves in the West Indies) (Oxford English Dictionary Online). When referring to the group of languages called creole the word “creole” is not capitalized except when referring to Haitian Creole. (Prou et al., 2010).

Elite. A group or class of people seen as having the most power and influence in a society, especially on account of their wealth or privilege (Oxford English Dictionary Online). For

the purpose of this study, elite refers to the “French-speaking Haitian minority (Hebblethwaite, 2012).

Haitian Creole. The French-based Creole language spoken in Haiti (Oxford English Dictionary Online). This study recognizes that Haitian Creole is spoken by the majority of Haiti’s inhabitants as much as 95% (Hebblethwaite, 2012).

Haitian Classroom. A room in which a class of pupils or students is taught (Oxford English Dictionary Online). This term refers to Haitian schools in general.

First Language. A person's native language (Oxford English Dictionary Online). In this work, the term is used interchangeably with mother tongue, indigenous language, and native language.

Foreign Language. In the case of Haiti, although French is an official language, because so few people master it, it is considered a foreign language for the purposes of this research.

Kreyol. The Haitian Creole spelling of the native language of Haiti.

La Gonave. Gonâve Island is an island of Haiti located west-northwest of Port-au-Prince in the Gulf of Gonâve.

Mass. A large number of people or objects crowded together (Oxford English Dictionary Online). The term is used in this study to refer to the monolingual Kreyol speaking majority of Haiti’s population.

Medium of Instruction. Refers to the linguistic tool used to present concepts to students.

National Exams. Exams taken at the end of secondary schooling in the 12th and 13th grades.

Philosophie. 13th grade, end of secondary level schooling.

Rhétorique. Equivalent of the American schooling system’s 12th grade.

Second Language. The non-native language.

Transact. Conduct or carry out (business) (Oxford English Dictionary Online). In this study this term is used to refer to create meaning for oneself.

Viable. Capable of working successfully; feasible (Oxford English Dictionary). In this study the term refers to the effectiveness of use.

Assumptions, Limitations, and Delimitations

One of the limitations of this study was the familiarity of students with the language that is being used in the classroom. When the language used for instruction is not conversant to students it actually becomes an obstacle to the learning process. It is believed that this would not be the case of Kreyol in this study because:

Haitian Creole, the language of Haiti, is spoken by the entire population of just over nine million people (in 2010) and by perhaps three-quarters of a million to a million Haitian immigrants in the U.S. A very small minority of the population also speaks French (Spears, 2010, p. 1).

Proficiency in content will affect how well the teacher transmits information to students. Ball and McDiarmid (1989) contend that:

After all, if teaching entails helping others learn, then understanding what is to be taught is a central requirement of teaching. The myriad tasks of teaching, such as selecting worthwhile learning activities, giving helpful explanations, asking productive questions, and evaluating students' learning, all depend on the teacher's understanding, of what it is that students are to learn (p. 6).

Teacher's perspective on language acquisition and value of respective languages used in Haiti will affect their perception of language issues in the classroom. "Taken together, the above and related claims by both linguists and non-linguists imply that Creoles as a group are, theoretically at least, unusable for "advanced" cultural and intellectual purposes in the modern world" (DeGraff, 2005, p. 543). Creole, as a group of languages, are used, to a lesser extent, as educational tools compared to prominent languages such as French as a result of adverse popular assumptions claiming that they are subpar in terms of their morphology and not complex enough to respond to academic needs (DeGraff, 2005). "Similarly, the positive

and negative ideas regarding French and Haitian Creole and the contexts in which they are deemed appropriate reveal the complexity of Haitian identity” (Gibson, 2011, p. 21).

The researcher was the only individual providing instruction to students participating in this study. In each level, students were divided into two groups. This grouping was done using a consecutive sampling method and switch replication method.

As such, the researcher taught the same concept to students in French condition group in French and students in the Kreyol condition group in Kreyol. Before instruction, students completed a pre-test to assess prior knowledge. After instruction, students completed a post-test to assess their understanding of the concepts presented. The data from pre-and post-tests were collected.

An additional limitation was that the study was conducted at an all-female school. It would be obviously difficult to generalize the study’s findings to an all-male school because the two genders may likely react differently to the intervention. This limitation was not addressed as further studies could be conducted to help to generalize findings to both genders.

The academic schedule was also a limitation as students from the sample had to focus on standardized State exams during the research period. To address this limitation, the researcher worked closely with administration to work around state exams to get full student and teacher support. The intervention took place during student’s study hall period as to limiting disruption to their schedule.

Time was also a limitation. If the study could have been extended for a longer time period, the results might have been different. The study was designed to take place over a shorter more manageable time period.

Organization of the Remainder of the Study

The remainder of the study will include the following. Chapter 2 will review the literature on the history of language in Haiti, Research on mother tongue as an effective learning tool, the necessity for research on mother tongue instruction, and the obstacles to the implementation

of models that have worked in other countries. Chapter 3 will detail the methodology of this study.

Chapter 4 will relate the analysis of the data collected and the results. Chapter 5 will present the conclusions and recommendations. The references of the works cited in study follow this chapter. The appendices contain questionnaires.

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CHAPTER 2: THE LITERATURE REVIEW OF THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION

Introduction to the Literature Review

The question of which language should be used in Haitian classrooms has long been a controversial issue because this topic not only has an educational implication, but it also has historical, cultural, and social facets. Failed attempts at implementing educational reforms have only aggravated the disagreements as to which language is most appropriate and effective to serve as an instructional tool in Haitian classrooms. Moreover, the research on this subject has yet to convince the general public of the true benefits of using one language versus the other.

Many theories have been suggested as to the most effective use of language as an instructional tool in the classroom. Although many have broached this topic, this review emphasizes the issues of teaching in a language that is not a child's first language and the implications involved in the use of a foreign language as the medium for instruction, the issues of the use of language as a means to discriminate, and the issues with the attitudes towards the use of specific languages including the political and social background leading to such attitudes. Although some of these concerns have been discussed in various contexts, this literature review will focus on how they have impacted the Haitian classroom.

In most cases, Haitian students enter schools at the age of about five or six fluent in their mother tongue which is Kreyòl. Although some Haitians will argue that the language spoken in their homes is French, thus this constitutes their first language, the majority of Haitians do not have the same experience (Degraff, 2007). Note that Haitian Kreyòl is spelled in two different ways: the "Kreyòl" spelling is what the word looks like in the actual Haitian language and the "Creole" spelling is the French and English spelling of that language.

It is also worth noting that when referring to the group of languages called creole the word “creole” is not capitalized except when referring to Haitian Creole. (Prou et al., 2010). In his 2010 publication *Creole and Education in Haiti*, Dejean affirms that:

To assert that Haiti is a French-speaking country is to play on the confusion created by French being an official language. (Creole was made a co-official language by Article 5 of the 1987 constitution.) French is official due to the clout of a few members of the country’s elite (1918 constitution, Article 24; 1987 constitution, Article 5). This notwithstanding, Creole is the language understood and spoken by everyone born and raised in Haiti (between eight and nine million people) (p. 7).

These students spend the extent of their academic life, building and developing technical skills that will determine not only academic success but ultimately success beyond school, in a language that is foreign to them. Because proficiency of language has such a considerable implication on acquisition of specialized skills, such as understanding of complex math and science concepts, it is understood that the choice of language to use as a medium for instruction is crucial to students’ success (Degraff, 2016).

Research has demonstrated that the failure to use mother tongue as a medium for at least the fundamental years has a lasting and detrimental impact on students’ cognitive competence and emotional stability (Dutcher, 2004). It is through language that a child may express his/her understanding of the world around him/her. It is through language that a child asks for clarification when an idea is not well understood.

Moreover, language is also used in demonstrating understanding of complex concepts. Vygotsky, Hanfmann, and Vakar (2012) contributed much data to the theories of language development. When discussing these theories, Wells (1986) stated that humans develop their mental processes by working with others, by collaborating with other humans, using cultural apparatus of which language is the most significant.

In the case of Haiti, students are expected to express themselves and acquire knowledge in French, which is a language that is foreign to them. Although 10 percent of school-aged children in Haiti grow up in houses in which both French and Kreyol are naturally acquired, that is not the case for the other 90 percent of children (Dejean, 2010). Furthermore, as Gibson wrote in 2011:

If these children's previous language experience [Kreyòl] is not taken into account when they start school, and if they are expected not only to learn a second language but to learn *in it* as well, it is hardly surprising that without focused English [French in this case] language support in all subjects they may start to fall behind their peers who are operating in a language they have been familiar with since birth (p. 10).

The students in Haitian classrooms are expected not only to become experts in a second language that they only practice at school, but they are also simultaneously supposed to assimilate technical information to move forward in their academic career using this language in which they lack mastery. Obviously, this creates a snowball effect as the foundational concepts on which students may build an understanding of more complex concepts are never seized (Hebblethwaite, 2012). In this view, it may be said that the refusal to use Kreyòl, the only language that the greater number of Haitians speak and understand, as the medium of instruction in schools accounts for the major nonsuccess of general education in Haiti. (Dejean, 2010).

One way to start seeking solutions to the failure of Haiti's education system is to look at data from other countries that have dealt with similar linguistic issues. Research from first language and bilingual programs from such countries as Peru, Bolivia, and the United States have also shown that students are better off when they acquire knowledge in their mother tongues and continue to use this language throughout their lives. In the case of Peru, students begin the first years of schooling in their native tongue. Then they are introduced to Spanish as a second language while students continue to use their mother tongue (Bühmann & Trudell, 2008).

In this sense, learning of new material is not deferred until students become proficient in the second language. Students are therefore "not expected to adopt a foreign, world language such as English as their primary one, but to use it as their secondary language in order to access advanced education and other resources made available by those world languages" (Dejean, 2010, p. 13). That is not the case in Haiti, where students are required to acquire technical knowledge and skills in a language that is not native, French. Furthermore, as soon as children enter school, they are taught that the use of Kreyòl is frowned upon and, in some cases, even forbidden. Thus, these children are to leave Kreyòl behind as soon as they enter school. They are expected to communicate effectively and interact in French for the duration

of the day without being able to ask for clarification if need be because they are not allowed to use Kreyòl in school.

As discussed in the book *Theories of Second Language Acquisition*, students may begin to encounter some difficulties stemming from the theory that acquiring language skills has a lot to do with social interactions to arrive to mastery level as advanced by Vygotsky's Social Cultural Theory (Lantolf, Thorne, & Poehner, 2015). If the only interaction the child has with French is through the classroom, it is difficult for him to master this language as all his other social interactions are done in his native language, Kreyòl. Furthermore, in the case in which a teacher is not allowed to explain a difficult concept to a student using Kreyòl, the language he understands well and has experience with, the student is expected to assimilate new concepts while also trying to learn the language being used to advance this new concept. Thus, the issue of language plays a crucial role in the catastrophic success rates of the national exams taken by students at the end of the sixth, ninth, twelfth, and thirteenth grades. "In 2003, for example, only 21.99% of all those enrolled in school passed the *rhétorique* exams (12th grade exit exam) and 17.75% passed the *philosophie* exams (13th grade exit exam)" (Hebblethwaite, 2012, p. 268).

Beyond the issues impacting the education system, some of the effects of the use of French as the medium for instruction in Haiti have provoked systemic issues that transcend all layers of society (Hebblethwaite, 2012). Although Haiti has two official languages, only one serves as the language for any and everything official, to include government documents, announcements, and guidelines. "Such French-only policies, at least at the level of the written record, effectively create a situation of 'linguistic apartheid' in the world's most populous Creole-speaking country" (Degraff, 2007, p. 101). The majority of Haitians are not able to effectively comprehend the workings of the country's politics because of a lack of mastery of the language in which business is done. This issue of language also excludes this majority from participating in the political process.

Since French is also used as the language for business in Haiti, it could be postulated that the majority of Haitians are also excluded from this world. To experience social mobility, one must be fluent in French or be disregarded as uneducated, thus the fate of ninety percent of the population. "The French educational language policy is a strategy for keeping the masses

at their low station and for keeping job opportunities within elite families” (Hebblethwaite, 2012, p. 275).

Theoretical Framework

Organizations are made up of a complex structure that relies on the collective efforts of humans making up a system, the operations it utilizes, and the output it generates. As such, organizations build their efficiency based on their systems, operations, and capacity. In this paper, the researcher analyzed, from a theoretical perspective, a chosen site for the objective of understanding the behavioral relationships, structure, and technology of the research site based on the following perspectives: systems theory, action science, and change theory.

Site Analysis Based on Language and Its Effects on Learning

“While there are many factors involved in delivering quality basic education, language is clearly the key to communication and understanding in the classroom” (Benson, 2004, p. 1). This would explain why so many students in Haiti are failing. Students are taught in French, which is a foreign language to about ninety seven percent of the Haitian population. As Desai (2012) advances:

Language plays a crucial role in learning as it is through language that children develop ideas or concepts of the world around them; it is through language that children make sense of the input they receive in the classroom from the teacher and the written texts; and it is through language that children express their understanding of what they have learnt from this input. (Desai, 2012, p. 1)

In Haiti, students are presented concepts in a foreign language and are expected to grasp these concepts. The reality is they memorize the information presented and seldom develop a strong understanding of what they are studying. This process has had a terrible impact on the education system in this country as students lack the basic foundation for them to be successful in school.

Furthermore, even when students would like to seek help, because of lack of mastery in the language used in school, it would be difficult for them to communicate their needs. As Vygotsky advanced, language is a tool for social interaction so that if students are unable to

effectively communicate, they will not be able to acquire much needed skills. This study relates to Vygotsky's theory on language in that it aims to postulate any significant differences in student interaction and impact on communicating needs when French and Kreyol are used in the classroom as students will have the opportunity to note the difference in their experience with these languages in terms of facilitating acquisition of concepts.

This project aims to highlight the importance language plays in education, because it is through language that students are able to process thoughts and associate old notions in building new learning. In the view of Chomsky, the environment plays an important role in acquisition of language in that the more a child hears a language been spoken the more he/she assimilates meaning to words and builds vocabulary (Chomsky, 1997). Chomsky's views on language acquisition relate to this project in that he argued that the most effective learning happens when people learn in their native tongues as they discern nuances that they would not in a language that they are less familiar with (Chomsky, 1997).

Site Analysis Based on Systems Theory

In general terms, a system, an organization may be described as a composite of interacting components in conjunction with the included relationships that make it up and that create an entity, a sort of complex machine that maintains certain margins. "Organizations have been conceived as behavioral settings for human interaction, fields for the exercise of power, systems of institutionalized incentives that govern individual behavior, or socio-cultural contexts in which individuals engage in symbolic interaction" (Argyris & Schon, 1996, p. 7). Systems theory provides a means of analytically describing and explaining an organization's structure.

Upon analysis, the chosen research site seems to have a goal-seeking component in which the various parts work in tandem towards a common goal. "Social organizations seek multiple goals, if for no other reason than that they are composed of individuals and subunits with different values and objectives" (Kast & Rosenzweig, 1972, p. 450). One of these goals is to promote best teaching practices to ensure all students have the opportunity to reach their full academic potential. Every part of the system from the workshops set up to train teachers, to the activities set up for use with the students, demonstrate the desire to implement best

practices. This aforementioned desire to use best practices at the research site was one of the reasons that it was chosen as the research site.

In terms of this research project, the goal-seeking component with which the organization functions provided a positive framework on which to implement the intervention. However, it was important for the researcher to understand the inner workings of the organization as to be clear on the specific functions of each part of the organization and how these various parts worked together. As such, it was crucial that teachers, administrative staff, and board members were made aware of the implementation of the intervention as to lessen the disruptions it may have caused to the usual functioning of the institution. Researcher met with teachers who provided assessment instruments to be used in the interventions, administrative staff to create a schedule for the intervention that would not interfere with state exams, and with Board of Directors to ensure that intervention remained ethical and harmless to participants.

Site Analysis Based on Action Science

An organization's success depends on how well it improves its business operations over time. Ideally, this continuous progress relies on how well this organization learns from its mistakes and how well it adapts to the evolving world around it. According to Argyris and Schon (1996), our actions are governed by two theories.

The espoused theory is the one we speak of if we are asked how we would react to a specific situation. It is the theory that we express implicitly, our intention. The other approach we take to our actions is the theories –in-use. It is what we actually meant to do, the actual way we reacted to a situation. Argyris and Schon (1996) state that we will become much more effective and efficient in our organizations if we find a way to create harmony between these two theories in our actions.

At the research site there exists a connection between the espoused theory and theories-in-use. The intent of many decisions made at the research site supports the outcome expected. One such example is in the care taken to ensure that the material available to students is written in a manner that both honors the intricacies of the language but also respects Haitian cultural nuances.

Furthermore, the intention and actions of individuals contribute to organizations' practices. Employees espoused theories and in-use theories affect operational systems within an organization.

An organization's learning system is interdependent with the theories-in-use that individuals bring to its behavioral world. Individual theories-in-use help to create and maintain the organization's learning system; this system, in turn, contributes to the reinforcement or restructuring of individual theories-in-use (Argyris and Schon, 1996, p. 18)

Thus, the research site has taken strides to create an environment in which employees are encouraged to keep an open mind as it plays a major factor in promoting an environment of continuous learning and improvement of operational systems. Employees have many opportunities to express their thoughts. Whether it is through evaluation forms at the end of workshops or through the various "*brase lide*" (sharing ideas) sessions, the research site aims to make staff feel empowered to share information that may help to improve services offered.

Site Analysis Based on Change Theory

Change management is sometimes one of most significant obstacles to deal with when managing an organization. The key is to create an environment that does not rely on the influence or actions of one individual to deal with transitions, operations, and issues. Dr. Eoyang's (1997) book discusses self-organization as a means of dealing with disruptions to an organization's normal operation. In her theory on complex adaptive systems, Dr. Eoyang recognizes four quadrants that determine the level of effect of interactions and variances on the various agents within an organization.

Many of the challenges that have surfaced at the research site have been dealt within Dr. Eoyang's self-organization quadrant one as they have been met with a high level of differentiation and high level of transfer within the organization, at times, creating conflicts within the organization. When met with a problem, the organization sets up discussion sessions that often lead to concrete action plans to implement ideas discussed. When the project was introduced to the research site's Board of Directors, it was important for the researcher to look into the various interactions of agents within the organization's system as

suggested by the self-organization systems theory in order to predict how these agents would react to the changes the intervention would create within the established structure and to adapt to these reactions and ensure that the data collected would not be influenced by the agents within the organization.

Organizations are made up of a complex system that relies on the interactions of its staff, its operations, and its output. Theoretical perspectives aim to provide some understanding of the structure of such a complex system. As such, the structure of the research site was analyzed using system theory, action science, and change theory. Analysis of this site provided information as to how well the organization deals with change as it empowers its employees to provide ideas and suggestions on creating and implementing change. This research site also displays a good balance between the espoused and theories-in-use leading to the creation of a community of continuous learning within the organization. This organization, as a community in turn, focuses on common goals that help to promote, facilitate, and implement organizational goals.

Review of Research Literature

History of Language in Haiti

In order to understand the importance of the language issue in Haiti it is important to revisit the history of language and the impact it has had on all aspects of Haitian society. The Haitian population consists of a majority of monolingual Kreyol speakers and bilingual French and Kreyol speakers; the latter belonging to the elite class of Haiti (Gibson, 2011). Although both of these languages are legally official languages of this country, one, notably the French language, is used as the language of power while Kreyol is seen as the language of the masses (DeGraff, 2007).

Political and Economic Impact

Haiti has had a long history of using the French language as a means to exclude a portion of its population from what are considered higher social ranking political and economic activities. “The negative attitudes expressed by many members of the French-speaking Haitian minority for the monolingual Creole-speaking majority originates in colonialism,

class ideology, and race-based slavery in Saint-Domingue (a French plantation colony from 1697 until 1803)” (Hebblethwaite, 2012, p. 257). In fact, as with many other aspects of Haiti’s history, the language issue stands out even more in that, unlike other Latin American countries in which the indigenous languages are spoken by a minority of people, Kreyòl is spoken by the majority of the population of Haiti.

Hence, the crucial role that language plays in all facets of Haiti’s inner workings. Some proponents of the use of French agree with the use of the language as a means to keep the masses stagnant while opportunities continue to be available to the minority French speakers of the country (Hebblethwaite, 2012). Furthermore, the use of French and the exclusion of monolingual Kreyòl speakers create an oppressive environment in which the majority of Haitians do not possess the skills to express themselves effectively for lack of mastery of the French language (Hebblethwaite, 2012).

Long before its independence, language in Haiti was used as a tool for oppression. As clearly stated by Gibson (2011), language, being the primary means of communication, serves, as well, as a means to control through the swaying and compelling of judgement and mindsets. The French used many tools, including language, as a mechanism to grandstand predominance, thereby brandishing French as the language of authority while Creole served as the tool of the lesser people and thus introducing the linguistic discrimination, aforementioned, which still exists today in Haiti. As Gibson (2011) attests, the inability of Haiti’s generals after the independence to disburden the country of the French way of executing and implementing, but more importantly of the French language, gave way to the hierarchy that has been so detrimental to Haiti’s development, specifically in terms of educating its inhabitants. In such a way, French became and remained until the 1980s the official language of Haiti. More recently, the constant political instability in the country since 1986, with the fall of the Duvalier regime, also contributed to the ineffective implementation of any reform to improve the education system (Gibson, 2011).

Today, the supporters of the continuation of a French-only system in Haiti claim that Haitians will isolate themselves from international communication if Creole (Kreyòl) were to have the same standing as French in its society. What is implied, but not directly stated, is that such a system aims to keep 9,500,00 Haitians sequestered from participating in any viable economic or political activity in their own country (Hebblethwaite, 2012). The antiphon to this point is

that Kreyòl is a viable language as all others are and that not every Haitian needs to speak an international language in order for Haiti to do business internationally. Only a few designated individuals need to be able to communicate in international languages in order to do business with other countries (Hebblethwaite, 2012).

What the previous view seems to discount is the direct link between Haiti's education system and its ongoing impetuous contentions, specifically in the use of French as a means to exclude the masses. The people of Haiti understand that mastery of the French language almost guarantees their participation in the socio-economic development of the country (DeGraff, 2007). It is also understood that the education system is set to marginalize the majority of Haiti's inhabitants in that students acquire low levels of literacy and experience unmeasurable stress from the devaluation of their mother tongue and their self-worth (DeGraff, 2007). These two aforementioned components of the fabric that makes up this country only add to the buildup of frustrations that often leads to many violent conflicts within the society. What is further demoralizing is that, as stigmatized as Kreyòl is in this country, the people cannot fathom that its use as an instructional method could help them to acquire the so-desired French language, hence affording them the opportunity to participate in its economic growth (DeGraff & Ruggles, 2014).

Thus, Haiti finds itself in a unique position in that the one thing that could possibly ensure the advancement and development of its people is the one thing that is thought to be so inutile, the Kreyòl language. Spears (2010) asserts that:

The preceding points are especially important to make because many people, educators included, mistakenly believe that Creole, as other stigmatized languages, cannot be used in education because it has no grammar, and that it cannot be studied because it consists of nothing more than mistakes and corruptions of the related colonial language. (p. 3).

Apropos of development, language plays a primordial role as it serves as the tool by which education is disseminated. In the Human Development Approach, as per Carlson et al. (2012), "factors such as health and education are effective indicators of a country's economic well-being" (p. 9). It could be advanced that the dismal economic standing of the country may have a great deal to do with how well the education system is working there (DeGraff, 2007).

The education system, as it stands, may not provide the necessary knowledge and skills for graduates to enter the workforce in positions that may have a meaningful impact on the economy. Without the necessary knowledge and skills, a great number of graduates may be deadlocked into entry-level, low-paying employment that contribute to the vicious cycle of poverty that exists in this country. “Using mother-tongue instruction, or Creole as a medium of instruction, in Haitian schools would reduce Haiti’s illiteracy rate, creating economic development for the nation” (Gibson, 2011, p. 23).

Educational Impact

UNESCO’s 2000 report on Haiti written by Jules, and Panneflek, headed by then the UNESCO representative in this country, Hadjadj, provides recent statistics on the status of the education system of Haiti for a period of about 20 years (Hadjadj, 2000). As this report indicated, there are two major events that have marked the Haitian education system in terms of reforms. The first happened in 1979 with the Bernard Reform. Then Minister of Education, Joseph C. Bernard, launched several meetings throughout the Caribbean and his work might have led to the introduction of Creole as one of the official languages in Haiti as per the 1987 Constitution, but, more noteworthy, it proclaimed Creole as a viable language for instruction.

According to the Bernard Reform (Dejean, 1993), Creole was to be used as the primary language of instruction for the first four years of elementary school while French was to be taught orally as a subject first and in written format during the third year of schooling. In this optic, Bernard’s goal was to provide Haitians a wider access to education and to promote for effective learning, specifically in monolingual creole speakers which represent about ninety percent of the population. However, the political and social instability that prevailed during this period kept the Bernard Reform from ever being concretely implemented throughout the country. “This instability, which also resulted in a lack of continuity in government policy, is illustrated by the large number of occupants of the Ministry of National Education: 23 Ministers in 20 years!” (Jules & Panneflek, 2000, p. 13).

Other issues with the use of Kreyòl specifically in the academic arena arose as a result of many people, including educators, thinking that Kreyol, like other stigmatized mother tongues, is not suitable for educational advancements due to its presumed deficient grammar

and represent mere broken versions of colonial languages (Spears, 2010). However, Michel Degraff, linguist and researcher, has been researching and gathering valuable data demonstrating the worthiness and benefits of using the Kreyòl language as a means to improve the Haitian education system (Degraff, 2013). With such programs as the MCLC Community Learning Center (MCLC) in La Gonave, Haiti, Degraff is gathering data that proves that the use of Kreyòl absolutely promotes effective learning in Haitian students.

The MCLC began in 1996. It is different from other Haitian schools in that it uses Kreyòl as the medium for instruction and textbooks through the third grade, at which point French is introduced to students as a second language. Data gathered from the MCLC demonstrate, among other improvements, a significant growth in percentage of students that passed the 6th grade National Exam, from 35% in 2011 to 78% in 2014 (Friends of MCLC, 2014).

The ideology that perpetuates the inferiority of indigenous languages or mother tongues is so strong that even when data has been collected establishing the benefits of mother-tongue instruction, parents may still not agree with using native language as a medium for instruction. This was reported in a study on mother tongue education in Bolivia where parents demonstrated pronounced disagreement with teaching literacy in Quecha, the indigenous language, as they believe that this would hinder their children's acquisition of Spanish (Danbolt, 2011). This accurately depicts the experience of many schools in trying to establish Kreyòl as a means to teach literacy in Haiti. It is certain that further data, such as that from the MCLC, needs to be collected in order to bring increased awareness to the viability of the Kreyòl language as an academic tool. However, a starting point is to look at the research from other countries and the results they have yielded.

Research on Mother Tongue as an Effective Learning Tool

In order to speak to the role that mother tongue may play in the improvement of education in Haiti, it is important to review research from linguists and from other countries that have used mother tongue to make their educational systems more effective. In this sense, the literature may serve as a framework on which to gather data to substantiate findings from this study.

Use of Mother Tongue Yields Superior Academic Achievement

Research from such authors as DeGraff (2013), Trouillot-Levy (2010), and Dejean (2010) have shown that Kreyòl is a viable language that has orthography, grammar, etc. and is adequate and effective for use in education. Programs like the National Science Foundation that funded MCLC demonstrate significant learning improvements when students learn to read in their mother tongue (DeGraff, 2013). According to the 2004 EFA Global Report (Benson, 2004), teaching a child to read in a language that is familiar helps to connect sounds with symbols and thus creates an opportunity to use psycholinguistic deductions to also make sound and meaning connections. This enables a child to acquire new concepts without having to wait on second language acquisition to grasp understanding of this concept.

If, for example, a Haitian student learns a basic concept in French when he has yet to acquire the French language, it may take years before he actually understands this concept. He/she may have memorized the concept, but is unable to explain the meaning behind it. However, if he/she learns the concept in Kreyòl, he/she is more apt to understand said concept and to transact meaning with the instructor as he/she is able to interact with classmates and instructor due to comfort with the language being used as medium for instruction. As was demonstrated by the research study in Peru, when students learn in their native tongues, they are more engaged and participate more actively in the learning process (Bühmann & Trudell, 2008).

Achievement in Second Language is Comparable to that in First Language

Research has shown that once basic reading skills are acquired in mother tongue and that students can express themselves orally in second language, the transfer of acquired concepts happens organically without an instructor having to teach the same concepts in second language (Cummins, 1991). Research from studies such as that of Modiano in Mexico (1973), and Fanfuwa (1975) in Yoruba primary schools demonstrated that students who acquired reading skills in mother tongue surpassed the performance of monolingual second language students. Also, students who began school with a strong base in their mother tongue were better equipped to take on learning in the school language and were able to transmit knowledge from home to the classroom effectively (Benson, 2004).

Furthermore, bilingual students seem to demonstrate increased pliability and resilience in their thought processes as they have the ability to comprehend and analyze information through two different languages. Another strong indication of acquisition of a concept is the ability to be able to explain this concept in more than one language. Thus, bilingual students have the upper hand when it comes to being able to express themselves in two languages (Cummins, 2000a).

Research, as indicated by Cummins (2000a), has shown that how well a student learns in his/her mother tongue can serve as a predictor of how he/she will achieve in another language. In his 2000 publication, Cummins concludes that first and second languages actually helped promote each other's development as long as the students had the flexibility to use either language as need be (Cummins, 2000b). In 1993, results from a model tested in Mali called *Pédagogie Convergente* also yielded concrete results demonstrating that the use of the mother tongue along with a second language had a positive impact on students' achievement (Bühmann & Trudell, 2008). After six years of using this model, in which students began their studies in their first language and four to five years later half of the teaching was done in mother tongue and the other in French, results were significant enough to lead other elementary schools to begin to use the *Pédagogie Convergente* as well. Further research using this model also demonstrated that the use of the two languages had a direct and positive impact on the acquisition of mathematics skills (Bühmann & Trudell, 2008).

The *Pédagogie Convergente* (1993) model of Mali includes guidelines that are reminiscent of the Bernard Reform in Haiti. It is based on the same premise that students should begin their schooling in Kreyòl, the mother tongue, and that by the fourth-grade students would start learning in French. Unfortunately, without the proper economic structure and political support for this reform, Haiti has not been able to show any concrete results using this model. The 2008 UNESCO report also provides insights into some of the difficulties in implementing such a model which may certainly bring some support in seeking effective and efficient solutions to Haiti's educational problems. One of the major lessons learned in this study and in others, such as the vernacular education model used in Papua, New Guinea, is that without political, community, and the educational establishments' support, education reform will likely be ineffective (Bühmann & Trudell, 2008).

Use of Mother Tongue Increases Student Participation in the Learning Progression

One of the points noted in the Friends of MCLC report (2014) about MCLC is that the use of Kreyòl increased students' interaction and active participation in classes. However most importantly, teachers noted that the use of Kreyòl has created a desire for students to gather information thus increasing their desire to read and to share knowledge with others through their writing. In this way, not only have reading and writing scores increased but the students have also developed a need for learning which may not have previously existed. Data has also shown that students fully immersed in a second language classroom may present passive characteristics, just listening and not engaging actively in classroom activities and discussions, whereas students who are able to use mother tongue feel free to express their thoughts (Benson, 2004). This inadvertently helps instructors to assess just what the students have learned as an ongoing activity.

Research such as that from the 2008 UNESCO report on Papua New Guinea's use of vernacular languages also yields some significant data that demonstrate the importance of using mother tongue as an instructional tool (Bühmann & Trudell). Papua New Guinea has over 800 local languages that were used before the 1900s in the education of its people (Bühmann & Trudell, 2008). However, the government decided to use English as the language of instruction in order to create a national education system. Not long after this decision, "dissatisfaction with the relevance and evident lack of effectiveness of this system began to grow" (Bühmann & Trudell, 2008, p. 17).

As a result, a new program, in the 1970s, began in preschool using local languages to teach children how to read and count. As more frustrations with the national education system continued to arise, more programs using local languages were instituted in various other communities. Results demonstrated not only that student achievement increased, but also that students were more actively engaged in the learning process when local languages were used as instructional tools (Bühmann & Trudell, 2008).

Necessity for Research on Mother Tongue Instruction

The research on mother tongue instruction provides a background of information and experiences that served as the foundation for this research project. Reviewing the research on

mother tongue education provided this study with arguments for and evidence of improvements in learning and other aspect of the societal fabric due to its use.

Educational Impact of Second Language as Instructional Tool

According to Behaviorists, such as Skinner, and Interactionists, such as Bruner, Piaget and Vygotsky, children learn language through mimicry of what they see and hear in their environment and social interactions (Ormrod, 2003). In this view, using the language in which students begin to formulate their thoughts plays a significant role in their language acquisition and, in turn, in their learning processes. As such, requiring that a child learns in a second language the fundamental skills on which to build more complex attainments would probably pose a problem. Such thinking can help to explain some of the failures of the Haitian education system in which students are required to learn basic skills in French, a language that only few speak in Haiti.

Economic Effect of Second Language as Instructional Tool

Hebblethwaite's (2012) article on the impact of the use of the French language on the underdevelopment of Haiti argued that the use of a language that ninety five percent of the population does not speak or understand as an instructional tool has a direct impact on Haiti's economic standing. He also indicated that "Data on educational language policy compared internationally show that the use of a second language in schools correlates with high illiteracy rates and poverty" (p. 255). With the education system as it currently exists, students arriving to university do not master the French language enough to be successful; thus, adding year after year to the statistics of generations that are unable to occupy higher paying jobs and contributing to the already overwhelming rate of poverty in Haiti.

Obstacles to Implementation of Models That Have Worked in Other Countries

Disparate access to education is one of the main causes of poverty and inequality in the world (Degraff, 2013). Haiti is one of the countries that has some experience with this phenomenon. In order to solve the issue of educational inequality in this country, it is helpful to look into other countries' involvement in addressing the marginalization of mother tongue speaking portions of their populations.

Governmental and Community Support

Researches on other models, such as that of Papua New Guinea (2008), that have been implemented in other countries provide a plethora of potential, cautionary pitfalls to avoid. One of the main issues discussed in most of the studies was the definite need for governmental support. The greatest impact of not having the support of the authorities is perhaps in the financial planning for the programs implemented. Without this support, many countries had to rely on external financial support, which always comes with an expiration date. The reality is that, in the short term, external financial support is very helpful. However, planning for any long-term, sustainable program requires the support of national resources, which cannot be had without the support of the government (Bühmann & Trudell, 2008).

In the case of the Bernard Reform in Haiti (1979), the lack of support from established educational agencies played a crucial role in the failure of the remodeling that was to make improvements to the education system. The instability that followed the institution of this reform did not help the situation; neither did the economic issues that have always existed in Haiti. However, there seems to have been an effort put towards not implementing the reform. From 1982 to 1987, it was even suspended using specious issues to support this decision (Dejean, 2010).

One of the issues discussed earlier was that insufficient teacher training also played a role in the failure of the Bernard Reform Programs such as the MIT-Haiti Initiative, provided support in terms of teacher training. In this program, university teachers participate in workshops that help them to become more at ease with using Creole as an instructional tool (Degraff, 2013). Teachers are also provided the opportunity to interact with software and other resources in Creole which they now have access to thanks to the MIT-Haiti Initiative. Such programs should be spread nationwide as to provide teachers with the skills and practice necessary to increase their comfort level with using more effective methods of teaching.

As far as community support is concerned, if the people in need of improvements in the realm of education do not believe that Creole is a viable tool, then any reform using this language as a tool for instruction will not be successful. The issue of language has always

been a point of contention in Haitian society and one that remains. There are many who claim that Creole is not a language and cannot be used effectively to educate Haitian students (DeGraff, 2014).

However, Haiti's history and fascinating culture demonstrate the intrinsic role that Creole has played in the Haitian identity, unity, and self-worth (Buchanan, 1979). Others claim that the use of Creole in schools would aggravate an already poor situation and further deprive and exclude a large part of the population (Zefi, 2011; and Buchanan, 1979). Although, various studies, articles, such as that by Degraff (2014), and programs like MCLC have argued the viability of this language as an educational tool, much more needs to be done to inform the larger public about its potency for academic achievement. For instance, "Trouillot-Levy found that when middle-class parents are educated about the academic benefits of using a Creole language curriculum, some parents support it" (Dejean, 2010, p. 26).

Another obstacle lies in the flaws, as some may see it, in the Bernard Reform. One of the more pertinent issues with this reform, one that may have also played into the failure in implementing it, is the premise that students, although starting school in their native language, were expected to learn a foreign language and drop the mother tongue after the initial four years of schooling. In this view, Haitian students are expected to embrace a second language as theirs rather than use that second language as a tool for advanced educational studies. "The error is in believing that Haiti has the resources, educational or other, to produce on a mass level any outcome even approaching competence in French, in addition to competence in Creole" (Dejean, 2010, p. 13).

Chapter 2 Summary

There are issues that arise from the use of French as the tool for instruction in the Haitian classroom. Low-test scores, inability to grasp complex concepts, and socioeconomic injustices are just some of the problems that have been discussed. According to documents from the Commissioned study for EFA Global Monitoring Report of 2005, using a foreign language as the main tool for education is equivalent to requiring that learners complete a task without providing them with the tools or skills necessary to complete it effectively.

The analogy used in this report accurately depicts the perception of many Haitian students who feel that this compares with being held under water without having been taught to swim (Benson, 2004). Furthermore, this homology substantiates Vygotsky's theory that asserts that language is acquired through social interaction. This view is crucial to understanding students' failure in Haitian classrooms as the majority of Haitian students have the larger part of their social interactions in Kreyòl except for their schooling.

Of course, there are some researchers such as Dutcher (2004) who claim that French is the legitimate medium of instruction as it allows for wider communication and that it provides Kreyòl the support it needs as to not isolate the Haitian population. What seems to be lacking from this judgement is documenting the actual number of people who have mastered this language in Haiti. This view thus conjures ties to the historical context in which French came to be an official language in the country. This perspective also besieges the contemporary rationalizations for the continued use of French as the language for instruction in Haitian schools. Most importantly though, this view controverts language theories and research which assert that language plays a primordial role in the acquisition of knowledge and that the most effective and efficient tool to disseminate education is through the use of language that is most familiar, the mother tongue.

In terms of major contributions of significance to this research study, one criterion stands out: data is lacking when it comes to action research based on the use of Kreyòl as an educational tool in Haiti. Any contributing factor deducted from this literature review and used in this research project was based on work that has been applied elsewhere. As such, data from programs such as MCLC and the MIT-Haiti Initiative are the most compelling measurements enticing the need for this project and providing some quantitative evidence of the positive results of the use of the mother tongue in Haitian education. These programs speak to the impact that using Kreyòl as the medium of instruction has had on students. Data from MCLC demonstrated by "field research in elementary schools in Haiti where children in the early grades (1st through 3rd grades) achieve much higher reading scores (up to three times better) when instruction takes place systematically in Kreyòl" (Degraff, 2013, p. 3).

However, as with many other studies, both the MCLC and MIT-Haiti Initiative programs speak to some of the adverse perspicacity of implementing such language approaches. Some of the issues faced were the teachers' ease with using the new language, the support received

from the community including apprehensions toward the mother tongue, governmental support, and access to resources in mother tongue language. In the case of Haiti, governmental support and attitude toward the Kreyòl language proved to be two major pitfalls when it came to implementing the Bernard Reform designed to introduce this language as a medium of dissemination in classes. In this stance, historical context still predominates how Haitians view Kreyòl and assures the vicious cycle that hinders the success of the majority of Haitian students even beyond school.

The problem of which language is used in the Haitian classroom not only affects the success of students but also denotes some of the foundational concerns that impact the overall functioning of the country. Language, being a core component of a nation's culture, speaks to the importance it plays in the development and sustainability of its population. "The competitive market will tend to minimize communication through segregation, but if interaction is required, the cost will be borne by the minority" (Lang, 1986, p. 363). Although the majority of people in the Haitian population are monolingual, Kreyòl speakers, the preeminence of French renders them the minority, demonstrating the inconsequential part that Kreyòl plays in the development and sustainability of Haiti's economy.

The undeniable bearing that language plays in all facets of the Haitian society determines not only individual success, but ultimately the success of the nation as a whole. This is certainly the case in Haiti. This "élite closure" seems impenetrable as the perceived superiority of French over Kreyòl is often internalized, from a tender age, by those very Kreyòl-speaking Haitians. The latter are effectively handicapped and excluded by the pressure to learn and speak French in schools and other venues that paradoxically make it largely impossible for them to do so successfully (Degraff, 2013, p. 3). The lack of mastery of advanced concepts, due to language barrier, leads to countless young men and women being unable to enter the workforce in employments that play a role in the evolution and progression of the nation.

Looking to the future points is the necessity for supplementary action research to demonstrate the positive impact of using mother tongue language, in this case Kreyòl, in classrooms. Providing conclusive data will supply the influence needed to impart change, at least in the arena of education. Thus, as a first step, data must continue to be gathered so that a clearer picture of the role of language on education may be recognized and further understood.

A follow up would entail the promulgation of this data to the larger public as this process will be met with ample resistance due to the historical context tied to the use of Kreyòl in the realm of education. The critical element will be to promote the use of Kreyòl as a means to improve the acquisition of concepts rather than as a means to replace French. Essentially, the goal would be to work towards a truly bilingual society in which Kreyòl would be the language in which students start to learn and that, upon mastery of foundational concepts, French would be introduced.

Citation

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CHAPTER 3: MEASURING THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION

This section provides a description of the methodology used in this study. According to Kothari (2004), methodology refers to a systematic way of answering a research question or solving a research problem. Methodology goes beyond finding tools and devising tests to use during a research study in that it entails sorting out which of the plethora of research tools available are most appropriate to use in answering the research question. In this sense, the research methodology not only delineates the various techniques that will be used during the research study, but it also provides the rationale behind the choice of techniques used based on previous research, literature review, and the scope and details of the particular problem to be solved.

Purpose of the Proposed Study

The purpose of this study was to determine if there were differences in the academic performances in math and science of Haitian students when providing instruction using the native language of Kreyol rather than the mandated language of French. This study fell within the larger continuing debate “that Haiti’s French-dominant school system is an impediment to the nation’s development, whereas Haitian Creole-dominant education will lay the foundation for long-term development” (Hebblethwaite, 2012, p. 255). This study was an attempt to test possible solutions that may ameliorate student success in Haitian classrooms. It touches on the importance of language in student performance, a controlled experiment to test the ramifications of using French versus Kreyol in the classroom, an analysis of data collected and a summary of students’ perception on the use of these languages as instructional mediums.

Research on linguistic theories such as that from Gibson (2011) and DeGraff (2014) have highlighted the importance of language in the processing of new information, thus the choice

of language as the main variable in this study. It was therefore hypothesized that the use of student's mother tongue will increase the efficiency of understanding and processing technical information presented in classes. The results of the study may provide useful information as to improvements necessary to increase student success.

Research Questions and Hypotheses

Because math and science are taught separately, there are three main research questions.

1. What are the differences in test scores in the learning of math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?

- H1: There are significant differences in test scores in the learning of math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?
- H0: There are no differences in test scores in the learning of math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?

2. What are the differences in test scores in the learning of science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?

- Kreyol and those instructed in the mandated language of French.
- H1: There are significant differences in test scores in the learning of science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?
- H0: There are no differences in test scores in the learning of science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?

The hypothesis was that there would be a significant difference in mean pre-test and post-test scores when the teaching intervention is in Kreyol compared to presenting similar concept in French. This hypothesis would be supported by finding the mean of sample 2 to be significantly greater than the mean of sample 1 ($M_2 > M_1$). An additional research question was developed to guide the process of telling the story of the intervention and the study.

1. How will the use of Kreyol affect students' perception of the use of language in their education?
2. How will the use of Kreyol affect students' perception of their identity as Haitians?

Research Design

This was a quasi-experimental research study, which used the nonequivalent control group design with pre-test and post-test for a treated and comparison group to collect data from the participants. The data was generated from these pre-and post-tests. Although true experimental designs are considered more precise in terms of internal validity, they require a large sample and randomization. Forasmuch as there was access to a sample from a larger population within a traditional academic setting, a quasi-experimental design was chosen for this research. This specific type of design works well on non-random, small samples and with systematically formed groups, in this case classes, such as that present in schools (Best & Kahn, 2016). Similar studies such as Chen (2010) made use of the quasi-experimental design to analyze processing instructions in Taiwanese learners of L2 English. In this study pre-and post-tests were also used to assess the learning of the of the English 'ed' verb inflection.

Groups were dissimilar as they received instruction in two different languages. Thus, data gathered from the groups was evaluated by grade level and conclusions were also drawn by grade levels to decipher similarities and differences in performance when the French and Kreyol were used as the medium for instruction. Using this method of grouping students meant that some may have figured in both Kreyol condition and French condition groups during subsequent interventions, essentially groups were randomly switched during successive interventions. Although this study was quasi experimental, the switching replication method helped to increase its validity.

In this study, the sample received both pre-tests before the intervention and post-tests after the intervention. Only the test group was exposed to the independent variable, the Kreyol language, as the medium for instruction. The comparison group was taught in the usual language of instruction at Institution X, French. The choice to use a pre-test before the intervention was to minimize selection bias as much as possible and also to isolate and investigate any heterogeneity that may have existed between the Kreyol condition and French

condition groups prior to the intervention (Green, Camilli, & Elmore, 2012). This assumption was that if the two groups score similarly on their pre-tests but show differences in post-test scores, after they have received the intervention, then results may more closely fall in line with the hypothesis (H1) which states that there are significant differences in the learning of math and science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French.

Target Population, Sampling Method, and Related Procedures

This section provides a description of the population or people that encompass the particularities being studied in this project. Usually a subset of a particular population is drawn and represents the sample of the research study. However, in this case the researcher had access to the entire population, which served as the sample for the project. This section also outlines the methods used to choose the sample, to determine the appropriate size of the sample, and discusses specifics about the setting in which the study will take place. Finally, the recruitment process that was utilized will also be presented in this section.

Target Population

Target population consisted of 246 girls enrolled at Institution X, a private school, as are ninety percent of schools in Haiti (WorldBank, 2015). Students enrolled in this institution are taught in French as are the majority of schools in Haiti. Students at this school are part of the twenty-nine percent of people who attend secondary schools (USAID, 2015). This institution also has what is considered a high rate of retention as the school has a ninety percent rate of students that remain through graduation as per Institution X' Board statistics. Students attending Institution X come from lower middle-class income families earning between HTG 20,000 to about HTG 80,000 (one US dollar is equivalent to about sixty-eight Haitian Gourdes) (USAID, 2010).

Sampling Method

A non-random sampling method; specifically, consecutive sampling was used to determine the study sample. The sample selected for this study was Haitian, Kreyol speaking, high school students enrolled at Institution X in grades seven thru thirteen. The researcher

provided participants with a survey to complete to ensure students met these inclusion criteria. This sample selection process was chosen because as indicated by Lundsford:

consecutive sampling is a strict version of convenience sampling where every available subject is selected, i.e., the complete accessible population is studied. This is the best choice of the nonprobability sampling techniques since by studying everybody available, a good representation of the overall population is possible in a reasonable period of time (1995, para. 42).

Using this sampling method and this sample size allowed the researcher to gather and analyze data that can be used for further studies that will strengthen conclusions.

Sample Size

This sample consisted of one group per grade (sixième: The equivalent of seventh grade to Philo: Haitian schools go one year beyond the 12th grade 13th grade) for seven grades. Students that participated in this study were French and Kreyol speakers between the twelve and nineteen years of age. Exclusion criteria for this study are students younger than twelve or not attending above cited institution in Ouest Department, Haïti.

There was on average 13 students per group for an approximate total of 140 students in the study sample. A study sample is dependent on three components: “the significance level, power, and magnitude of the difference” (McCrum-Gardner, 2010, p. 10). The conventional significance level (α) is 0.05 or 95%, power is the odds of dismissing the null hypothesis when the alternative hypothesis is accurate, and effect size can be calculated using freeware such as GPower (McCrum-Gardner, 2010). Using the usual significance level of 0.05, power of 0.95 and, an effect size of 0.5 the sample size calculation using GPower for a dependent t-test for paired samples, predicted a sample size of 54.

The researcher wanted to increase the significance of data used in this study and seeing that Institution X provided access to 139 students out of the 246 students that made up its population, the researcher chose to use every prospective student as the sample for this study. The sample size of 139 provides an Elevation Factor or percentage of population in the study of 63% and a sampling factor of 1.58. In other words, with these numbers, each student in the sample represents approximately 1.58 students of the population.

Setting

The research study took place at Institution X, Ouest Department, Haiti, Private, K-12 all-female school. Institution X represents a typical private Haitian school in its choice of state-mandated curriculum and socio-economic group services. Institution X is presided over by a board of five educators that administer and supervise its proper functioning.

The school is located in the heart of the Ouest Department of Haiti and has been servicing its clients for approximately fifty years. Students are taught in French which is also the language used in textbooks. Students attend five-fifty minutes periods of classes Monday through Thursday and three-fifty minute periods of classes on Friday ; this is also a typical academic schedule in Haiti.

Recruitment

Recruitment sessions were held in September, after school, at Institution X for the potential participants. Parents and students were informed about the recruitment session through an invitation letter that was sent home with students two weeks before the session. The invitation letters were provided to the school administration by the researcher and served as an invitation to the recruitment session. Letters were disseminated by classroom teachers to all students in secondary level.

Parents and students received information about the study including consent forms during recruitment session. All questions from parents and students were answered. Parents and students were provided a one week deadline to sign and return forms to a drop box which recruiter placed in a designated office on the Institution X campus.

Instrumentation

This section discusses the plan devised in order to designate the various measurement techniques that were used in this research study. This process included deciding between measurement instruments that were already created or developing new ones based on the research question. This section will also describe the field-testing of the selected measurement techniques and the procedures by which they were implemented.

Quantitative Data

Baseline data from students' most recent final exam test scores in math and science were collected to note typical student performance in these subjects and serve as a standard against which all changes were measured after implementation of the intervention. Data provided information on students' general academic ability and performance in math and science. Tests developed by students' instructors and typically used for assessment for the concepts that were taught were used as pre-and post-test. Since these tests were developed in French, they were translated to Kreyol and field-tested by students outside of the sample for clarity and conformity with French translation.

The investigator used a standardized test created by teacher at Institution X to measure an identical concept taught at an identical level of difficulty. Each of the seven grade levels was divided into two groups. A specific math or science concept was taught in French to Group 1 and students were provided with an item of measure in French (standardized pre-and post-tests developed by Institution X teachers) to assess whether language made a difference in students' performance even when instruction was in French. The same process applied to concepts taught in Kreyol to group 2. Both the items used to evaluate students at the end of each concept taught measured the same concept at the same level of difficulty since these items were translations of each other. The data gathered from the two groups in each grade level was evaluated and used to determine whether there was a difference in student comprehension and performance when French or Kreyol were used as the medium of instruction.

Qualitative Data

Students were asked to talk about the experiences, reactions, thoughts on learning in their native language. Data collected from the group interviews were compiled in an Excel spreadsheet and coded to categorize themes and patterns in responses. Data is presented in a table along with figures.

Students were also asked to complete the Student Perception Questionnaire found in Appendix A on how they perceived using their native language impacted their learning

experience. Responses were compiled in Excel and coded to categorize themes and patterns. Data is presented in figures and tables.

Participants were also interviewed in order to gather data on their perception of the use of Kreyol in the classroom and their perception of the effects of the intervention. Responses were compiled in Excel and coded to categorize themes and patterns. Data is presented in a table.

Description of Intervention

This study received Board approval from Institution X and the Internal Review Board. The recruitment session was held in September, after school, at Institution X for the potential participants. Parents and students were invited to this session through an invitation letter that was sent home with students two weeks before session. The invitation letters were provided to the school administration by the researcher and served as an invitation to the recruitment session. Letters were then disseminated by classroom teachers to all students in secondary level classes. Parents and students received information about the study including consent forms during recruitment session.

The researcher answered any questions from parents and students and parents and students were provided a one-week deadline to sign and return forms to a drop box which recruiter placed in a designated office on Institution X campus. After the consent forms were returned, the researcher visited Institution X to collect baseline data in the form of student scores from standardized tests in math and science as a means to set a standard for the typical performance of students that participated in the study. These scores were compiled in Excel.

The study involved a comparison of students' math and science proficiency in French and Kreyol in grades seven to thirteen. To begin the study, the researcher collected a matrix from Institution X instructors, which included concepts that had not yet been taught but that students would be exposed to in subsequent classes for each of the seven grade levels included in the research study. The instructors also provided accompanying pre-and post-tests, by grade level, that had been previously used by the school to assess student performance and comprehension of these concepts. Then the researcher scheduled her visits with the administration based on the academic schedule provided and the matrix from

Institution X instructors. The researcher also collected class lists from the administration and entered students into an excel spreadsheet per grade level.

Then researcher randomly divided each grade/class into two groups, a French condition and Kreyol condition group. Each class was entered using ID numbers in Microsoft Excel then the “random” option was used to pull half of the sample for the Kreyol group and the other half for the French group. Then the researcher taught a concept by grade level, either in math or science, using French or Kreyol. Note that each grade level was taught a science concept and a math concept in both languages based on groupings. There were twenty-eight sessions, which lasted forty-five minutes each: ten minutes for the pre-test, a twenty-minute oral presentation with examples of concept taught on the blackboard, five minutes of answering students’ questions, and ten minutes for the post-tests. Sessions were based on concepts provided by Institution X teachers, originating from subsequent concept needing to be taught according to course curriculum. Institution X teachers also provided habitual post-tests used to assess how well students grasp a particular concept presented.

Both groups in each grade levels received the same treatment in whichever language condition to which they belonged (French or Kreyol). Students in each group (French or Kreyol) were first provided, by grade level, a pre-test, were taught the same concept in the language condition to which they were assigned, then were provided a post-test in that same language. Quantitative data was collected from pre-and post-test scores. In the end, researcher taught seven French math concepts, seven Kreyol math concepts, seven French science concepts, and seven Kreyol science concepts for a total of twenty-eight sessions, each comprised of a pre-test, a presentation of concept, and a post-test, in grades seven to thirteen at Institution X. Qualitative data was also collected from student group interviews and responses on student perception questionnaires. This data was compiled in Excel tables and analyzed using priori codes from which larger concepts were drawn.

Field Test

A questionnaire was used to gather data on students’ perception on the effect of language used as medium for instruction. A field test was designed to determine the validity and reliability of the student perception questionnaire. A group of experts in the field were used

to gather information on clarity of questions, flow of questions, and the time it takes to complete the questionnaire.

The five experts in the field (two administrators from the research site, two administrators from researcher's work site, and one university professor from the Teaching Department completed the questionnaire so that they could provide feedback on clarity of questions, structure of test, and the appropriate time for completing this questionnaire. The researcher provided the questionnaire to participants for a one-week period for review. Participants provided feedback on the questionnaire using a survey provided and designed by the researcher. Feedback was reviewed, and any needed changes or improvements were made.

Operationalization of Variables

The independent variable (IV) in this study is language of instruction. The use of which is believed to have a direct effect on academic achievement, specifically in math and science, the dependent variable (DV). "Academic Achievement", the dependent variable, is operationally defined, for the purpose of this study, as a significant difference in mean of pre-and post-tests scores using Kreyol than the mean of the pre-and post-tests using French as the instruction medium in math and in science. The null hypothesis H_0 was the mean of differences between pre-and post-test scores of Kreyol condition group is less than or equal to that of French condition group. The alternative hypothesis H_a or operational hypothesis is that the sample mean of sample 2 would be greater than the mean of sample 1.

Data Analysis Procedures

Quantitative Data

Pre-and post-tests scores were compiled on an Excel data spreadsheet. Pre-and post-tests was analyzed using a Paired Sample t-test. This method analyzed average scores on pre-tests and post test scores to determine whether there was a significant difference in scores of post-tests following a teaching intervention, in this case, teaching in participants' mother tongue Kreyol. The same procedure was applied after pre-and post-tests were collected following instruction in French to determine if there is a significant difference in average pre-test and post test scores. The alternative hypothesis (H_1) was that there would be a larger positive

difference in mean pre-test and post-test scores when the language used for the intervention was Kreyol compared to the intervention presenting similar concept in French.

Data analysis of ANCOVA was conducted to show if improvements had occurred if the difference in mean of pre-and post-tests scores using Kreyol were larger than the mean of the pre-and post-tests using French as the instruction medium while presenting individual concepts in math and in science and null hypothesis has been proven false. Performance assessments were also analyzed using the ANCOVA as well. The test assessed the significance of the difference between the means of sample 1 (students receiving instructions in French) and sample 2 (students receiving instruction in Kreyol. This hypothesis will be supported by finding the mean of sample 2 to be significantly greater than the mean of sample 1 ($M_2 > M_1$).

Qualitative Data

Qualitative data: student group interviews and student perception questionnaire results were recorded and compiled in an Excel spreadsheet and coded to categorize themes and patterns in responses. Data collected was presented in tables. All data was stored in an external drive that will be kept locked overnight in a safe. The investigator will use tables and charts to display results of data analysis.

Questionnaire: Students were asked to complete a questionnaire on how they perceived using their native language and how it impacted their learning experience. Responses were compiled in Excel and coded using recurring terms to categorize themes and patterns. Data was presented in graphs and tables.

Limitations of the Research Design

Limitations in a research study provide an opportunity for investigator to assess deficiencies that may affect the study. Limitations, once identified, also present the researcher with the option to make changes to address these deficiencies before data collection or to provide justifications for pursuing research studies as is (Schanzenbach, 2012).

The following limitations were considered in this study:

1. A limitation was that the study was conducted at an all-female school. It was difficult to generalize the study's findings to an all-male school because the two genders may likely react differently to the intervention. This limitation was addressed as further studies could be conducted to help to generalize findings to both genders.
2. The academic schedule was a limitation as students from a sample may have to focus on standardized State exams during the research period. To address this limitation, the researcher worked closely with administration to work around state exams to get full student and teacher support.
3. Time was also a limitation. If the study had been extended over a longer period of time, the results might have been different. Time constraints within the academic year determined the length of the study.

Internal Validity

Internal validity denotes the legitimacy of the results of a research study. It aims to regulate the peripheral variables that may guide and sway the results of the research study. This section provides an explanation of the various items that may pose a threat to the internal validity of this project.

History - history posed a threat to the research study in terms of unexpected events such as, school closure due to political unrest, and weather. Fortunately, during the data collection process these disturbances were minimal.

Instrumentation – was not a threat because the researcher was the examiner for and administered both pre-and post-tests for both groups.

Maturation - Any maturation threats would stem from students adapting to the ways in which pre-and post-test questions were posed. However, researcher made sure to use random sampling as a means to minimize the incidence of students figuring in the same group (Kreyol condition or French condition) within consecutive interventions.

Mortality - was not a threat to this project as all students participating in it remained for the duration of the data collection process.

Selection bias – selection bias was minimized in that the students were randomly assigned to groups (French condition and Kreyol condition) every time they participated in research activities. As such, same student may or may not have been part of French condition group for one intervention and Kreyol condition group for the next intervention.

Testing - As far as testing is concerned, researcher used equivalency reliability by using two items to measure an identical concept taught at an identical level of difficulty. The concept was taught in French to Group 1 and students were provided an item of measure to assess whether language makes a difference in students' performance even when instruction was in French. The Kreyol condition group followed the same process using an item of measure at the end of each intervention. Both these items were identical and measured the same concept at the same level of difficulty. The same process applied to concepts taught in Kreyol.

Furthermore, because students essentially were only tested twice, once in biology and once in math, there should not have been enough repetition for their participation in pre-tests to affect their performance on post-tests. Also, the fact that both groups were subjected to pre-tests increased that likelihood that differences in scores were not due to testing.

External Validity

External validity refers to the confidence level with which the results of a study may be generalized and applied to other studies. It determines whether or not the findings of a study may predict results of consequent studies with similar settings or populations for example. This section provides a listing of elements that may influence the external validity of the research study.

Ecological validity – A non-random sampling method was used; specifically, consecutive sampling was used to determine the study sample. This sample selection process was chosen because consecutive sampling is a strict version of convenience sampling where every available subject is selected, i.e., the complete accessible population is studied. This was the best choice of the nonprobability sampling techniques since by studying everybody available, a good representation of the overall population was possible in a reasonable period of time (Lunsford & Lunsford, 1995, para. 42). In addition, because Institution X represented a

standard Haitian academic setting and that sample was taken randomly from the population, ecological validity represented a minimal threat.

Generalizable conditions – Although sampling was done randomly, because testing was done on, an all-female group in a secondary school setting, generalizability was minimized as different genders may likely react differently to the intervention or to the researcher. Further testing using other samples likely provided increased generalizability to this study.

Pre-test treatment – although pre-tests were administered to the participants, because they were randomly chosen and because they participated in one science and one math intervention, they did not affect participants' responsiveness to experimental variable.

Expected Findings

The current practice of utilizing French as the sole language of instruction leads to an ineffective classroom in which students do not grasp concepts presented by instructors (DeGraff, 2013). This trickles down to failing students and a failing educational system.

Successfully implementing Kreyol as one of the mediums for instruction in Haitian classrooms as the Matenwa school in La Gonave has done, provides evidence that students have the opportunity to seize concepts presented much more effectively, helping them to not only improve their academic performance, but also to utilize more effectively their learning in the real world (Friends of Matenwa, 2014).

Expected findings from this research study conceptually would contribute to the statistical literature that proposes the use of Kreyol in the classroom as a means to improve student performance in math and science classes. As with the results of such institutions as the MATENWA school in La Gonave, which utilizes Kreyol as the primary means of instruction “13 schools in the LKM network had significantly improved their national 6th grade exam passing rate. All 25 LKM students passed the Certificate 100%.” (Friends of MATENWA, 2014, para. 11), the researcher hoped to provide supplementary evidence of the benefits of using students' mother tongue in grasping science and math concepts in Haitian schools.

The analysis of performance assessments and pre-and post-test scores using the ANCOVA was expected to demonstrate a significance in the difference between the means of sample 1

(students receiving instructions in French) and sample 2 (students receiving instruction in Kreyol). The researcher hypothesized the direction of the difference as: task performance will be better with instructions in Kreyol. This hypothesis would be supported by finding the mean of sample 2 to be significantly greater than the mean of sample 1 ($M_2 > M_1$) and that there will be a statistically significant difference between the Kreyol condition and French condition group at the p value is less than or equal to 0.05.

Ethical Issues

The issue of ethics is most important to the field of education and even more essential to conducting research as it is concerned with the conventions that dictate how we should regard each other and should interact with one another (Eikeland, 2006). Although the level of risk of this research study was minimal as it presented minimal harm in the daily lives of participants; the probability and magnitude of possible harm was no more than when the students are attending school as part of their daily routine, the researcher proceeded with caution considering the safety and well-being of students participating in this study.

Conflict of Interest Assessment

A conflict of interest takes place when a researcher has to confront interests that may clash with each other. In order to ensure that there are no conflicts of interest involved in a research study, it is imperative for the researcher to evaluate all aspects of the project and to honestly divulge any possibilities of competing interests. After careful assessment of the various facets of the research project, it has been found that no conflict was present in the form of moneys received, work performed for, shared ownership in, or any close relationship with Institution X, and that this organization does not stand to gain any interests, financial or otherwise from the publication of this paper.

Position Statement

The investigator is an insider in collaboration with other insiders and is collaborating with the research site administrative team, instructors, and the students to create an environment of change that will directly benefit the students as well as provide the organization with a means to better serve the student population and hence increase its own marketability. The

investigator is well placed to answer research questions as she serves as an integral part of a project to promote math and science education using active learning in Haiti. The unique aspect of this project is that the medium of instruction is Kreyol. Many critics of the MIT-Haiti Initiative claim that any improvement in student performance is due, solely, to the use of active learning methods:

In Haiti, such active learning, especially the interactive part, cannot be done in French or English or any other language that the students, by and large, do not speak fluently. In Haiti, it is only in Kreyòl that the majority of students can truly participate in interactive learning (Degraff, 2014, p. 5).

Thus, the data gathered from this investigation provided statistics that speak to the effects of the use of Kreyol as the medium of instruction in the acquisition of math and science knowledge.

In considering ethics in this study, the researcher made certain that participant information remained confidential. To begin with, all participant and research site names were anonymized. Data collected were kept stored in a locked box on an external drive and no one was able to access data unless authorized by the researcher. In keeping with ethical considerations in this research study, the researcher took careful precautions to maintain communication with all participants pertaining to research proceedings, background, goals, and activities. All participants were also informed of their right to stop participating or to decline interviews and participation in other activities related to the collection of data involved in the study. Furthermore, whenever tape recorders were used during interviews to ensure that data would remain as reliable and valid as possible, participants were made aware ahead of time and were provided the opportunity to decline the use of such tool in their presence.

Knowing that the issue of language in Haiti is one that may conjure up resentment and conflicts, the researcher paid particular attention to the formulation of survey and interview questions to ensure that researcher's beliefs and biases about the language issues in Haiti would not coerce participants input in any manner. In this vein, field tests on survey and interview questions were conducted in order to receive feedback from colleagues and linguists in striving to minimize any biases present in wording.

Chapter 3 Summary

The methodology of a research study provides the scaffolding on which the researcher will rely to answer a particular question or solve a problem. It entails figuring out the most effective tools to be used in conducting research. This chapter presents the methodology of this research study. It begins with the purpose of the study, which was to determine if there was a significant difference in performance when Haitian students were taught in French as opposed to Kreyol. This chapter also discusses the research questions and hypothesis of the study and provides a description of its quasi-experimental design, while highlighting rationale behind the choice of such a design. Nonequivalent groupings were used as to respect the participants' unequal individualities along with the switching replication method to increase chances of equal probability within the samples used in the study.

This section further described the target population and how samples from this population were selected from 246 girls attending Institution X, a typical private school in the Ouest Department. Students were provided a survey to ensure that participants met inclusion criteria. The sample from this population included French and Kreyol speaking students enrolled in seventh to thirteenth grade for seven classes, one per grade level. Students participated in math and science interventions that included a pre-test followed by a presentation of a concept, then a post-test at the conclusion of the session. The setting and recruitment procedures were also described in this chapter.

The description of the methodology used in this study also included explications on the measuring methods used in this study. Quantitative data in the form of pre-and post-tests were gathered and measured using Paired t-test and ANCOVA to determine whether or not the alternative hypothesis would be proven. The alternative hypothesis would be proven if the mean of post-tests of sample 2 (group taught in Kreyol) were greater than that of sample 1 (students taught in French). Qualitative data in the form of group interview comments entries were also collected and analyzed.

This chapter further delineates the limitations of the research design including the internal and external validity of the study and how expected findings might contribute to the statistical literature that proposes that the use of Kreyol in Haitian classroom would help to improve student performance. As language is such a loaded subject in Haiti, ethical issues were also

discussed in this chapter. After careful assessment the researcher determined that conducting this research study presented no conflict of interest.

Citation

Behrman, T. (2018). Measuring the effects of mother tongue on math and science instruction. In I. Sahin & T. Shelley (Eds.), *Evaluating the effects of mother tongue on math and science instruction* (pp. 33-50). Monument, CO, USA: ISTES Organization.

CHAPTER 4: RESEARCH FINDINGS FOR THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION

This chapter presents the findings and analysis that emerged from the interventions of the research study. French is currently used as the language for instruction in Haitian classrooms. However, most Haitian students do not have a solid grasp of this language. As such, the students are unable to effectively understand and assimilate concepts. This leads to an ineffective education system, which renders tens of thousands of students graduating yearly without basic skills. The study aims to answer the question: what are the differences in test scores of math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French?

The objective of the study was to determine potential differences in math and science academic performance of students when concepts were taught in French versus Kreyol. This study falls within the larger discussion about the role of language in the failing Haitian education system. Expected findings predicted that there would be significant differences in the learning of science and math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French. This hypothesis would be supported by finding the mean of sample 2 (students in Kreyol groups) to be significantly greater than the mean of sample 1 (students taught in French) ($M_2 > M_1$) as the researcher hypothesized that students would perform better with the Kreyol language. A total of 139 students represented the sample of the study and participated in a total of twenty-eight sessions. The participants were divided per grade level into a French condition group and a Kreyol condition group using consecutive sampling and switch replication methods. Both groups received, per grade level, a pre-test prior to intervention and a post-test following the intervention. Data from pre-and post-tests were collected and analyzed along with student perception questionnaires and student group interview. This chapter aims to describe the sample involved in the study, to summarize results, and to provide details of the data analysis.

Description of the Sample

The study sample was composed of 139 students in grades seven through thirteenth at Institution X, in Ouest Department, Haïti (Table 1). The sample was representative of a typical private, all girl school in Ouest Department in that it served lower to middle class families with an income range of \$500 to \$1000 and that it abided by the curriculum set by the Ministry of Education. The sample was pulled from a population of 246 students and contained all the students attending secondary level courses at this institution. Each class level was separated randomly into two groups: the French condition and Kreyol condition group, thus each group contained varying ability students and was representative of a typical class at Institution X.

Table 1. Sample Demographics

Variable	Information
School population	246
Participants	139
Family Income Range	\$500-\$1000
Age Range	12-19
Grades Surveyed	6 ^{eme} (7 th) –Philo (13 th)
Gender	Female

Summary of the Quantitative Results

This section provides a description of the results of the study in line with the research questions and hypothesis. The aim of the study was to determine if there were differences in the learning of math and science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French. In this vein, the first hypothesis H1 stated that there are significant differences in the learning of math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French and H0 claimed that there are no differences in the learning of math concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French. The second hypothesis H1 stated that there are significant differences in the learning of science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the mandated language of French and H0 claimed that there are no differences in the learning of science concepts of Haitian students instructed in their native language of Kreyol and those instructed in the

mandated language of French. Before determining whether there existed a significant difference between post-test scores for French condition and Kreyol condition groups, tests on pre-test data establishing normal distribution were performed. These tests were important as they would provide evidence that any significant difference detected between French condition and Kreyol condition groups scores were due to language used with participants and not to differences in participant’s abilities or other criteria.

Results of Dispersive Tendency of Pre-Test Scores

Descriptive statistics support a judgment of normal distribution if: Skew < 1 and Kurtosis < 7. If Descriptive statistics demonstrated abnormal distribution Skew > 1 and Kurtosis > 7, ANOVA Single Factor Test equivalent to Levene’s test (used to assess equality of variances) scores were calculated. Descriptive statistics analysis of dispersive tendencies of pre-tests of French and Kreyol condition groups per grade levels are displayed in Table 2 and 3 respectively. The data that was not normally distributed in the French and Kreyol condition groups were further analyzed using ANOVA single factor and displayed by grade level in Table 3, 4 and 5 respectively.

Table 2. Descriptive Statistics of French Condition Groups

Grade Level	Skew	Kurtosis
6 ^{eme} (7 th Grade) Math	1.16*	0.73
7 ^{eme} (8 th Grade) Math	0.60	-0.07
8 ^{eme} (9 th Grade) Math	0.42	-1.53
9 ^{eme} (10 th Grade) Math	2.80*	8*
Second (11 th Grade) Math	0.67	-1.15
Rheto (12 th grade) Math	0.05	-2.06
Table 2 Continued		
Grade Level	Skew	Kurtosis
Philo (13 th Grade) Math	0.27	-2.25
6 ^{eme} (7 th Grade) Science	1.14*	-1.11
7 ^{eme} (8 th Grade) Science	2.34*	5.92
8 ^{eme} (9 th Grade) Science	-0.27	-1.39
9 ^{eme} (10 th Grade) Science	-0.28	-1.39
Seconde (11 th Grade) Science	0.64	-2.24
Rheto (12 th Grade) Science	1.80*	3.98
Philo (13 th Grade) science	0.06	-0.35

Table 3. Descriptive Statistics of Kreyol Condition Groups

Grade Level	Skew	Kurtosis
6 ^{eme} (7 th Grade) Math	0.57	0.38
7 ^{eme} (8 th Grade) Math	0.12	-1.17
8 ^{eme} (9 th Grade) Math	1.19*	-0.39
9 ^{eme} (10 th Grade) Math	3.16*	10*
Second (11 th Grade) Math	1.62*	0.73
Rheto (12 th grade) Math	1.41*	3.35
Philo (13 th Grade) Math	1.32*	0.88
6 ^{eme} (7 th Grade) Science	0.99*	0.97
7 ^{eme} (8 th Grade) Science	-0.09	0.29
Table 3 continued		
Grade Level	Skew	Kurtosis
8 ^{eme} (9 th Grade) Science	-0.42	-0.43
Table 3 Continued		
9 ^{eme} (10 th Grade) Science	0.42	0.43
Seconde (11 th Grade) Science	0.13	0.18
Rheto (12 th Grade) Science	1.80*	4.0
Philo (13 th Grade) science	-0.5	-1.27

Table 4. ANOVA Single Factor Analysis for French Condition Groups

Grade Level	P-Value
6 ^{eme} (7 th Grade) Math	0.42
9 ^{eme} (10 th Grade) Math	0.63
6 ^{eme} (7 th Grade) Science	0.09
7 ^{eme} (8 th Grade) Science	0.09
Rheto (12 th Grade) Science	0.63

Table 5. ANOVA Single Factor Analysis for Kreyol Condition Groups

Grade level	P-Value
8 ^{eme} (9 th Grade) Math	0.18
9 ^{eme} (10 th Grade) Math	0.63
Table 5 Continued	
Grade level	P-Value
Seconde (11 th Grade) Math	0.05
Rheto (12 th Grade) Math	0.24
Philo (13 th Grade) Math	0.34
Table 6 Continued	
6 ^{eme} (7 th Grade Science)	0.09
Rheto (12 th Grade) Science	0.63

Results of t-Test between Means of Pre-Test Scores per Grade Level

A t-Test: Two-Sample Assuming Equal Variances was conducted to evaluate the difference between pre-test scores of French condition and Kreyol condition groups of this research study. Results are displayed in (Table 6). t-test demonstrated that variances between pre-test of both French condition (standard) and Kreyol condition groups were not the same for 4 groups (seconde and 7^{eme} math and seconde and philo science) p-value < 0.05. As such, outliers were rejected and t-Test was once more conducted.

t-test with outliers rejected demonstrated that variances between pre-test of both French condition (standard) and Kreyol condition groups were the same if p-value > 0.05. Although differences were detected in pre-test scores, further testing established that these differences were not significant, for the majority of groups, thus the researcher could proceed with testing of post-test scores in order to accept or reject the hypothesis (H1) stating that there would be significant differences in the learning of science and math concepts of Haitian students instructed in their native language of Kreyol as opposed to those instructed in the mandated language of French. Eleventh grade math, eight grade science, eleventh grade science, and thirteenth grade science demonstrated a p-value < 0.05 meaning that variances between these groups were not the same (Table 7).

Table 6. t-Test between Pre-test Scores of French and Kreyol Condition Groups

Grade Level	df	t Stat	P(T<=t) one-tail	t Critical one-tail
6 ^{eme} (7 th Grade) Math	11	-0.80	0.22	1.79
7 ^{eme} (8 th Grade) Math	27	-0.15	0.44	1.70
8 ^{eme} (9 th Grade) Math	11	-1.23	0.12	1.80
9 ^{eme} (10 th Grade) Math	10	0.46	0.326	1.81
Second (11 th Grade) Math	7	1.92	0.05*	1.89
Rheto (12 th grade) Math	14	-1.22	0.12	1.76
Philo (13 th Grade) Math	13	0.99	0.170	1.77
6 ^{eme} (7 th Grade) Science	12	-1.74	0.053	1.78
7 ^{eme} (8 th Grade) Science	13	-1.85	0.043*	1.77
8 ^{eme} (9 th Grade) Science	16	-1.67	0.056	1.74
9 ^{eme} (10 th Grade) Science	11	-1.08	0.150	1.79
Seconde (11 th Grade) Science	16	2.12	0.025*	1.74
Rheto (12 th Grade) Science	16	0.49	0.32	1.74
Philo (13 th Grade) science	14	-1.27	0.111	1.76

Table 7. t-Test Between Pre-test Scores of French and Kreyol Condition Groups Outliers

Rejected				
Grade Level	df	t Stat	P(T<=t) one-tail	t Critical one-tail
6 ^{eme} (7 th Grade) Math	11	-0.80	0.22	1.79
7 ^{eme} (8 th Grade) Math	27	-0.15	0.44	1.70
8 ^{eme} (9 th Grade) Math	11	-1.23	0.12	1.80
9 ^{eme} (10 th Grade) Math	10	0.46	0.326	1.81
Second (11 th Grade) Math	5	1.56	0.09	2.01
Rheto (12 th grade) Math	14	-1.22	0.12	1.76
Philo (13 th Grade) Math	13	0.99	0.170	1.77
6 ^{eme} (7 th Grade) Science	12	-1.74	0.053	1.78
7 ^{eme} (8 th Grade) Science	8	-1.50	0.08	1.85
8 ^{eme} (9 th Grade) Science	16	-1.67	0.056	1.74
9 ^{eme} (10 th Grade) Science	11	-1.08	0.150	1.79
Seconde (11 th Grade) Science	14	0.25	0.40	1.76
Rheto (12 th Grade) Science	16	0.49	0.32	1.74
Philo (13 th Grade) science	14	-1.27	0.111	1.76

Results of ANCOVA between Means of Math Post-Test Scores per Grade Level

ANCOVA analysis was conducted to evaluate the difference between post-test scores of French and Kreyol condition groups of this research study. The null hypothesis was that there is no significant effect of language of post-test scores controlling for pre-test scores. Analysis yielded results that reject the null hypothesis, demonstrating that there are significant differences between post-test scores from French condition group to Kreyol condition group for the following groups: seventh grade math (Table 8), ninth grade math (Table 10), tenth grade math (Table 11), eleventh grade math (Table 12), and twelfth grade math (Table 13). The results confirm the H1 hypothesis which predicted a significant difference in post-test scores for the groups stated above which used Kreyol as a medium of instruction.

Furthermore, the ANCOVA analysis of math test scores demonstrated that there was no significant effect of using Kreyol as the language of instruction on math post-test scores after controlling for pre-test scores for the following groups: eighth grade math (Table 9) and thirteenth grade math (Table 14) as the P-value was greater than 0.05.

Table 8. ANCOVA Results Math 6eme (7th grade)

Source	SS	df	MS	F	P-value
Between Groups	2943.937	1	2943.94	5.491773318	0.035658
Within Groups	536.063	13	41.24		
Total	3480				

Table 9. ANCOVA Results Math 7^{eme} (8th grade)

Source	SS	df	MS	F	P-value
Between Groups	6961.482916	1	6961.48	3.492977	0.082694393
Within Groups	1992.994408	14	142.36		
Total	8954.477324				

Table 10. ANCOVA Results Math 8^{eme} (9th grade)

Source	SS	df	MS	F	P-value
Between Groups	16023.6463	1	16023.65	4.36015	0.057031
Within Groups	3675.021443	13	282.69		
Total	19698.66774				

Table 11. ANCOVA Results Math 9^{eme} (10th grade)

Source	SS	df	MS	F	P-value
Between Groups	2676.816	1	2676.82	4.990717794	0.039206
Within Groups	536.359	17	31.55		
Total	3213.175				

Table 12. ANCOVA Results Math Seconde (11th grade)

Source	SS	df	MS	F	P-value
Between Groups	3200.282	1	3200.28	4.775461033	0.045145
Within Groups	670.1515	15	44.68		
Total	3870.434				

Table 13. ANCOVA Results Math Rheto (12th grade)

Source	SS	df	MS	F	P-value
Between Groups	8775.829	1	8775.83	4.941866662	0.042005
Within Groups	1775.813	15	118.39		
Total	10551.64				

Table 14. ANCOVA Results Math Philo(13th grade)

Source	SS	df	MS	F	P-value
Between Groups	3310.867617	1	3310.87	1.031092	0.343707259
Within Groups	3211.029321	7	458.72		
Total	6521.896938				

Results of ANCOVA between Means of Science Post-Test Scores per Grade Level

ANCOVA analysis was conducted to evaluate the difference between science post-test scores of French and Kreyol condition groups of this research study. The null hypothesis was that there is no significant effect of language of post-test scores controlling for pre-test scores. Analysis yielded results that reject the null hypothesis, demonstrating that there are significant differences between post-test scores from French condition group to Kreyol condition group for the following groups: seventh grade science (Table 15), eighth grade science (Table 16), tenth grade science (Table 18), and eleventh grade science (Table 19). The results confirm the H1 hypothesis which predicted a significant difference in post-test scores for the groups stated above which used Kreyol as a medium of instruction. Furthermore, the ANCOVA analysis of science test scores demonstrated that there was no significant effect of using Kreyol as the language of instruction on science post-test scores after controlling for pre-test scores for the following groups: ninth grade science (Table 17), twelfth grade science (Table 20), and thirteenth grade science (Table 21) as the P-value was greater than 0.05.

Table 15. ANCOVA Results Science 6^{eme} (7th grade)

Source	SS	df	MS	F	P-value
Between Groups	3807.28	1	3807.28	4.715155609	0.039592
Within Groups	807.4559	25	32.30		
Total	4614.736				

Table 16. ANCOVA Results Science 7^{eme} (8th grade)

Source	SS	df	MS	F	P-value
Between Groups	9491.48654	1	9491.49	8.052531912	0.008885922
Within Groups	1178.69592	25	47.15		
Total	10670.1825				

 Table 17. ANCOVA Results Science 8^{eme} (9th grade)

Source	SS	df	MS	F	P-value
Between Groups	773.33756	1	773.34	4.172529583	0.055209225
Within Groups	185.340222	19	9.75		
Total	958.677782				

 Table 18. ANCOVA Results Science 9^{eme} (10th grade)

Source	SS	df	MS	F	P-value
Between Groups	2947.01	1	2947.01	5.212278096	0.03557
Within Groups	565.3976	17	33.26		
Total	3512.407				

 Table 19. ANCOVA Results Science Seconde (11th grade)

Source	SS	df	MS	F	P-value
Between Groups	5354.64	1	5354.64	5.993162721	0.029318
Within Groups	893.4582	13	68.73		
Total	6248.098				

 Table 20. ANCOVA Results Science Rheto (12th grade)

Source	SS	df	MS	F	P-value
Between Groups	35.43265	1	35.43	0.004242	0.948931
Within Groups	8353.278	15	556.89		
Total	8388.711				

 Table 21. ANCOVA Results Science Philo (13th grade)

Source	SS	df	MS	F	P-value
Between Groups	909.7219	1	909.72	0.195588434	0.664616
Within Groups	4651.205	15	310.08		
Total	5560.927				

Detailed Analysis of Quantitative Data

The following section aims to provide an in-depth description of the analysis of the quantitative data. It delineates the various methods used to evaluate the data gathered from the pre and post-test scores of French condition and Kreyol condition groups participating in this research study.

Dispersive Tendency of Pre-Test Scores

To begin the analysis of collected data, the researcher calculated the mean of pre-test scores for the two groups, French condition and Kreyol condition to compare the center values of both groups and observe how similar or different they are from each other. The researcher then calculated the standard deviation in order to measure the dispersive tendency of the data in each group. A smaller standard deviation means that the variance within the group was small. To estimate the variability between the means of the two groups if repeated samples from the same population were taken, the standard error of the means was also appraised. A smaller standard error of the mean value demonstrated a more accurate measurement of the population mean. In this case, the descriptive statistics of the pre-test scores of French condition (Table 1) and Kreyol condition (Table 2), specifically the skew and kurtosis values, supported a judgment of normal distribution as the skew was less than 1 and the kurtosis less than 7 for both French condition and Kreyol condition groups.

t-Test of Pre-test Scores

Since both groups demonstrated normal distribution, hence fairly equal variances, the data were evaluated using a t-Test two samples assuming equal variances between the pre-test scores of both French condition and Kreyol condition groups for each class (Table 5). The goal of this analysis was to further look into any significant differences in variance in pre-test scores of both samples. A significant difference in means of the pre-test scores would mean that sample is not representative of the population. In this sense, the lower the significance level, the more confident the researcher could be about the replication of the results of the research study. The hypothesis for this analysis was that the p-value is greater than 0.05 and would demonstrate that samples essentially started at the same level. A p-value greater than 0.05 would also demonstrate that the difference between the means of the two samples were

not significant enough to say that some other characteristics such as teaching method, teacher, or gender could have caused the difference in means of post-test scores. t-test analysis yielded a p value less than 0.05, which demonstrated that the variances between the French condition and Kreyol condition groups are different.

If groups demonstrated an abnormal distribution then an ANOVA Single Factor test, which is equivalent to a Levene's test used to assess equality of variances between two groups, was run to check if the variances were the same in both French and Kreyol condition groups. This test established a normal distribution if P-Value > 0.05 and demonstrated that variances, although existing, were the same between the two groups' pre-tests. The French condition groups that demonstrated an abnormal distribution were the seventh grade and tenth grade math, seventh, eighth, and twelfth grade science.

Upon analysis through ANOVA Single Factor test all groups demonstrated a P-value > 0.005 hence establishing that any significant difference detected between French condition and Kreyol condition groups scores were due to language used with participants and not to differences in participant's abilities or other criteria. The Kreyol condition groups that demonstrated an abnormal distribution were further analyzed using ANOVA Single Factor test as well. All groups but the eleventh grade math group demonstrated a p-value > 0.05.

To address this result, the researcher rejected outlier scores, the values that were much larger or smaller than the majority of data values collected. The data sets that fit the outlier criteria were found first by putting the data values in order from least to greatest and calculating the median of the data sets. Then Excel formulas were used to calculate the lower (Q1) and upper (Q3) quartile of the data sets. From the quartile calculations, the observer calculated the interquartile range (IQR) which is the range from the first or lower quartile to the third or upper quartile. The IQR is crucial to setting the boundaries within which non-outlier data values will fall. Further Excel calculations provided the upper ($Q3 + (1.5 * IQR)$) and lower ($Q1 - (1.5 * IQR)$) boundaries.

Finally, the Excel Outlier formula was used to see which data values do not fall within the calculated boundaries, the outliers. Once outlier values were rejected, the researcher ran descriptive statistics on remaining data sets. Again, the researcher looked for kurtosis and skew values to fit the requirements of equal variances between pre-test scores for both French

condition and Kreyol condition groups ($skew < 1$, $kurtosis < 7$). Descriptive statistics demonstrated that data from both groups were normally distributed. As such, the researcher ran a t-test with the hypothesis that data would demonstrate that variances between groups were equal if the p-value is greater than 0.05 (Table 7).

ANCOVA of Post-Test Scores for Both Groups

ANCOVA was used as one of the data analysis tools as it controls for pre-test values and allows for observation of post-test scores to see if there was a significant difference between the French condition or standard and Kreyol condition groups. In this sense, ANCOVA eliminated any difference between groups before the experiment in order to test for which language was more effective in teaching math and science. The hypothesis for this analysis was that the p value was smaller than 0.05 and demonstrated that samples essentially were not at the same level and that the difference between the means of the two samples were significant enough to say that the difference in the language used for instruction caused the difference in means of post-test scores. For the ANCOVA calculations, the pre-test scores were used as a covariate to be removed as an antecedent variable and allowed researcher to look at post-test values and assess any significant differences between performance of French condition and Kreyol condition groups.

Assumptions were checked to ensure that covariate met requirements to run ANCOVA. In order to meet criteria for ANCOVA, French condition and Kreyol condition pre-test data values could not demonstrate significant difference between them, if insignificant difference p-value > 0.05 was demonstrated then the covariate met the requirements for homogeneity of regression and data was ready to be used in ANCOVA testing. Hypothesis for ANCOVA: students with like aptitude were expected to score higher on post- tests when Kreyol is used as the language for instruction.

Subsequently, researcher compiled the math post-test scores for both French condition and Kreyol condition groups per grade level as the y value and ran a Single Factor ANOVA test to obtain $SS_{total(Y)}$, $SS_{within(Y)}$, and $SS_{between(Y)}$ values, then the same was done for pre-test scores, the covariate variable, to obtain $SS_{total(X)}$, $SS_{within(X)}$, and $SS_{between(X)}$ values. These values were then used to compute $(adjusted)SS_{within(Y)}$ and $(adjusted)SS_{between(Y)}$ and were arranged in the ANCOVA output data table per grade which served as a means to calculate the p value

for the data set. Tables 8 through 14 display the results of the ANCOVA test using Single-Factor ANOVA in Excel per grade level for math groups.

Analysis yielded results that reject the null hypothesis, demonstrating that there are significant differences between post-test scores from French condition group to Kreyol condition group for the following groups: seventh grade math (Table 8), ninth grade math (Table 10), tenth grade math (Table 11), eleventh grade math (Table 12), and twelfth grade math (Table 13). The results confirm the H1 hypothesis which predicted a significant difference in post-test scores for the groups stated above which used Kreyol as a medium of instruction. Furthermore, the ANCOVA analysis of math test scores demonstrated that there was no significant effect of using Kreyol as the language of instruction on math post-test scores after controlling for pre-test scores for the following groups: eighth grade math (Table 9) and thirteenth grade math (Table 14) as the P-value was greater than 0.05.

In addition, a Single Factor ANOVA was run on the science post-test scores for French condition and Kreyol condition groups to obtain $SS_{total(Y)}$, $SS_{within(Y)}$, and $SS_{between(Y)}$ values. Then, the same was done for pre-test scores, the covariate variable, to obtain $SS_{total(X)}$, $SS_{within(X)}$, and $SS_{between(X)}$ values. These values were then used to compute $(adjusted)SS_{within(Y)}$ and $(adjusted)SS_{between(Y)}$ per grade level and were arranged in the ANCOVA output data table (Tables 15 through 21) which served as a means to calculate the p value for the data set.

Tables (15 through 21) display the results of the ANCOVA test using Single-Factor ANOVA in Excel and demonstrates that there are significant differences between post-test scores from French condition group to Kreyol condition group for the following groups: seventh grade science (Table 15), eighth grade science (Table 16), tenth grade science (Table 18), and eleventh grade science (Table 19). The results confirm the H1 hypothesis which predicted a significant difference in post-test scores for the groups stated above which used Kreyol as a medium of instruction. Furthermore, the ANCOVA analysis of science test scores demonstrated that there was no significant effect of using Kreyol as the language of instruction on science post-test scores after controlling for pre-test scores for the following groups: ninth grade science (Table 17), twelfth grade science (Table 20), and thirteenth grade science (Table 21) as the P-value was greater than 0.05.

Summary of the Qualitative Results

Data from group interview were compiled in Excel using priori codes that served as major categories from which associated concepts were drawn. Data from student perception questionnaires were also gathered and coded using recurring themes from responses. This section summarizes the results of the qualitative data of the research study.

Student Group Interview Results

Three student volunteers from each grade levels were interviewed using an eight question interview protocol, found in Appendix B, containing questions on language learning history, perception of use of French versus Kreyol as a teaching medium, and students' experiences with both languages. Data collected from student group interview demonstrated that the majority of students interviewed perceived that the first language they were exposed to was Kreyol almost unanimously (17 out of 20 participants) (Table 22). Participants also deemed that their first exposure to French was in school and that this is also one of the only places that they use French. A student in the seventh grade added, "that's why I was sent to school, so I could learn French."

Furthermore, fifteen of the twenty participants disclosed, with some reserve, that they were the only person who could speak French in their homes. A student in the ninth grade timidly stated that "of all the people in my family, I am the only who speaks French at home." This last statement validates data that ascertains that the majority of the Haitian population is monolingual Kreyol speaking (Byrne & Holm, 1993). When asked which language does you feel will take you to a higher academic level and why, students felt that French would help them achieve success much faster and a student from the twelfth grade exclaimed:

even if I'm not saying anything smart in French, speaking it already makes me smart, even here, some teachers will not even give me the time of day if I address them in Kreyol, can you imagine at university level?

When asked to explain her comment she added, "I could be the smartest person in a room, but if I'm expressing myself in Kreyol, I will be seen as uneducated, like I never attended school."

Table 22. Student Interview Results

Major Categories	Associated Concepts
Language exposure/learning	<ul style="list-style-type: none"> • First language exposed to was Kreyol • Learned French in school • I'm the only who speaks French at home • I speak French only at school • Mastery in Kreyol/ still learning French • Don't always understand French • Think in Kreyol and translate in French
Learning in French vs. Kreyol	<ul style="list-style-type: none"> • Teacher will not pay attention to me if I ask a question in Kreyol • More at ease expressing myself in Kreyol • More interaction in Kreyol • Comfortable in both languages • Felt good expressing myself in Kreyol • Understood better when Kreyol was spoken • In Kreyol I felt better explaining things • Uncomfortable at first because we are not allowed to speak Kreyol in school • Interaction is vulgar in Kreyol • Kreyol is more helpful to understand and explain but French has more value • Words came more rapidly in Kreyol
Viability of Kreyol in academia	<ul style="list-style-type: none"> • Kreyol can serve as a standard to meet students' needs • Kreyol could be used but it's better to use French • People that speak Kreyol seem uneducated • Some concepts cannot be expressed in Kreyol • Using French is more helpful in getting ahead • Not enough resources in Kreyol • All my books are in French

Students' perception of differences in learning when course was taught in French versus Kreyol also confirms data connecting French mastery with economic success in Haiti as students confirmed that although they understood better and more rapidly in Kreyol, the use of French made them seem more educated and ensured that they would experience social mobility due to its use (Gibson, 2011). One student said "Ma'am, you know that if I walk

into a place of business and speak Kreyol, the owner will automatically know I don't have money." Another student added that "she could not go anywhere with Kreyol." When asked to clarify this statement she added, "yes learning in Kreyol would be easier for me, but I was sent to school to learn French so that people know I'm educated and give me respect."

Participants also noted that they initially felt uncomfortable speaking Kreyol to the instructor as it is forbidden to use this language in school. One student in the seventh grade stated that, "Although I understand faster in Kreyol, if I speak Kreyol to my teacher, I will be disrespecting him." Participants spoke to the increase in comfort level when they were allowed to express themselves in Kreyol. One participant further affirmed that when speaking in Kreyol, instructors do not pay attention to her confirming Degraff's contention that Haitian schools have played a role in degrading the Kreyol language.

Student Perception Questionnaire Results

Appendix C presents the data gathered and analyzed from student perception questionnaires. The questionnaire was comprised of eighteen questions and students were provided a scale with which to answer. A Likert scale was used for participants to choose their level of agreement with the eighteen questions on the form. The questionnaire sought data on how the students perceived the use of Kreyol versus French in the academic world and in the professional world.

The data demonstrated that although the majority of students felt more comfortable, learned more rapidly, and expressed themselves more confidently in Kreyol, French was deemed more valuable in and beyond school. Although fifty six percent of the seventh graders agreed that they expressed themselves better in Kreyol and translated their thoughts from French to Kreyol, fifty percent of the same students, fifty six percent of eighth graders and fifty percent of eleventh and twelfth graders felt that studying in Kreyol would not earn them any respect. Sixty three percent of seventh and tenth graders and seventy five percent of ninth graders strongly agreed that parents stressed the importance of French beyond school whereas sixty three percent seventh graders strongly disagreed that parents stressed importance of Kreyol beyond school. The data also circumstantiated the idea that Kreyol was not important for academic or social advancement. The highest percentage of students that agree that Kreyol was important for advancement of careers was found in the tenth-grade responses with only

twenty five percent whereas forty four percent of thirteenth graders strongly disagreed that Kreyol was important for their career.

Data confirmed that although (sixty three percent of eleventh grade) students stated that they did not experience anxiety when they used French to answer questions in class, they strongly agreed that they (seventy five percent) felt more confident expressing themselves in Kreyol. Furthermore, about twenty percent of students all students surveyed felt that French-speaking teachers were better than those that spoke Kreyol. Data further demonstrated that although less than half of participants believed that Kreyol was needed for their career of choice an almost equal number of students wish that they had more access to resources in Kreyol.

Notably, more than half of the participants disagreed that parents stressed the importance that French will have for them beyond school. Close to sixty percent of participants confirmed that they thought in Kreyol and translated data into French in order to answer questions in class. More importantly, almost seventy percent of participants felt that studying in Kreyol would not earn them any respect.

Chapter 4 Summary

This chapter disclosed the analysis and conclusions that emanated from this research study. The aim of the research study was to look into significant differences in student performance when they were taught math and science in French versus Kreyol. There were 139 participants, pulled from a population of 246 girls at Institution X, grouped randomly into French condition and Kreyol condition groups. The sample participated in twenty-eight sessions composed of a pre-test, lesson, and post-test each. The French condition groups were taught math and science in French and the Kreyol condition groups in Kreyol.

Descriptive statistics of pre-test scores for French condition and Kreyol condition yielded data that was not normally distributed. Thus, outliers were rejected and descriptive statistics were once more conducted. These results yielded a normal distribution.

Then, t-test between the means of the pre-test scores was conducted assuming equal variances. The results demonstrated that there were no significant differences between the pre-test scores of the French condition and Kreyol condition groups. Next, ANCOVA

analysis calculations demonstrated a significant difference between pre and post-test scores for five out of the seven math groups and four of the science groups.

Citation

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CHAPTER 5: IMPLICATIONS FOR THE EFFECTS OF MOTHER TONGUE ON MATH AND SCIENCE INSTRUCTION

The purpose of this study was to determine the effects of using Kreyol versus French as the instructional language on math and science performance. The research was designed as a quasi-experimental study, which used the nonequivalent French condition group design with pre-test and post-test for a treated and comparison group to collect data from the participants. Quantitative data from pre-and post-tests were gathered and measured using Paired t-test and ANCOVA to determine whether the alternative hypothesis would be proven. The alternative hypothesis would be proven if the mean of post-tests of sample 2 (group taught in Kreyol) were greater than that of sample 1 (students taught in French).

This chapter provides a summary of the results of the analysis of the data collected for the research study. It discusses the results in terms of statistical significance and in relation to the literature review. This chapter further provides limitations of the research study and possible obstacles that may make it difficult to generalize its results. It also considers the implications of the results of this study for the Haitian education system and provides suggestions for future research.

Summary of the Results

Descriptive statistics of pre-test scores for French condition and Kreyol condition yielded data that did not demonstrate normal distribution. To further determine the significance of the differences between the pre-test scores of French condition and Kreyol condition groups an ANOVA single factor test was conducted. If results yielded a p-value greater than 0.05, then this meant that although there were differences between pre-test scores of French condition and Kreyol condition groups, these differences were similar between the groups; this establishing a normal distribution. Results for some of the grades yielded a p-value smaller than 0.05 (Table 5).

To address these results, outliers that may have skewed the results as they were either too far right or left of the mean scores of French condition and Kreyol condition groups were rejected and descriptive statistics were once more conducted. These results yielded a normal distribution. The researcher proceeded with a t-test between the means of the pre-test scores assuming equal variances. The results demonstrated that there were no significant differences between the pre-test scores of the French condition and Kreyol condition groups as the p-value was greater than the hypothesized p-value of 0.05 (Table 7).

For the ANCOVA calculations, the pre-test scores were used as a covariate to be removed as an antecedent variable and allowed researcher to look at post-test values and assess any significant differences between performance of French condition and Kreyol condition groups. Assumptions were checked to ensure that covariate met requirements to run ANCOVA. To meet criteria for ANCOVA, French condition and Kreyol condition pre-test data values could not demonstrate significant difference between them. Indeed, t-test of pre-test scores demonstrated an insignificant difference p-value >0.05 proving that this covariate met the requirements for homogeneity of regression and data was ready to be used in ANCOVA testing. Hypothesis for ANCOVA: students with like aptitude were expected to score higher on post- tests when Kreyol is used as the language for instruction. ANCOVA analysis calculations demonstrated a significant difference between pre and post-test scores for five out of the seven math groups and four of the science groups.

Discussion of the Results

The objective of this research study was to determine any significant difference in students' performance in math and science when they were taught in Kreyol as opposed to French. To concretely determine such differences, a statistical analysis was conducted using various measurement instruments such as t-test, ANOVA, and ANCOVA. The data collected from pre-tests provided to both French condition and Kreyol condition groups were first analyzed to ensure that students did not present significant variances before participating in the intervention. The reason this analysis was important was to establish that both groups started at essentially the same level of understanding. Preliminary results from the descriptive statistics of pre-test scores were not normally distributed, thus outliers were rejected, and

further testing was conducted on data. The results supported a judgment of normal distribution as the skew was less than one and the kurtosis was less than 7.

As both groups demonstrated a normal distribution, a T-test between the pre-test scores was conducted and results yielded a p-value greater than 0.05. This result provided evidence that although the French condition and Kreyol condition groups may have shown differences in their pre-test scores, these variances were normally distributed, essentially meaning that both groups displayed equal variances thus started out from the same level of understanding. The results were very significant to the validity of the study as it was important to show that students participating in the research displayed like abilities to start out with so that any difference in the post-test scores could not be associated with differences in capability, or strength, or level of understanding.

Once it was established that the pre-test scores for both French condition and Kreyol condition groups were normally distributed, an ANCOVA test was used on post-test scores of both French condition and Kreyol condition groups to eliminate any differences that may have existed in pre-test scores to test for which language was more effective in teaching math and science concepts. In this sense, ANCOVA for pre-test values and allowed the researcher to determine any significant differences between post-test scores of French condition and Kreyol condition groups. Essentially the hypothesis for the ANCOVA analysis was that students with like aptitude are expected to score higher on math and science post-tests when Kreyol is used as the language for instruction. The results of the ANCOVA demonstrated a significant difference between pre and post-test scores for five out of the seven math groups and four of the science groups.

Discussion of the Results in Relation to the Literature

The issue with the language used in Haitian classrooms stems from the fact that the majority of students are being taught in a language that they do not master. Research states that as much as 85% of the Haitian population are monolingual Kreyol speakers (Byrne & Holm, 1993). This means that 85% of this population cannot be expected to perform well in schools that are taught in a language that is foreign to it. The issues with the language used in Haitian schools further affects society as ineffective education leads to negative economic growth (Hebblethwaite, 2012). Facing these results provided the researcher with an opportunity to

bring awareness to the crucial role which language plays in the effective functioning of Haitian society. However, the research was lacking in terms of statistical data based on the role of Kreyol in bringing about improvements in the Haitian education system.

Other countries had experimented with similar issues and provided a foundational literature on which the researcher would build the hypothesis and experimental procedures for the study. Research on acquisition of literacy states that children learn more effectively in their mother tongue (Spears, 2010). Further studies as such conducted by Degraff (2014) and Bühmann & Trudell (2008) provided additional proof of the importance of using native language as the most effective tool for acquisition of academic knowledge.

Faced with this data, the researcher decided to design an experiment that would determine the differences in acquisition of math and science concepts when Kreyol and French were used as the medium for instruction. The results from this quasi-experimental study provided data that aligned with the literature review and demonstrated that there was in fact a significant difference in performance when Kreyol was used as a medium for instruction instead of French.

Limitations

Although the results from the research demonstrated a positive relationship between higher performance and use of Kreyol as a teaching tool, they may pose limitations in generalizing the findings to the overall Haitian population. Another limitation of this study was that the participants were all females so that results may not draw similar conclusions in all-male or co-ed settings. A further limitation may stem from the fact that specific subjects were used in conducting the research. This may limit the generalizability to other subjects taught in the Haitian classrooms. Overall the limitations of this study have to do with generalizable conditions.

Implication of the Results for Practice

The results from this research study conceptually would contribute to the statistical literature that proposes the use of Kreyol in the classroom as a means to improve student performance in math and science classes. Along with the results of institutions like that of the

MATENWA school in La Gonave, which uses Kreyol as the medium for instruction “13 schools in the LKM network had significantly improved their national 6th grade exam passing rate. All 25 LKM students passed the Certificate 100%.” (Friends of MATENWA, 2014, para. 11), the results of the study provide supplementary evidence of the benefits of using students’ native language in the acquisition of science and math concepts in Haitian schools.

Recommendations for Further Research

The initially stated goal of this research study was to determine if there were differences in performance in math and science when Kreyol and French are used in a typical Haitian school. While literature is available on the importance of using Kreyol in Haitian classrooms, the statistical data providing proof of need to move to a bilingual system in schools is lacking. Whereas identifying the limitations of the study, it is worth noting that the results of this research study will contribute to the deficient statistical data available providing evidence of the importance of using native language in the Haitian educational system. However, to address the limitations of this study, further research is recommended. One of the recommendations would be to run a similar experimental design for a longer period and to conduct the research in various settings (all-male, co-ed institutions). Another recommendation would be to conduct the study at institutions serving different socio-economic populations. The school used for this study was a private, all-girl institution serving lower to upper middle-class students. It would be interesting to see results from public schools serving lower income students and private schools serving upper class families with highest incomes in Haitian society.

Conclusion

The main objective of this research study was to determine if there were differences in performance in math and science when Kreyol and French are used in a typical Haitian school. Although Kreyol is viewed as the language of the poor, it is the sole language that about 85% of the population has mastered (Byrne & Holm, 1993). As such, the research questions of this project not only had a potential impact on the existing educational system in Haiti but would also have a much larger reach as education is tied to economic growth (Hebblethwaite, 2012). The hypothesis to be tested was that there would be a significant

difference between post-test scores of students who were taught math and science concepts in Kreyol versus those taught in French. The results agreed with the hypothesis in that they demonstrated a positive covariance between language used, Kreyol, and higher performance on math and science post-test scores.

Although the study presented some limitations in terms of generalizable conditions, the data collected provides statistical confirmation of the positive effect of the use of native language in the acquisition of knowledge. This effect is of great importance as statistical data confirming the positive impact of the use of Kreyol on student performance is scarce. Further research involving students of diverse socio-economic backgrounds and genders would help to generalize findings to the population at large. Although the issue of which language to use in Haitian classrooms remains a controversial subject, statistical data would help to provide evidence for the move to establishing, at the very least, a bilingual system that would ensure that students acquire the concepts and skills on which to build a better future and in turn positively contribute to society at large.

Citation

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APPENDIXES

Appendix A. Student Perception Questionnaire

1. French speaking teachers are better than Kreyol speaking teachers

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

2. I don't get anxious when I have to answer a question in French

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

3. I would get nervous if I had to speak Kreyol to a teacher

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

4. I feel confident when I have to answer a question in Kreyol

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

5. Speaking Kreyol is important because I will need it for my career

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

6. I wish I could read textbooks, newspapers, and magazines in Kreyol

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

7. Speaking Kreyol in school makes me feel worried

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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8. My parents want me to speak Kreyol

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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9. My parents have stressed the importance that Kreyol will have for me when I leave school

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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10. My teachers feel more confident when explaining concepts in Kreyol

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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11. I don't understand when my teacher explains the lesson in Kreyol

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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12. I can express myself better in Kreyol

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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13. It embarrasses me to volunteer answers in French

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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14. The language I use to express my understanding in class determines how much I will participate

Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
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15. My parents have stressed the importance that French will have for me when I leave school

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

16. I tend to give up and stop paying attention when I don't understand my teacher's explanation in French

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

17. Studying in Kreyol is important because people will respect me if I can express myself well in Kreyol

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

18. I think in Kreyol and translate in French to answer questions in class

Strongly	Moderately	Slightly	Slightly	Moderately	Strongly
Disagree	Disagree	Disagree	Agree	Agree	Agree

19. Do you believe that Kreyol can be used as a standard to meet the classroom demands?

20. What do you think about the availability of learning resources in Kreyol?

21. How do you believe the use of Kreyol in the classroom affected your participation?

22. What are your thoughts on classroom interaction when Kreyol is used as the medium for instruction?

Appendix B. Participant Interview Questions

1. Can you talk about your language learning history?
2. When were you first exposed to each of the languages you speak?
3. In what context did you start learning each and how long did it take you to master (if you feel you've mastered any of these languages) each of these?
4. Do you feel that there is a difference between your ability within each of the languages you speak? Please describe the difference (s).
5. Describe in your own words the difference you experienced when the course was taught in French as opposed to Kreyol?
6. Was there a language that was more helpful in your acquisition of the concept presented? If so explain which one and how this language helped you to seize the concept more efficiently.
7. Do you believe that Kreyol is a viable academic language? Explain your choice.
8. Which language do you feel will take you to a higher academic level and why?

Appendix C. Student Perception Questionnaire Results

Q1. French speaking teachers are better than Kreyol speaking teachers

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	3	2	4	5	3	4	5
Moderately Disagree	3	1	2	0	0	2	1
Slightly Disagree	2	5	3	4	1	3	1
Slightly Agree	1	1	2	1	2	3	5
Moderately Agree	2	1	2	3	2	1	1
Strongly Agree	4	4	3	2	3	1	1
Undecided	1	2	0	1	3	2	2

Q2. I don't get anxious when I have to answer a question in French

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree					1	1	1
Moderately Disagree			5	1	1	1	1
Slightly Disagree		1	1	1	1	2	1
Slightly Agree	8	7	2	3	1	2	2
Moderately Agree	1	1	1	2	1	1	3
Strongly Agree	6	6	6	9	10	9	8
Undecided	1	1	1	0	1	0	0

Q3. I would get nervous if I had to speak Kreyol to a teacher

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	1	1	2	2	3	3	5
Moderately Disagree	2	2	1	1	1	1	
Slightly Disagree	1	2	2	2	2	4	4
Slightly Agree	1	1	1	1	3	4	4
Moderately Agree	1	2	2	3	4	1	1
Strongly Agree	10	8	7	6	2	2	2
Undecided			1	1	1	1	

Q4. I feel confident when I have to answer a question in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	2	1	2	2	1	1	1
Moderately Disagree		1	2	2	2	1	
Slightly Disagree		1	1	2	3	2	1
Slightly Agree	1	1	1	2	4		

Q4. I feel confident when I have to answer a question in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Moderately Agree	1	1	2	1	5		
Strongly Agree	10	7	8	6	1	12	14
Undecided	2	4		1			

Q5. Speaking Kreyol is important because I will need it for my career

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	1	3		1	1	1	7
Moderately Disagree	4	1	1	2	1	6	3
Slightly Disagree	3	6	4	3	4	2	2
Slightly Agree	2	3	2	2	1	1	1
Moderately Agree	4	1	6	4	7	5	1
Strongly Agree	1	1	3	4	2	1	1
Undecided	1	2					1

Q6. I wish I could read textbooks, newspapers, and magazines in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	7		4	4	1	2	1
Moderately Disagree	3	2	2	3	4	3	5
Slightly Disagree	2	4	1	2	3	2	1
Slightly Agree	1	3	4	1	2	1	2
Moderately Agree	1	2	1	2	4	1	2
Strongly Agree	1	2	3	2	1	1	4
Undecided	1	3	1	2	1	6	1

Q7. Speaking Kreyol in school makes me feel worried

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	3	2	2	7	3	4	1
Moderately Disagree	2	1	2	3	1	1	4
Slightly Disagree	1	4	2	2	6	3	3
Slightly Agree	2	1	2	1	3	5	1
Moderately Agree	2	3	2	1	1	1	2
Strongly Agree	2	1	2	1	1	1	3
Undecided	4	4	4	1	2	1	2

Q8. My parents want me to speak Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	3	8	3	10	7	6	9
Moderately Disagree	1	1	5	1	2	2	1
Slightly Disagree	6	1	2	1	3	2	1
Slightly Agree	3	1	1	2	2	2	2
Moderately Agree	1	2	3	1	1	2	2
Strongly Agree	1	3	2	1	1	1	1
Undecided	2					1	

Q9. My parents have stressed the importance that Kreyol will have for me when I leave school

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	10	9	7	7	8	8	6
Moderately Disagree	2	3	3	2	3	1	2
Slightly Disagree	2	3	2	3	3	1	2
Slightly Agree	1	1	1	2	2	1	2
Moderately Agree	1		1	1		1	3
Strongly Agree			1	1		3	1
Undecided			1				

Q10. My teachers feel more confident when explaining concepts in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	2	1	2	1	2	3	1
Moderately Disagree	1	2	2	1	3	2	
Slightly Disagree	3	3	1	1	1	1	2
Slightly Agree	1	1	3	1	1		
Moderately Agree	1	2	1	1	1	4	
Strongly Agree	9	7	7	11	8	6	13
Undecided							

Q11. I don't understand when my teacher explains the lesson in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	5	7	3	6	5	4	6
Moderately Disagree	5	2	1	4	6	5	4
Slightly Disagree	2	2	6	2	2	4	3
Slightly Agree	1	3	3	1	1	1	2
Moderately Agree	2	2	1	1	1	1	1
Strongly Agree	1		1	1	1	1	
Undecided			1				

Q12. I can express myself better in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	9	7	7	6	5	7	4
Moderately Disagree	3	4	3	4	6	4	3
Slightly Disagree	3	2	2	3	2	3	4
Slightly Agree	1	1	1	2	2		2
Moderately Agree		1	1	1	1	2	2
Strongly Agree		1	1				1
Undecided			1				

Q13. It embarrasses me to volunteer answers in French

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	3	2	2	3	1	2	2
Moderately Disagree	4	6	4	6	6	4	2
Slightly Disagree	5	3	6	3	3	5	5

Q13. It embarrasses me to volunteer answers in French

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Slightly Agree	1	2	2	1	2	2	3
Moderately Agree	2	1	1	1	1	3	1
Strongly Agree	1	1	1	1	2		1
Undecided		1		1	1		2

Q14. The language I use to express my understanding in class determines how much I will participate

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	3	5	2	1	2	1	1
Moderately Disagree	1	4	2	3	5	3	3
Slightly Disagree	6	3	3	4	4	4	2
Slightly Agree	3	3	3	3	2	2	3
Moderately Agree	1	1	2	2	1	2	2
Strongly Agree	1		3	2	1	3	3
Undecided	2		1	1		1	2

Q15. My parents have stressed the importance that French will have for me when I leave school

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	10	7	12	9	8	10	9
Moderately Disagree	3	5	1	3	4	2	5
Slightly Disagree	2	2	1	2	2	1	1
Slightly Agree	1	1	1	1	2	2	1
Moderately Agree		1	1	1		1	
Strongly Agree							
Undecided							

Q16. I tend to give up and stop paying attention when I don't understand my teacher's explanation in French

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	8	6	4	3	6	7	5
Moderately Disagree	4	4	4	1	3	3	6
Slightly Disagree	2	2	3	6	2	2	2
Slightly Agree	1	1	2	3	3	1	2
Moderately Agree	1	2	1	1	1	1	1
Strongly Agree		1	2	1	2	1	
Undecided				2	1	1	

Q17. Studying in Kreyol is important because people will respect me if I can express myself well in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	8	6	4	3	6	4	5
Moderately Disagree	4	3	4	4	3	4	3
Slightly Disagree	3	2	3	2	3	3	2
Slightly Agree	1	2	3	3	2	2	1
Moderately Agree		1	1	2	2	2	2

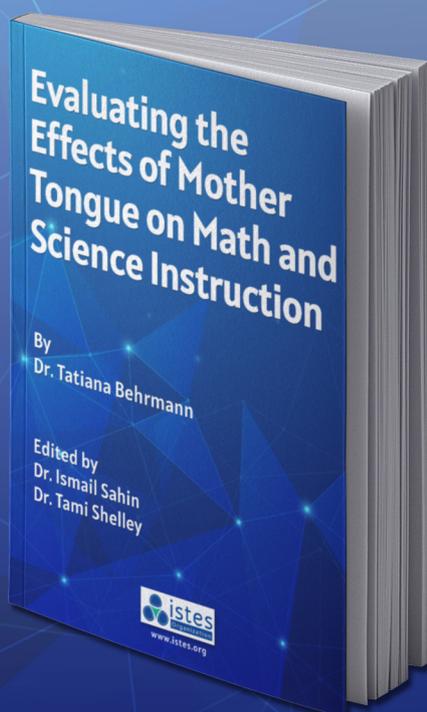
Q17. Studying in Kreyol is important because people will respect me if I can express myself well in Kreyol

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
7th Grade							
Strongly Agree		1	1	1		1	2
Undecided				1			1

Q18. I think in Kreyol and translate in French to answer questions in class

	7th Grade	8th Grade	9th Grade	10th Grade	11th Grade	12th Grade	13th Grade
Strongly Disagree	9	3	7	6	5	4	5
Moderately Disagree	3	1	3	4	3	5	3
Slightly Disagree	2	6	2	3	2	3	2
Slightly Agree	1	3	1	2	3	2	3
Moderately Agree	1	1	1	1	2	1	2
Strongly Agree		1	1		1	1	1
Undecided		2	1				

Although Kreyol is the language spoken and understood by the majority of Haitians, French is the language used as the medium for instruction. The use of a foreign language as a means for students to acquire literacy is a practice that has led to an ineffective educational system in Haiti. The aim of the quasi-experimental research study is to study the effects of using Kreyol versus French as the instructional method in math and science classes. Participants were selected from a target population of 246 girls at a private school. Students from this institution are part of the 29% of people who attend secondary schools in Haiti. The 139 students that were part of the sample were randomly divided into two groups per class (standard and Kreyol condition) and were given a pre-test followed by a lesson then a post-test. Students in the standard group were taught in French and those in experimental group in Kreyol. Data gathered from the intervention were analyzed and results indicated that pre-test scores of French condition and Kreyol condition groups were normally distributed. When ANCOVA was used as one of the data analysis tools, because it French conditions for pre-test values and allows for observation of post-test scores, results yielded confirmed a significant difference between the French condition and Kreyol condition groups. The results from this quasi-experimental study provided data that aligned with the literature review and demonstrated that there was in fact a significant difference in performance when Kreyol was used as a medium for instruction instead of French. The results further provide statistical data confirming the important role that Kreyol should play in the improvement of the Haitian education system.



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