

TEACHING LINGUISTICS &
LANGUAGE AND PUBLIC POLICY

**Kreyòl, pedagogy, and technology for opening up quality education in Haiti:
Changes in teachers' metalinguistic attitudes as first steps in a paradigm shift**

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We argue that local languages, coupled with modern pedagogy and technology, are necessary, though not sufficient, ingredients for universal access to quality education. Our case study is Haiti, where French is the primary language of school instruction, though it is spoken by only a small percentage of the population, while Haitian Creole (aka 'Kreyòl'), the language fluently spoken by all Haitians in Haiti, is mostly excluded from the formal discourse and written documents that create and transmit knowledge (and power) in schools, courts, state offices, and so forth. We first describe the historical, political, linguistic, and sociocultural backgrounds to such impediments to quality education in Haiti. Then we present and analyze data that begin to answer these two questions: (i) What does change look like in complex postcolonial contexts, especially change in educators' attitudes toward the use of stigmatized languages (such as Kreyòl) in formal education? (ii) How can local languages such as Kreyòl serve to enhance the promotion and dissemination of modern pedagogy and technology for STEM education, and vice versa—namely, how can STEM education, in turn, serve to enhance the promotion of stigmatized languages such as Kreyòl?*

Keywords: Haitian Creole, Creole languages, mother-tongue education, active learning, educational technology, human rights, STEM, social change

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The title of this article is inspired by Iiyoshi and Kumar's (2008) book *Opening up education*. Most of what we know about 'opening up' education through technology we have learned from Vijay and his team at MIT's Office of Digital Learning. We are grateful for Vijay's friendship, enthusiasm, and can-do attitude in the face of many challenges ... and opportunities, as Vijay would quickly add!

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1. INTRODUCTION. Nowadays the education-related literature gives many accounts of worldwide efforts to democratize education, not only in individual classrooms, but also on a larger scale via high-quality online platforms such as MITx and edX.¹ These efforts leverage technology and pedagogy to produce new ways of learning that were previously unavailable to most. Despite these well-intentioned efforts, an important barrier to such education remains: availability in most local languages. This raises two critical questions. (1) How can this technology-enabled education be made available to ALL around the world? (2) If this improved pedagogy and the related technology are made available in a broad diversity of local languages, how can teachers' attitudes be changed about the formal adoption of these languages in education, alongside the new pedagogy and technology—keeping in mind that negative attitudes resulting from colonial and neocolonial hierarchies have constituted a fundamental barrier leading to the exclusion of these local languages from the classroom?

In this article, we argue, based on our work in Haiti, that local languages, coupled with active-learning pedagogy and educational technology, are necessary, though not sufficient, ingredients for increasing access to quality education. We use Haiti as an example of a country struggling against a long history of exclusion and miseducation rooted in the linguistic preferences of those in authority, with these preferences influencing language attitudes nationwide. We posit that these challenges are not unique to Haiti, and that our work can inspire efforts by others to make high-quality technology-enabled education available to all around the world in spite of said challenges.

In Haiti, education (even traditional formal education, without modern technology) has never been available to all. This limitation is due to multiple socioeconomic and political impediments, including a well-entrenched language barrier that persists in spite of the existence of a language (Haitian Creole, a.k.a. 'Kreyòl') that, in law and in fact, should unite the entire population. Haiti's Constitution of 1987, though it declares both French and Kreyòl as 'official languages', rightly considers Kreyòl as the one single language that is spoken by all Haitians—thus, 'bonding all Haitians together'. In effect, then, there is no parity between the status of French and Kreyòl in Haiti, neither de jure (as in the Constitution) nor de facto (as in the actual use of the two languages by a population that is mostly monolingual in Kreyòl). But a basic paradox emerges in the fact that Haiti's sociolinguistic reality, as encouraged by the actual practice of those in authority, flatly violates what is rightfully prescribed by Haiti's constitution.

Let us flesh out this paradox at the core of miseducation, exclusion, and impoverishment in Haiti: French is fluently spoken by no more than 5% of Haiti's population, and perhaps as low as 3% if the benchmark for fluency includes the capacity to use spoken AND written French to comfortably converse on any familiar topic (cf. Saint-Germain 1997, Dejean 2006, 2010). Yet French is the primary language of school instruction (and of government, courts, formal business, print media, etc.). Kreyòl, the language fluently spoken by all Haitians in Haiti, is virtually excluded from the written documents that create and transmit knowledge (and power) in the aforementioned spheres—schools, government, courts, and so forth (see e.g. Dejean 2006).

Basic demographic facts about Haiti and well-documented findings in linguistics as well as in the science of education make a switch to Kreyòl as the primary language of instruction a long-overdue condition sine qua non for improving the country's education system. This language-and-education issue is at the core of our current work in Haiti.

Since its creation in 2010, a project named the 'MIT-Haiti Initiative'² has enlisted Kreyòl in the development of pedagogical resources in mathematics, physics, biology,

¹ <https://www.edx.org/school/mitx>; <https://www.edx.org>

² <http://haiti.mit.edu>

and biochemistry, with the recent addition of chemistry. The Kreyòl name given to these resources is *resous pou edikasyon san baryè*, that is, ‘resources for education without barriers’. The Initiative team translates into Kreyòl some of the innovative educational technologies that have been developed primarily at MIT; then we evaluate and disseminate these high-quality resources as tools for radically improving the educational system in Haiti. This is the first time that materials and technologies in Kreyòl have been made available in order to facilitate active learning in science, technology, engineering, and mathematics (STEM) at the university and high-school levels. Our hope is that this project and others like it will, in turn, strengthen Haiti’s prospects for economic development and provide a model for other communities that have been impoverished through linguistic and educational barriers.

Educational technology today (as in the aforementioned online platforms such as MITx and EdX) holds the promise of reaching beyond digital and socioeconomic divides, thus making quality education accessible to billions of students all over the world. However, in this article we evoke the (META)LINGUISTIC divide as well and ask how this particular divide can be bridged by changes in the use of, and in attitudes toward, the LOCAL language(s) spoken by students and their parents and peers, in their homes and communities.

Our broader concern is that, if designers of technology-enabled educational resources do not pay due attention to the world’s linguistic diversity (including ‘local’³ languages such as Kreyòl), quality education will not, and CANNOT, become available to all or benefit all to the same extent. Moreover, by ignoring the world’s linguistic (and cultural) diversity, we also miss out on the opportunity to understand different ways of learning and the opportunity to incorporate this diversity in our designs toward improved educational resources and pedagogies. Indeed, online learning offers a great opportunity for ‘a global laboratory for rigorous learning about learning’ (in the words of MIT President Rafael Reif⁴), and such a laboratory can be greatly enriched by the world’s cultural diversity—an additional opportunity not to be missed (Iiyoshi & Kumar 2008).

In light of the above concerns, this article addresses the ‘teaching linguistics’ theme of this section of the journal *Language* from a perspective that is broader than usual—a perspective that also addresses the themes of the ‘language and public policy’ section. Our focus here is not (only) on teaching linguistics, but it is a broader plea for linguistics to be leveraged toward improving the GENERAL practice of teaching in contexts where a deeply entrenched set of (meta)linguistic beliefs and attitudes have excluded or minimized the use of local languages, such as Creole languages. Often these beliefs, attitudes, and practices, alongside the concomitant stigmatization of certain local languages, are rooted in colonial and neocolonial patterns of exclusion and domination based on race, ethnicity, and class (see DeGraff 2005 for a case study with Kreyòl as its focus and DeGraff 2014 for a related comparative study on language and education in Latin America). In these postcolonial contexts, socially conscious linguists are invaluable in helping decolonize the corresponding teaching practices, thus making concrete contributions to the improvement of students’ learning gains via the use of these students’ native languages as indispensable tools for interactive pedagogy. Indeed, linguists have the relevant expertise and credentials to carry forward scientifically grounded arguments against linguistic discrimination and linguistic hegemony and in

³ We put ‘local’ in quotes to signal the fact that languages such as Kreyòl can, to some extent, be viewed as ‘international’. In fact, in the particular context of the Caribbean, Kreyòl is more ‘international’ than French. Indeed, Kreyòl is spoken throughout the Caribbean and in some cities in North America (Miami, New York, Boston, Montreal). Kreyòl also has a strong presence on social media. For example, its use in tweets coming from Haiti exceeds that of English and French (DeGraff 2016c, Scannell 2016, Ladouceur 2017b).

⁴ <http://web.mit.edu/communications/dev/facts/focus.html>

favor of linguistic equality, including the use of local languages in education, government, courts, and other domains where power is created and transmitted, and where respect of human rights demands the use of speakers' native languages.

These challenges set up the larger context and the structure for this article. We first describe the historical, political, linguistic, and sociocultural impediments to quality education for all in Haiti, and then describe the aspects of our education-related work that have addressed those challenges in Haiti. We present data and analyses that begin to answer these questions:

- What does change look like in these complex postcolonial contexts, especially change in EDUCATORS' attitudes toward the use of stigmatized languages (such as Kreyòl) in formal education? Given the historical background, this scenario toward change is a most challenging one. Here the focus is on a set of small, but crucial, ingredients in this change: mainly, shifts in TEACHERS' metalinguistic attitudes, and, secondarily, concomitant shifts in their knowledge base and teaching practices.
- How can local languages such as Kreyòl serve to enhance the promotion and dissemination of modern pedagogy and technology for literacy and STEM education, and vice versa—namely, how can literacy and STEM education, in turn, serve to enhance the promotion of stigmatized languages such as Kreyòl? What can linguists contribute to such enhancement processes? It is important to stress that the ultimate objective of our intervention, though it relies on fundamental linguistic findings about the nature and role of language in education, goes beyond language: our ultimate target is an improved education system through active-learning pedagogy and the use of technology. But the systematic use of the mother tongue is a NECESSARY ingredient for optimal access to efficient pedagogy and technology, hence the focus on Kreyòl and teachers' attitudes toward it as a first step in this process of change. Indeed, teachers' expertise and their metalinguistic attitudes, alongside availability and quality of education resources, are crucial factors in determining how students will, through their mother tongue, benefit from the corresponding pedagogy and technology.

Using Haiti as a case study, we thus discuss some of the initial effects of such use of local language (for greater access to quality education) on individual and systemic change within a developing country—with Kreyòl-related attitudes among STEM faculty providing the basic units of our analysis. We conclude with a broader recommendation for the use of three key vectors for quality education that can be accessible to all: (i) local languages, (ii) active-learning pedagogy, and (iii) educational technology.

2. IMPEDIMENTS TO EDUCATION IN HAITI.

2.1. HISTORICAL AND POLITICAL PERSPECTIVES: THE ELITES VS. THE MASSES. Haiti's national motto is *L'union fait la force*, which means 'Unity makes strength', evocative of the Haitian Creole proverb *Men anpil, chay pa lou* 'Many hands make light work'. This *L'union fait la force* motto comes from the Haitian Revolution in the eighteenth century, during which both the blacks and the mulattoes, both the enslaved and the free people of color came together to show the world that each person, no matter their race, ethnicity, language, or other accident of history, is indeed human and deserves freedom and equality. From this perspective, one can say that eighteenth-century Haiti is where the 'Black Lives Matter' movement first started, *avant la lettre*.

Indeed, the history of Haiti from the eighteenth century onward has involved a variety of preeminent personalities who have fought toward liberty and equality for all during a colonial period when Black lives were deemed to not matter at all. One of Haiti's

Independence War heroes, Jean-Jacques Dessalines, who became Haiti's first president (1804–1806), is a frequently mentioned example in the context of Black liberation movements. Dessalines is famous for his words and deeds in class- and race-based struggles around land ownership in post-independence Haiti, where landless blacks had to compete against mulattoes who were claiming land inheritance from their white-colonist fathers. Dessalines's response to these claims is one that school children in Haiti still have to memorize to this day: 'And the poor negroes whose fathers are in Africa, shall they stay with nothing!' (Casimir 2011:33). In any case, dire inequality, often with racial, ethnic, and linguistic dimensions harking back to colonial times, still exists in Haiti today. The majority of Haitians, most of them Black and primarily Kreyòl-speaking, are still struggling to get by, at the bottom of the pit of one of the highest levels of income inequity in the world. The *Boston Globe* addressed this inequality in an article published on January 31, 2010, about the aftermath of the earthquake in Haiti, with explicit comments about race, class, and economic opportunity:

The question now is whether the wealthy élite that controls the bulk of the economy will help rebuild Haiti and create a thriving middle class. Eighty percent of Haitians live in poverty, while a handful of often light-skinned descendants of the French, who ruled the country's coffee and sugar slave plantations until Haiti declared independence in 1804, and other groups control most of the wealth. (Sacchetti 2010)

2.2. SOCIOCULTURAL AND LINGUISTIC PERSPECTIVES: YON LEKÒL TÈT ANBA NAN YON PEYI TÈT ANBA 'AN UPSIDE-DOWN SCHOOL IN AN UPSIDE-DOWN COUNTRY'. Although the aforementioned *Boston Globe* article highlights some of the racial correlates of class differences in Haiti, it is not only 'light-skinned descendants of the French' who have placed barriers before the masses.⁵ Barriers have been created by the elites in general—whether they are light-skinned or of darker complexion, and wherever their ancestors hail from. Influential Haitians of diverse racial and ethnic backgrounds continue to place barriers before the masses, often unwittingly as a result of a social 'habitus' (in Pierre Bourdieu's sense) that has been seamlessly transmitted through centuries in homes and, especially, in the schools. As a result of this age-old 'habitus', French is de facto the single legitimate language for academic and socioeconomic success in Haiti, and Haitians who speak only Kreyòl are often considered to be inferior to Haitians who know how to speak French. For the latter, such fluency in French is usually gained either by life-long immersion in French from the womb onward, as a side effect of being born in French-speaking families, or through hard work in the few schools that can afford adequate French-language materials and the relatively rare teachers who are fluent French speakers.

A fundamental problem arises when Haitian children who do not speak French at home (the statistically most common case) are made to learn, at the onset, IN French, most often with teachers who themselves are not fluent in French. Well-documented demographic and sociolinguistic facts reveal that most children in Haiti have little, if any, opportunity to learn French in any systematic way, either at home or at school (Dejean 2006, GTEF 2010, Jean-Pierre 2016).

⁵ In Haiti, the interaction between race, skin color, and social class can prove quite subtle and complicated. Revolutionary peasant leader Jean-Jacques Acaau, from nineteenth-century Haiti, is often quoted for his insight on this issue: *Nèg rich se milat*, that is, 'A rich black is a mulatto', with the corollary that a poor mulatto is a black (see e.g. Trouillot 1994). For Acaau, wealth (or lack thereof) was more important than skin color in determining status as 'mulatto' vs. 'black'. Actually, Acaau's analysis is even more complex (and more interesting for our purposes here!), as he included EDUCATION as another factor in determining 'mulatto' status. He thought that illiterate Haitians, no matter their skin color, would not be perceived as mulattoes, and he wanted education for all peasants, independently of skin color (Trouillot 1994). Acaau understood the strong link between education and socioeconomic progress.

The following scenario was witnessed by the first author in 2011 during an instructional unit on natural sciences in a third-grade classroom in a public elementary school in La Gonâve, Haiti. The teacher wrote on the blackboard this multiple-choice question, in French: *Qu'est-ce qu'un arbre? Les arbres sont des: a) êtres vivants; b) êtres non-vivant [sic];⁶ c) êtres passédant [sic] des pieds*. The translation for this question is: 'What is a tree? Trees are: a) living beings; b) nonliving beings; c) beings "passedant" [sic] feet'.

The string *passédant* in this context does not represent any contemporary French word. So how did the teacher come up with the phrase *êtres passédant des pieds*? The teacher may have intended to write the French word *possédant* 'possessing', although he did not seem to notice the mistake when the (non)word *passédant* was pointed out to him. Where did the word *des pieds* 'feet' come from? Lastly, why would he write 'possessing feet' as one possible answer for the students to choose from, alongside 'living beings' and 'nonliving beings'?

An explanation becomes clear if we take into account the fact that the teacher is primarily a Kreyòl speaker with limited fluency in French. The Standard French equivalent for *orange tree* is *oranger*. But in Kreyòl, *orange tree* can be translated as *pye zoranj*. And *pye* in Kreyòl also means 'foot/feet'. Similarly, the Standard French equivalent for *plantain tree* is *bananier*, whereas in Kreyòl it is *pye bannann* (again, with *pye*). The Kreyòl equivalent to the French word *arbre* 'tree' is *pye bwa* (literally: 'foot wood'). Therefore, a Kreyòl-speaking teacher who knows these Kreyòl terms for 'tree', all of which include a Kreyòl word (i.e. *pye*) that also means 'foot', could conceivably ask students if a 'tree' could be DEFINED as something that possesses feet (*possédant des pieds*).⁷

Also noteworthy is the student's perspective in this scenario: one student selected the answer whereby trees are defined as *êtres NON-vivants* or NONliving beings. That student was asked by the first author in Kreyòl: 'A tree, is it alive or not alive?'. The Kreyòl verb *viv* for 'to live' was used: *Yon pye bwa, l ap viv oswa li p ap viv?* (literally: 'A tree, it lives or it doesn't live?'). The student thought about it and replied in Kreyòl: *Yon pye zoranj, li bay fèy, li grandi, li mourì. Ki fè l ap viv!* 'An orange tree produces oranges, it produces leaves, it grows, it dies. So, it is alive!'. In other words, once the student was asked the same question in Kreyòl, he understood that a tree is a living being, and he gave the correct response, though he had given an incorrect response to the corresponding question in French.

A linguistic analysis of this student's logic is germane to our claim that local languages are indispensable to deep learning, thus a necessary tool for democratic access to quality education. In Kreyòl the expression *kreyen vivan* (literally 'living Christian'), like the word *vivan*, is typically used to refer to human beings, and to HUMAN beings only. One can reasonably hypothesize that the student implicitly made a connection between the Kreyòl word *vivan* and the French word *vivant*—Kreyòl *vivan* and French *vivant* have the exact same pronunciation even though they have different spellings.⁸ Then the student concluded that, since a tree is not a HUMAN being, it is not a *vivan* (in the Kreyòl sense) and, therefore, not a *vivant* (in the Kreyòl-based interpre-

⁶ The correct spelling is *êtres non-vivants* with a plural 's' on both the noun *êtres* 'beings' and the adjective *non-vivants* 'nonliving'.

⁷ Alternatively, one could imagine that the teacher was attempting to have students be trapped by false cognates ('faux amis') in order to eventually correct them and have them understand the relevant lexical differences between Kreyòl and French. Yet the teacher did not bring this up in conversation with the first author about this multiple-choice quiz, so it is impossible to tell whether this alternative scenario is at all likely.

⁸ Kreyòl spelling is phonemic and does away with silent letters such as the *t* in French *vivant*.

tation of the French word *vivant*). Thus, the student chose the response that was logical to him as a fluent Kreyòl speaker: a tree is not an *être vivant* given his understanding of the Kreyòl word *vivan* and the Kreyòl phrase *kreyen vivan*, notwithstanding the semantic difference between Kreyòl *vivan* and French *vivant*, which he seemed to be unfamiliar with.

To summarize, the student's response, in all likelihood, was based on the lexical semantics of his native Kreyòl. Given that Kreyòl is the one language that he was immersed in, it is not surprising that he did not know that in French the word *vivant* can be used to refer to trees since it can be used to refer to human beings and other living beings. The student's (mis)interpretation can be considered a normal consequence of his communal and scholastic environments: most likely, he spoke only Kreyòl in most circumstances of his everyday life—at home, on the playground, at the market, at church, among friends, and so forth. He was a child in a community where the majority speaks Kreyòl only, a community in which the word *vivan* is used to describe PEOPLE, not trees.

The scenario described above illustrates the fact that in most of Haiti, teachers—in addition to students—demonstrate a limited knowledge of French. In this case and many others, teachers as well as students use their knowledge of the one language they speak fluently (i.e. Kreyòl) to design assignments or to respond to these assignments, even if the assignments themselves are written in some variety of French (see Dejean 2006 and Jean-Pierre 2016 for more data and analyses of similar paradoxes).

In his 2006 book written in Kreyòl, Dejean makes two very important remarks that are germane to our reflection. First, when we look at countries that have been independent for more than one hundred years, Haiti is one of the rare nations that have a national language (i.e. Kreyòl) spoken by all, yet that national language is not used by schools as the main language of instruction and examination. This exclusion of the national language irremediably undermines any nationwide sustainable access to quality education (cf. UNESCO 2006). Second, Dejean explains that this 'upside-down' use of French in Haiti blocks the country's development (see Walter 2008, Hebblethwaite 2012).

Among the several documents that were published by the Haitian government after the 2010 earthquake, one of them stands out because of its goal of diminishing social inequality and promoting Haiti's cultural values and heritage through education. In the 2010–2015 Operational Plan of the Ministry of National Education and Professional Training, the government announced the goal of 'balanced bilingualism' whereby the whole country would eventually become fluent in both French and Kreyòl.

Now, let us consider the fact that THE VAST MAJORITY IN HAITI SPEAK ONLY KREYÒL. Given such a sociolinguistic profile, coupled with abject poverty levels and other major challenges to development, for Haiti to become a country in which EVERYONE SPEAKS TWO LANGUAGES FLUENTLY seems like an insurmountable task. The challenge worsens when the primary language of instruction, examination, and administration (i.e. French) is one that most Haitians do not speak fluently. Unfortunately, despite multiple plans, documents, and official decrees promoting the use of Kreyòl, Haitian schools, by and large, continue to impose French as THE main language of instruction from kindergarten onward, even when the children do not have a chance of becoming fluent in French, and even when the teachers themselves do not speak French fluently. This use of French is a consequence and a reflex of the aforementioned premium that Haitian society accords French. Other publications (e.g. DeGraff 2005) have shown that such anti-Kreyòl attitudes are partly entrenched in publications by a broad variety of LINGUISTS working on Creole languages who, in the past two centuries, have ranked Creole languages as exceptionally 'lesser' on various developmental and structural grounds.

These linguists, whose writings have, in effect, lessened the importance of Creole languages, come from a wide range of ethnic backgrounds, from both Creole- and non-Creole-speaking communities, and from diverse theoretical perspectives (see DeGraff 2005 for details).

Furthermore, in many places in Haiti, students taking official exams do not have access to the Kreyòl versions of these exams. In instances when they do have access to the exams in Kreyòl, many prefer to take the exam in French, because they have already memorized the corresponding materials in that language. Typically students do not have access to a full range of books in Kreyòl, and especially not in science and mathematics at the more advanced levels. Very often, the only exams that students take in Kreyòl are the exams ABOUT Kreyòl as an object of study. For all of the other exams, the majority of students take them in French, which leads to their regurgitating French texts that they have memorized, often with little, if any, understanding.

In Haitian classrooms, Kreyòl-speaking students are still punished and humiliated (given a ‘symbol’⁹) when they speak Kreyòl—except in the courses where they are taught about Kreyòl. This practice, which reflects deeply entrenched anti-Kreyòl attitudes, interferes with the skills and creativity of Haitian students, especially those who come to school speaking Kreyòl only. Research shows that of ten children entering first grade, only one (10%) will finish school (GTEF 2010). Interestingly, 10% is one of the percentages that have been reported for the proportion of Haitians in Haiti who speak French, to various degrees, in addition to Kreyòl (Dejean 2010). The match between the reported percentage of (somewhat) bilingual students and those who finish school suggests that Haiti’s school system plays a powerful role in producing and reproducing socioeconomic inequalities through linguistic prejudices.

In Haiti, the use of French for ‘elite closure’ (in Myers-Scotton’s 1993 terminology) is one of the reasons for Haiti’s underdevelopment, just as in many other countries in Asia and Africa in similar situations—countries where schools do not make systematic use of the local languages spoken by the population (see e.g. Babaci-Wilhite 2014b). Studies have shown a substantial overlap between the set of underdeveloped countries and the set of countries in which the languages spoken at home by the students are not the ones used as primary languages of instruction in the schools (UNESCO 2006, Walter 2008, Hebblethwaite 2012). The schools’ exclusion of students’ home languages (as in the case of Kreyòl in Haiti) is also considered a violation of human rights in various United Nations conventions (see Babaci-Wilhite 2014b). A plea to the United Nations High Commissioner for Human Rights (DeGraff 2016a, 2017a) argues that the use of local languages in education is a necessary condition for the protection of children’s rights and for sustainable development (also see DeGraff 2010 and DeGraff & Ruggles 2014).

⁹ A ‘symbol’ (*senbòl* in Kreyòl) is a form of public punishment whereby students are given a symbolic item such as a tag to affix to their shirts or hang around their necks if they are caught speaking Kreyòl at school outside of the classes that teach Kreyòl orthography, Kreyòl composition, and so forth. (Note the paradoxical discrepancy between teaching/learning Kreyòl vs. teaching/learning IN Kreyòl.) The goal of the punishment is to humiliate the offending students and turn them into snitches who betray other Kreyòl-speaking students. The student given the ‘symbol’ needs to catch another student speaking Kreyòl in order to pass the symbol to the next victim. Teachers often ask students to keep lists of their peers who violate the no-Kreyòl policy. Such forms of repression and public humiliation as punishment exist in many Haitian schools despite ongoing efforts to promote the use of Kreyòl as language of instruction. It must be noted that this practice of the ‘symbol’ was inherited from the French, who also used it in the nineteenth and twentieth centuries in their efforts to eliminate regional languages such as Basque, Provençal, Breton, and Occitan.

3. INTERVENTIONS TO CREATE CHANGE. Educational research has provided a significant amount of evidence to show that superficial learning strategies such as memorization do not produce the sort of deep, sustained learning that can transfer across contexts (e.g. Marton & Säljö 1997, Prosser et al. 2000). Furthermore, and as already mentioned, it has been convincingly argued that countries that do not use their populations' native languages as generalized media of instruction are those with the worst records of academic achievement and worst levels of national development (Walter 2008). Thus emerges the transformative potential of Kreyòl-based and technology-enabled active learning for Haiti.

At its root, such transformation demands a change in attitudes among educators—a change that is necessary to modify the teaching- and language-related beliefs that were most likely inculcated by their own education. The next two sections (§§3.1 and 3.2) represent a chronological sequence of two education interventions in Haiti from 2010 to 2016. The first intervention, in 2010–2011, serves to document the crucial importance of the students' native Kreyòl toward achieving learning gains in literacy and mathematics. That initial intervention, at the elementary-school level where we worked directly with students, also highlighted the importance of directly targeting teachers and their trainers at the university level in order to better understand and help improve their metalinguistic attitudes and pedagogical practices. We then describe the second intervention in 2012–2016, along with data and analyses from 2013–2016 that trace changes in teachers' metalinguistic attitudes and use of active-learning pedagogy.

3.1. SUMMARY OF CONTRIBUTIONS TO THE MOTHER TONGUE BOOK PROJECT. In 2010, the National Science Foundation (NSF) funded the first author's project on reading, writing, mathematics, and science in Kreyòl at Lekòl Kominotè Matènwa (LKM), a primary school in Matènwa, La Gonâve. The study was inspired by a World Bank/USAid study that reported high failure rates among 2,515 children in first through third grades in eighty-four schools, 40% of them public. Nearly one half of the third graders in that study could not read one single word.

The study results showed that, with LKM students writing and reading their own books in their native Kreyòl, early-grade readers (fifty-five students from first through third grades) outperformed their counterparts in schools nearby and in schools funded by the World Bank. The World Bank study had also documented that reading and comprehension scores were up to five times higher for students who owned books. In 2011, LKM's third graders in the first author's study read an average of sixty words per minute, whereas their non-LKM counterparts' average was twenty-three words per minute, as reported in the earlier World Bank study. Unlike other teachers, LKM teachers used Kreyòl exclusively when children STARTED school, and introduced French in later grades (more details below). In a follow-up project funded by World Vision, LKM's Kreyòl-based approach was introduced to two cohorts of students in five nearby schools—approximately 220 students. When the project began, these two cohorts were in either first or second grade, and when the project ended, they were in either second or third grade, respectively. The results showed that in approximately one year, the non-LKM students were able to substantially reduce the gap vis-à-vis their LKM counterparts, thus illustrating the power of Kreyòl and active learning to improve reading gains (see DeGraff 2015b, 2017b for a comprehensive description of this study).

The results of this study also showed encouraging outcomes for the use of mother tongue, technology, and active-learning pedagogy for mathematics instruction. This was the first opportunity for both students and teachers at LKM to engage with technology-

enabled active-learning activities in their native Kreyòl. These activities were mostly based on ‘virtual manipulatives’—that is, interactive computer programs whereby students can manipulate virtual objects in order to understand mathematical operations such as addition, subtraction, multiplication, division, fractions, and place values. Such digital tools for interactive pedagogy in mathematics instruction were introduced, all in Kreyòl, to twenty-four fourth graders with the goal of making their learning of mathematics friendlier, easier, more dynamic, and more enjoyable, thus deepening their interest in the subject. This interest was even expressed through song and dance, in spontaneous outbursts of joyful enthusiasm on the part of some of the students.¹⁰ Exit interviews with both students and teachers suggested that, for the most part, the intervention contributed to self-pride and to a positive attitude toward mathematics as well as Kreyòl. The majority of the twenty-four students interviewed reported that Kreyòl materials helped them understand the information and improve their knowledge of mathematics. There were a couple of students, however, who would have preferred French as the language of instruction. These students stated that having the tools in French would help them learn FRENCH, and their explanation regarding their preference for French focused on their desire to learn FRENCH RATHER THAN LEARN MATH. This rationale reflects the superior prestige given to the use of French among much of Haitian society, including among the many parents who invest much of their meager resources into sending their children to school with the hope that they will learn French.

The teachers in this study reported that the intervention improved their understanding of concepts that they themselves had been struggling with, such as fractions and computation with time measurements. They also reported friendlier teacher-student relationships through collaborative play—all too rare in Haitian schools, whose modus operandi is usually authoritative, test-driven, and rote-based. The positive effect of such joyfully interactive Kreyòl-based pedagogy on the students’ learning gains and on their sense of pride and dignity cannot be easily measured by numbers. But what can be observed is the fact that the active-learning activities that were introduced in Kreyòl during the pilot in 2010 are still in use by students and teachers alike, including during summer camp activities.¹¹

DISCUSSION. The NSF-funded project summarized above was the first empirical study of Kreyòl-based and technology-enhanced interactive pedagogy in Haiti at any grade level. It is not surprising that the key outcomes of this project suggest that Kreyòl can indeed improve education in Haiti. Scholars who have done in-depth research in education have already shown that active learning helps students build knowledge (see Freeman et al. 2014 for a review). Such active learning, which can include observation, experimentation, and project- and inquiry-based collaborative tasks, helps students construct their own understanding of complicated concepts. Moreover, when students use their native language, or a language they already know, they have better opportunities to clearly express their ideas and to strengthen their linguistic competence. These students are then able to effectively report what they observe—to themselves, their peers, and their teachers—as they develop their scientific hypotheses and test those hypotheses for correctness and adequacy (see e.g. Webb 2010).

¹⁰ <https://youtu.be/CU4NuFcK8D0>

¹¹ See for example <https://youtu.be/XPNnpIePYa8>. Though the video is in Kreyòl, without subtitles, it does show that the children in the school still engage in the technology-enabled activities even during their summer vacation, as indicated in the English version of the description of this video.

This idea is worth stressing in the context of Haiti and other postcolonial communities where most formal teaching still happens in a language other than the students' native languages. It is crucial that pedagogical practice be based on active learning, including experimentation and collaboration, both of which call for the use of the language that the students are most fluent in. Typically this is the language that is spoken regularly in the students' homes and communities. Indeed, most scientific activities that children should master at school depend on children's ability to communicate clearly with themselves and with others. For that reason, science and mathematics classes should use questions, practical experience, observation, and experimentation that come from the students' own lives and communities. By using the language that they speak best, students are in a better position to share their lived experiences in the classroom, and to explain their ideas and exchange these ideas with other students, their teachers, and other people in their communities.

Furthermore, once the mother tongue is used to build the foundations of knowledge through active-learning methods in reading, writing, science, and mathematics, students can transfer that knowledge to any other language they learn subsequently—French, English, Spanish, or any other foreign language. There is an abundance of research that shows that students are better language learners when they have strong foundations in reading and writing in their native language (see Skuttnab-Kangas & Cummins 1998, Benson 2012 for overviews of that research).

In effect, the above-mentioned research provides a ready-made answer to educators and policy makers who are concerned about the fate of French in Haiti: quality education in Kreyòl is indispensable to the successful teaching of French to children who live in Kreyòl-speaking communities. From that perspective, teaching in French to Kreyòl-speaking children has drastically negative consequences on these children's mental well-being and on their learning gains, including the learning of French. In other words, Kreyòl (or 'Kreyolofoni') is the 'best friend' of an inclusive and respectful *Francophonie* movement in Kreyòl-speaking communities. The latter proposition, which is grounded in the aforementioned references, should come as a relief to francophile intellectuals and the many other advocates of French who, for much too long, have perceived any promotion of Kreyòl as a fatal threat to the vitality of French in Haiti.

The second intervention described in this article, to which we turn next, highlights the positive changes in attitudes among teachers toward Kreyòl. We then argue that such attitude changes are an indispensable first step toward improving access and quality for the whole of Haiti's education system.

3.2. THE MIT-HAITI INITIATIVE.

DESCRIPTION. At a 2010 symposium organized jointly by MIT and the Port-au-Prince-based Foundation for Knowledge and Liberty (FOKAL), MIT faculty with interests in global education, along with Haitian faculty, administrators, and entrepreneurs, identified high-priority goals for improving education in Haiti. Since then, an interdisciplinary team of educators and researchers from MIT and Haiti have been involved in the MIT-Haiti Initiative, a project funded by the NSF in 2012, to explore the use and benefits of Kreyòl as language of instruction, coupled with active-learning pedagogies and innovative digital AND nondigital resources for STEM education at high schools and universities in Haiti. The overarching goal of the Initiative is to create systemic change in Haiti's education system by providing three elements—Kreyòl-based materials, active-learning pedagogy, and innovative and accessible resources—to STEM faculty in universities and high schools. The target audience also includes fac-

ulty at teacher-preparation programs whose students (i.e. future teachers) can, in turn, make an impact at the primary levels of STEM education as well. In collaboration with educators from Haiti, the MIT-Haiti Initiative team has developed tools and methods that use Kreyòl for active learning through simulation, visualization, modeling, and virtual experimentation in science and mathematics in university and high schools. In order to achieve sustainable and systemic change in the Haitian education system, the MIT-Haiti Initiative also seeks to build capacity for the development of digital resources and other innovative materials for STEM education in Kreyòl. This focus on STEM is all the more important for Haiti given that STEM education is arguably one of the most important drivers of innovation and economic progress.

The resources—all in Kreyòl—at the core of the Initiative, along with evidence-based strategies to stimulate students' active learning, have been introduced through a series of faculty-development workshops that began in March 2012. To date, members of the MIT-Haiti Initiative have conducted seven workshops in Haiti. These workshops have enrolled a combined total of more than 250 faculty, university administrators, and government officials. Five additional workshops have been conducted by the 'Konbit MIT-Ayiti', an offshoot of the Initiative that is composed solely of Haitian educators based in Haiti. The Konbit (discussed below) is a key component of our efforts toward sustainability (i.e. for the Initiative to be eventually 'owned and operated' by and for Haitians in Haiti).

At these workshops in Haiti, most presenters (MIT faculty and staff) presented their materials in English, with verbal translation into Kreyòl, and all written materials were translated as well. One of the workshop leaders, Dr. Paul Belony (leader of the physics group), is a native Kreyòl speaker and presented directly in Kreyòl. The methods and resources that are introduced through the workshops help teachers become proficient in the theory and practice of active-learning pedagogy in STEM. Such objectives align with the goals of the 2010–2015 Operational Plan of Haiti's Ministry of National Education. For example, the Initiative has introduced tools in which teachers or students can do virtual genetic experiments, visualize proteins, visualize mathematical equations, and simulate physics experiments in electromagnetism, electricity, movement, and so forth. These technologies and other similar resources, available on the Internet or on USB drives, have given faculty and students in Haiti access to virtual laboratories on their own computers or on the computers of their classmates or colleagues.¹² In combination with evidence-based pedagogy, such resources belong to a class of materials that have been shown by education researchers (e.g. Freeman et al. 2014) to be effective for deep learning—as they afford students the opportunity to become actively engaged in their learning.

However, a significant aspect of this dramatic shift in educational praxis is the willingness of those in academia to endorse the use of a local language (i.e. Kreyòl) traditionally associated with nonformal contexts or lower social class. Another aspect of this shift requires the teachers to relinquish their role as the sole purveyor of knowledge in the classroom. Models of pedagogical conceptual change posit that the following attitudes must be present in order for teachers to even consider pedagogical change: (i) they first need to be dissatisfied with their current pedagogy; (ii) they need to view the change as intelligible; (iii) they need to view the change as plausible; and (iv) they need to view the change as fruitful (Thorley & Stofflett 1996). The next section of this article describes a

¹² A sample of these resources is available online on the website of the MIT-Haiti Initiative: <http://haiti.mit.edu/resources>.

gradual shift in faculty's attitudes toward using Kreyòl and active learning as part of the teaching of STEM subjects. This shift can be viewed as one outcome of our introduction of active-learning pedagogy with new technologies translated into Kreyòl. For this analysis, we use qualitative data collected during the period 2013–2016 (i.e. from the first four years of a five-year longitudinal study funded by the NSF).

THEORETICAL FRAMEWORK. From a professional-development perspective, Desimone's (2009) conceptual framework describing the effects of professional-development efforts on pedagogical change guided our work with Haitian faculty. Desimone posits that the core elements of effective professional development are: (i) content focus; (ii) active learning; (iii) coherence with individual attitudes and beliefs, as well as with context, for example, local or national policies; (iv) duration; and (v) collective participation, or opportunity to engage collaboratively with peers. She maintains that, when these attributes are included in professional-development experiences, teachers' knowledge and skills and/or attitudes and beliefs will change, that they will then use their new knowledge, skills, attitudes, and beliefs to improve their pedagogy or the content of their instruction, or both, and that these changes will be followed by changes in student learning.

Our intervention with Haitian faculty included four of the five attributes of effective professional development postulated above. The workshops focused on discipline-specific content that could be delivered effectively with the help of technology for active learning. All content was produced or translated into Kreyòl, in light of our assumption that use of the mother tongue is a precondition for effective active learning in Haiti. In addition, we utilized instructional strategies that engaged the Haitian faculty as collaborative, active learners. Our workshops were offered at planned intervals to reinforce previous learning and to provide continued support as faculty implemented new pedagogy. However, as we initiated the project, we were aware that our teaching was PURPOSEFULLY somewhat at odds with the larger context of education in Haiti. More specifically, we did not endorse the long-held pedagogical practices of top-down content delivery via the French language; rather, our pedagogical approach—the one we hoped faculty would use to transform the country's educational practices—was directly in opposition to this trend. Additionally, we were uncertain of our teaching's coherence with faculty's personal attitudes and beliefs, especially with regard to the traditional priority given to French as the primary language of formal instruction. Although Kreyòl is an official language alongside French, the day-to-day practice in Haitian schools still maintains the status of Kreyòl as a stigmatized language—on a par with the widespread stigma toward Creole languages across the globe, even among linguists, notably those analyzing Creole languages based on the assumption that they are 'exceptional' or 'lesser' languages (see DeGraff 2005 for documentation of such 'exceptionalist' claims).

It is this aspect—faculty attitudes and the larger educational context—that we elaborate upon in the study that follows. We describe the impact of our intervention on the attitudes of Haitian faculty, concomitant with policy changes announced by the Haitian government. We argue that this is the first step toward systemic change in Haiti's educational ecology. Such description is important to an understanding of how complex systemic change may be brought about, how it may, at first, appear to the observer, or what it may 'look like' in similar projects. The changes we describe below may indeed signal a key step in the movement toward the democratization of Haiti's educational system and may serve as a model for other communities where native local languages are still excluded from classrooms.

METHODS. In this study, we use content analysis to describe and quantify the changes in the attitudes of Haitian faculty after their participation in workshops focused on technology-enabled active learning in Kreyòl, their mother tongue. More specifically, we coded workshop participants' responses to evaluation questions in order to understand their perspective. Implicit in this approach is the premise that what is said provides a relatively direct and unambiguous route to meaning and to the corresponding underlying attitudes. However, this interpretation is not without limitations; on occasion, we did find that our participants' statements or the translations thereof seemed to hold ambiguous meaning. In these instances, we obtained a second opinion of the translation from the first author; in all cases, the ambiguities were resolved after retranslation.

Workshop series. As mentioned previously, seven workshops were conducted between March 2012 and June 2016. Participants' responses to post-workshop evaluations from the first two workshops (held in March 2012 and January 2013) were not included as part of this study because our analysis of responses includes one question that was not asked in those evaluations. Thus our conclusions are based on participants' responses from workshops 3 through 7. Each of the five workshops that provided data for our study is briefly described below.

All workshops were organized according to a common template. The offerings were attended by faculty teaching STEM subjects—physics, mathematics, biology, statistics, and chemistry (statistics for workshop 4 only, chemistry for workshop 7 only—see details below). One prerequisite for workshop attendance was a bachelor's degree, although we made occasional exceptions for students in their last year of a STEM track at the State University's Teachers' College (*École Normale Supérieure*). Large plenary workshop sessions focused on topics common to all faculty: how students learn, evidence-based practices for improved teaching, a demonstration of active learning in a classroom context, and information about assessment and evaluation. Smaller parallel sessions were organized by discipline and focused on using active-learning technology and other interactive resources for classroom instruction: PhET interactive simulations for physics and chemistry (Perkins et al. 2006), Mathlets for mathematics (Miller & Upton 2008), and STAR tools for biology (Office of Educational Innovation & Technology n.d.). The workshop instructors modeled instructional strategies that encouraged classroom use of active-learning teaching techniques by workshop participants. For example, as they learned about new concepts in active learning or assessment, participants were asked to vote on the correct answer to discussion questions and then discuss their chosen responses with a partner, thus enacting a popular interactive learning strategy (Mazur 1997:9–18). Additionally, participants worked together in pairs or small groups to develop teaching plans that incorporated active learning and technology, if appropriate, into their lessons. All workshop materials, including the technology's user interfaces, were translated into Kreyòl, and the workshop sessions, though conducted mostly in English, were translated in real time by professional interpreters with native fluency in Kreyòl. As mentioned earlier, the physics sessions were presented directly in Kreyòl by a native Kreyòl speaker, Dr. Paul Belony.

Workshop 3 was offered in August 2013 to faculty who had attended workshop 2 in January 2013. The content of this workshop provided additional focus on understanding student learning from a theoretical perspective and on designing lesson plans in which learning objectives, content, classroom activities, and assessments were aligned.

In March 2014, a fourth workshop was offered with three distinct disciplinary tracks: physics, biology, and a new track in statistics. The physics and biology participants were returnees from previous workshops. The physics participants developed labora-

tory experiments using locally accessible materials. The biology participants created videos in Kreyòl for introducing biology faculty to the use of ‘StarBiochem’ and ‘StarGenetics’—digital platforms for active learning in biochemistry and genetics, respectively. The new statistics track was offered to faculty with a master’s degree in mathematics who were interested in statistics. The statistics faculty were introduced to the content related to pedagogy and assessment from workshops 2 and 3, along with discipline-specific content related to probability and statistics.

In January 2015, a fifth workshop was offered to all interested and qualified faculty teaching physics, mathematics, or biology. The format and content of this workshop was as described above: large plenary sessions focused on topics common to all faculty, whereas smaller discipline-based parallel sessions focused on lesson planning using active learning, as well as technology whenever feasible.

In August 2015, workshop 6 was offered to faculty teaching physics, mathematics, and biology. This workshop took place at the Campus Henry Christophe of Haiti’s State University in the town of Limonade in the northern region of the country. Workshop 6 was noteworthy because it was the first to be planned as a result of a special invitation from a local university. This was a significant advance for the Initiative, in that it was suggestive of the perceived value of the Initiative’s mission as well as of the workshop content by one influential set of Haitian university administrators (Miller 2016). This workshop followed the same format and offered content similar to that described above.

In June 2016, workshop 7—the second workshop at the Campus Henry Christophe of Haiti’s State University at Limonade—was offered to faculty teaching physics, mathematics, biology, and also chemistry. This workshop was jointly financed by NSF funding for the MIT-Haiti Initiative and by funding provided from the US Embassy in Haiti to the hosting institution. Although the workshop was once again offered in the northern part of the country, participants traveled from Port-au-Prince and other areas, as far as the south, to attend. The workshop followed the familiar pairing of format and content, as previously described, but with the addition of an extra day devoted to four special topics: student motivation, creating effective visuals for instruction, challenges when implementing active learning, and developing a syllabus.

Workshop participants. The number of participants for each workshop is shown in Table 1. As evidenced by the table, there was a moderate degree of participant overlap between workshops, indicating that participants often returned after attending their first workshop. The participants were predominantly male (95%), with a wide range of teaching experience. The low percentage of female faculty in attendance may be a reflection of the overall enrollment trend for females in STEM in Haiti (INURED 2010). In principle, all workshop participants were supposed to be bilingual in Kreyòl and French. As Haitians, they all speak Kreyòl as their native language, and having gone to university, they are also supposed to know French—at least, in principle. Moreover, most teaching materials and exams in Haiti are in French, which in principle requires some working knowledge of French on the part of teachers. As discussed above, however, teachers are often much less fluent in French than they are in Kreyòl.

Data sources. Our data were collected from online surveys completed by participants after workshops 3 through 7. The surveys were all administered in Kreyòl. We asked for the participants’ general impressions of the workshop, their perceived ability to meet the intended learning outcomes after attending the sessions, and their thoughts about the affordances and constraints of utilizing technology-enhanced, active-learning resources in Kreyòl in their classroom. For the analysis described below, we analyzed participants’ open-ended responses to one item on the post-workshop survey, namely: ‘What are the

	WORKSHOP						
	1	2	3	4	5	6	7
	March 2012	January 2013	August 2013	March 2014	January 2015	August 2015	June 2016
ATTENDANCE PATTERN							
Total attendance	47	58	38	22	74	31	39
Attended workshop immediately prior	N/A	8 (14%)	29 (76%)	11 (50%)	10 (14%)	8 (26%)	12 (31%)
Attended at least one previous workshop	N/A	see above	29 (76%)	13 (59%)	22 (30%)	8 (26%)	20 (51%)
Attended all prior workshops	N/A	see above	4 (11%)	2 (9%)	1 (1%)	1 (3%)	1 (3%)

TABLE 1. Attendance patterns of participants from all workshops. Note: Administrators ($N = 10$) who attended workshop 5 were omitted from the total attendance shown above.

positive and negative aspects of receiving this workshop content in Kreyòl?'. The surveys did not collect any personally identifying information. This was done in order to protect anonymity, with the hope of soliciting more honest responses. Consequently, evidence of longitudinal attitude change for individual participants cannot be provided. However, a substantial percentage of participants attended successive workshops (see Table 1), and these data support an attitude change on the part of the participants as a collective group. Though we cannot ascertain with perfect certitude whether this collective change is a direct result of our intervention, a qualitative analysis of the participants' responses to survey questions, as sampled below in our discussion section (§3.2), does suggest that the MIT-Haiti workshops were a factor contributing to their willingness to use Kreyòl and active learning when teaching STEM subjects.

Coding procedure. Our unit of analysis for coding participants' responses was at the response level. We coded the entire response as indicating a positive, negative, or mixed (or ambivalent) attitude toward use of Kreyòl as the language of instruction. A response coded as 'positive' indicated excitement or support for the use of Kreyòl in the workshop, for example: 'There are many things that I already knew, but many clarifications were made, and because Kreyòl was the language of instruction, that made things even clearer'. A response coded as 'negative' expressed apprehension about the use of Kreyòl, for example: 'There is not a word in Kreyòl for many scientific terms'. A response coded as 'mixed' reflected two or more ideas that expressed ambivalence about use of Kreyòl, for example: 'Students will understand better, but my school administrator will not support me'. A response coded as 'neutral' expressed no preference for the use of Kreyòl over French, for example: 'I think that it allows me to understand that language may be an aspect that influences learning'. Lastly, a 'no code' label was applied to responses that did not address attitudes about language at all.

Both authors coded the data. The coding protocol was refined during two iterations of coding and discussion. Using the final version of the coding protocol, interrater reliability was 100%, 92%, 92%, 100%, and 69% for workshops 3 through 7, respectively. The unusually low interrater reliability experienced during analysis of workshop 7 resulted from translation errors as well as differences in interpretation of participant responses. For example, one response—*Aspè pozitif: li mete tout moun alèz pou yo pale*—was translated as 'The positive aspect was that SHE made everyone feel comfortable to talk'. This was coded by the non-Kreyòl-speaking coder as not related to attitudes about using Kreyòl, but the Kreyòl-speaking coder recognized that, in the original response, the third-person singular pronoun (3SG) refers to the language in question (Kreyòl), not to a feminine animate referent. That is, the response meant that it was the

use of Kreyòl that made everyone feel comfortable to talk during the workshop. Such a response does relay a positive attitude toward Kreyòl as language of instruction. This particular interrater discrepancy was thus due to an error in translation that in turn was related to a linguistic aspect of the response, namely, the fact that the Kreyòl pronoun *li* ‘3SG’ is neutral for gender and animacy. The translator mistranslated *li* as ‘she’ (presumably referring to a female instructor) instead of ‘it’. All disagreements in applied codes were easily resolved through discussion between the authors.

RESULTS. Analysis of the data produced noteworthy findings related to workshop participants’ attitudes about the use of Kreyòl as the language of instruction. Overall, the attitudes held by workshop participants evolved over the three-year period (workshop 3 in August 2013 through workshop 7 in June 2016).

Figure 1 shows the proportion of responses that were either positive, mixed, or no code/neutral. It should be noted that no responses were totally negative; that is, the question asked about the positive and negative aspects, and respondents gave either a wholly positive response or one that included both positive and negative aspects (coded as ‘mixed’). The trend line applied to the proportion of positive and mixed statements over the five workshops highlights a gradual change in relative proportions—with successive workshops, the proportion of positive statements generally increased, whereas the proportion of mixed (ambivalent) statements showing some negative attitudes toward the use of Kreyòl decreased. One exception to this pattern can be seen for comments in workshop 4. The figure reveals a spike in the proportion of positive comments for that workshop; however, the response rate for this particular question was markedly low (55%), and thus this proportion may not represent an accurate comparison.

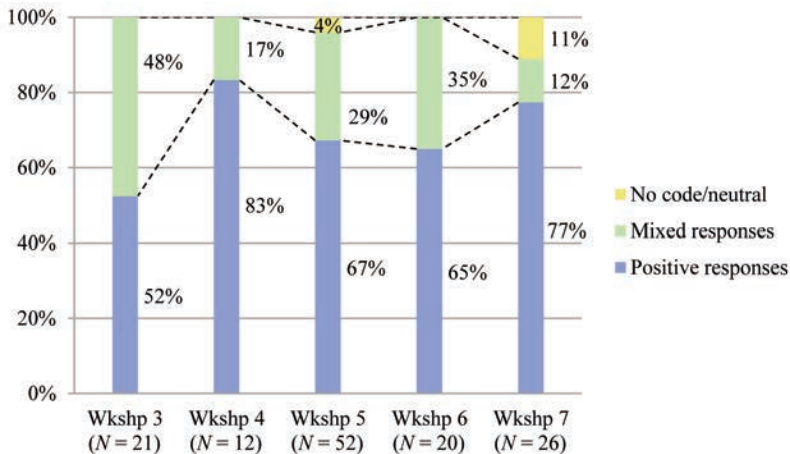


FIGURE 1. Percentage of responses coded as positive, mixed, or no code/neutral. Note: Coded responses to question, ‘What are the positive and negative aspects of receiving this workshop content in Kreyòl?’.

N = number of participant responses to the item.

DISCUSSION. The teacher professional-development literature depicts the relationship between professional development and resultant change in student learning as being a long trajectory that includes first a change in teacher attitude, followed by a change in teaching behavior, which ultimately results in changes in student learning (Desimone 2009). Our data answer our first question of what change in educators’ attitudes about use of Kreyòl may look like in the complex context of Haiti, which includes its history, culture, and politics. We fully explore the first phase of this progression in Haitian educators as they are immersed in workshops that introduce technology-based active learn-

ing in their native Kreyòl. With the exception of workshop 4, the qualitative data collected from workshop participants demonstrates a slow progression of attitudes from one of ambivalence about the use of Kreyòl to a more positive stance. Although this progression may seem slow to some, we argue that, since exclusion from knowledge and power due to the French-Kreyòl language divide has existed for 200 years, any systemic change to reduce or close that divide will indeed progress slowly. A more descriptive view of workshop participants' attitudes can be gained from looking at the actual content of their responses to the question asked. Tables 2 and 3 give examples of responses that were coded as either positive or mixed.¹³

Mwen menm mwen wè se yon gwo bagay le fè ke atelye a an kreyol li pèmèt plis deba fèt nan atelye yo. Epi tou lè nou pral itilize yo nan klas lap pi paske ak gen plis entèaksyon nan kou a.

'To me, the fact that the workshop was conducted in Kreyòl is an important step; it allowed more interactions. And also when we're going to use them in class there will be more interactions during instruction.'

lè materyèl yo an kreyol nou konprann pi rapid, etidyan yo konprann pi rapid

'When the materials are in Kreyòl, we understand quicker, the students understand quicker.'

Li pi bon paske kreyol se lang manman nou epi tou mwen pi byen konprann.

'It is better because Kreyòl is our native tongue and I understand better.'

pozitif: sa montre ke lang kreyòl la ka fè tout bagay. Li ka fè syans. Sa ban m kouraj pou m anseye san konplèks an kreyòl.

'Positive: This shows that Kreyòl can be used for everything. One can teach science in Kreyòl. This will give me the courage to teach in Kreyòl without any shame.'

Aspè pozitif lan sè ke mw wè ke edikasyon ka fèt an kreyòl nan peyi a.

'The positive aspect is that I see that instruction can be done in Kreyòl in this country.'

TABLE 2. Responses coded as 'positive', in Kreyòl with English translation.

Mwen te resevwa yon fomasyon pou mwen al anseye nan langaj matenel nou. men nan lekòl yo se pa tout ki dako yon pwofesè ansenye an kreyol.

'I received a training to teach in Kreyòl. But not all schools will allow teachers to teach in Kreyòl.'

Aspe pozitif la mwen rive konprann tout sa ki fet yo e m ap ka transmet yo tre byen. Aspe negatif la sèke mwen jwenn li an kreyol lekòl yo m ap anseye yo p ap kite m transmet yo an Kreyol

'On the positive side, I can understand everything and I will be able to pass it on to my students well. The negative side: This is provided to me in Kreyòl and the schools that I am working at will not allow me to teach it in Kreyòl.'

Aspè pozitif la, sèke nou wè vrèman tout ilustrasyon an kreyol ka fasilite timoun yo konpran. Aspè negatif la sèke jiska prezan nan inivèsite, yo atann ke profesè anseye an fransè.

'The positive aspect is that we really see that all the illustrations in Kreyòl can facilitate the children' understanding. The negative aspect is that, as of today, university professors are expected to teach in French.'

M pa gen kwak pwoblem ak anseyman kreyol la, sa k pral enpotan se rive fe etidyan yo konpran itilite l nan travay pa yo - Paske jiska prezan gen gwo stigmat sou lang kreyol la an Ayiti

'I have no issues with teaching in Kreyòl. What will be important is to convince students to understand the importance of Kreyòl in their own work. There is still some stigma attached to Kreyòl in Haiti.'

Aspè positif lan: mwen menm m' pale franse, men m' pi byen konpwann tout sa yo te di yo paske yo te di yo nan lang pa m' nan ki se kreyòl, sa m' pale pi byen an. Aspè negatif la: anpil moun ap gen pwoblèm ak lide sa a paske yo gen tandans panse yo siperyè ke lòt yo paske yo pale franse.

'Positive aspect: I speak French but I understood better because everything was said in Kreyòl, my maternal language, the language I speak better. Negative aspect: Many people will have issues with this idea because they seem to think they are superior to others because they speak French.'

TABLE 3. Responses coded as 'mixed', in Kreyòl with English translation.

¹³ The Kreyòl examples are quoted as originally written in online surveys, including occasional spelling or punctuation errors.

In general, the responses shown in the tables exemplify ‘growing pains’, or the messy innerworkings of transformative change when critical human attributes such as identity, politics, social class, and even job security are at stake. The examples in Table 2 reveal that participants’ positive attitude statements were often related to improved understanding by both faculty and students when Kreyòl was used as the language of instruction. However, the negative component of the responses coded as ‘mixed’ was often related to a certain resistance to the use of Kreyòl because it is perceived as a somewhat lesser language by school authorities and even students. Such negative comments illustrate the tight bond between language use and social class. One respondent did not convey either a positive or negative attitude toward use of Kreyòl, but rather acknowledgment of the social-class differences that accompany use of Kreyòl for instruction, stating: ‘In the majority of the schools we don’t have much problem to teach in Kreyòl ... We must also say that the schools in which we are allowed to speak Kreyòl while teaching are never the ones with materials such as computers, projectors available for classroom instruction’.

The second question at the onset of this article was: How can local languages such as Kreyòl serve to enhance the promotion and dissemination of modern pedagogy and technology for STEM education, and how can STEM education, in turn, serve to enhance the promotion of stigmatized languages such as Kreyòl? The answer to that question lies within the STEM- and language-related activities that were conducted during and after the workshop, as well as within the data collected in the post-workshop survey. Prior to and during workshops, members of the MIT-Haiti team and workshop participants developed glossaries that contained technical terms in Kreyòl for biology, chemistry, physics, and mathematics. When Kreyòl words seemed lacking for various technical concepts, such as ‘lattice point’ (for physics), the two groups worked together to develop the appropriate term (e.g. *pwen filyè* for ‘lattice point’). In physics sessions at one workshop, participants translated a number of PhET interactive simulations (Perkins et al. 2006) into Kreyòl. This resulted in the creation of words such as *kwonomèt baryè foton* (literally ‘timer gate photon’) for a photogate timer.

These lexical innovations for the expression of science and mathematics show that the Kreyòl lexicon will naturally continue to evolve as Kreyòl is utilized for teaching and communicating about complex concepts. This sort of lexical innovation is a development that Sapir predicted many years ago when he wrote that science can ‘readily deliver its message’ in any language whatsoever (Sapir 1921:223), be it a vernacular, local, or international language. This creative process also provides an answer to that second question. We argue that a mutually enhancing relationship exists between STEM education in local languages and the promotion of such languages. As shown by workshop participants’ responses to survey questions, the use of Kreyòl as language of instruction improves teacher understanding of information vital to improved pedagogy and use of technology. Concurrently, the use of Kreyòl triggers expansion and refinement of the language as lexical gaps are discovered and readily filled with the needed lexical innovations—‘on-demand fillers’, so to speak.

Such lexical expansion of Kreyòl, as the language entered new technical and scientific domains of use, was yet another stimulus to the slowly changing attitudes expressed by our workshop participants. These changes were also accompanied by rich accounts of the Haitian faculty’s successes and challenges as they used or considered using the methods and tools acquired at the workshops. According to verbal accounts by some of the university and secondary-school faculty who participated in our program, students, even those who speak French, consistently have a great deal of diffi-

culty when confronted with new and complex problems in STEM. Very often, they have difficulty solving these problems because they are accustomed to memorization of formulas and ‘solutions’ by heart, a practice that promotes superficial rather than deep learning and that does not result in transfer of knowledge to new and unfamiliar situations. This is perhaps one reason why there is not yet any major research program in Haiti in any scientific field.

In response to a different question on our post-workshop survey, one teacher explained that when he used the MIT-Haiti materials (e.g. digital learning tools in Kreyòl) in his physics class, his students’ understanding of the materials increased significantly. He went on to say that they then were sometimes ‘too excited, talking too much and asking too many questions’. In order to calm them down, the teacher, according to his own report, switched back to a discussion in ... French! This anecdote clearly shows that Kreyòl is an indispensable tool for interactive pedagogy in Haiti, while the use of French inhibits the free flow of conversation (French for ‘crowd control’!).

The power of French to ‘silence’ can even be observed among Haitian government officials, many of whom are concerned that mistakes in French will tarnish their image. Parliamentary debates conducted in French exclude the majority of senators and deputies. Recently, a well-known senator, who is usually quite verbose in Kreyòl, was unable to answer a simple question asked in French by a journalist and eventually walked out of the interview unable to finish his sentence, which he had started a few times, hopelessly stuttering. This phenomenon has been analyzed by Bourdieu (1982) in terms of ‘linguistic capital’ (or lack thereof) in a brutal ‘linguistic market’ where certain varieties are mercilessly devalued by a ‘habitus’ that is transmitted through social structures, especially the school system. In Haiti, the school system is the main locus where French tends to mute children’s participation. The observations in this article show how Kreyòl is indispensable to students’ expression of their intelligence and creativity.

Such anecdotes—from MIT-Haiti workshops to the Haitian Parliament—echo the implications of the Haitian proverb that describes French as a ‘language for purchase’ (i.e. a language acquired at great cost), in contrast with Kreyòl, which is the ‘root language’ (i.e. the communal ancestral language): *Franse se lang achte. Kreyòl se lang rasin* (i.e. ‘French is a bought language. Kreyòl is our ancestral language’).

With this in mind, the Kreyòl-based digital technology for active learning developed by the MIT-Haiti team not only pushes students beyond the old tradition of lecture and memorization that exists in Haiti and many other places, but also adds to Kreyòl’s ‘capital’ in Haiti’s linguistic market. On top of that, such systematic use of Kreyòl as part of active-learning pedagogy and interactive educational technology also pushes the boundaries of knowledge for Haitian teachers, for the majority of them have learned their trade according to the outdated rote-memorization tradition. This is one major reason why the efforts of the MIT-Haiti Initiative have been focused on STEM faculty at universities: in order to create systemic change in teaching practices at the university level. It is these universities who should be training STEM teachers at all levels—primary school, secondary school, and higher education.

In addition to improving students’ learning outcomes, in addition to contributing to Kreyòl’s cultural capital, and in addition to helping strengthen the intellectual and scientific capacity of Haiti via locally trained engineers and scientists, there is another important reason why STEM should be taught in Kreyòl at all levels in Haiti, including university. According to the United Nations, every person on earth has the right to enjoy the benefits of science (see article 15 of the International Covenant on Economic, So-

cial, and Cultural Rights¹⁴). Access to science through local languages has been advocated as a fundamental human right in other postcolonial contexts such as in Africa (see e.g. Babaci-Wilhite 2014a). More generally, the right to education in one's native language is another fundamental entitlement, enshrined in United Nations treaties such as the International Covenant on Civil and Political Rights and the Convention on the Rights of the Child (1989).¹⁵ The latter explicitly requires that member states ensure that education contributes to developing respect for children's home languages and that children enjoy the right to be educated in their native languages.

The findings from the Mother Tongue Book Project at LKM and our preliminary findings from the MIT-Haiti Initiative have an important logical consequence. If we wish to create a successful system for active learning and for in-depth research and innovation in Haiti, a system that allows all primary- and secondary-school and university students to become proficient in science and mathematics, this system must be implemented in Kreyòl, with materials in Kreyòl. In such a system, more students will have the opportunity to become scientists, engineers, or mathematicians, better prepared to solve the problems that affect them, their communities, or their country.

This opportunity is even more important in light of the recent natural disasters (earthquake, hurricanes) that have caused destruction in Haiti. Another dismal consequence of miseducation in Haiti is that even high-level officials seem to misunderstand the cause of natural disasters. As recently as October 2016, a prominent senator, who is also a medical doctor, made the outrageously unscientific claim that it is Haitian homosexuals who are the cause of natural disasters in Haiti—as divine punishments for their sins (Jean Baptiste 2017). The expertise of scientists and engineers who are intimately familiar with the Haitian context can help mitigate the consequences of these natural disasters and the ensuing unnatural HUMAN disasters that are caused by miseducation and the concomitant ill-preparedness, both of which are, in large part, due to misguided politicians and policy makers. Without countrywide access to modern pedagogy in Haiti's national language, relatively few Haitians can benefit from quality education, and this bottleneck will continue to block Haiti's development. But as Bourdieu (1982) has reminded us, social change is not easy, especially change to age-old habitus that has benefited the powerful for more than two centuries. So we now turn to the challenges and opportunities that lie ahead.

4. FURTHER OPPORTUNITIES AND CHALLENGES. Before the MIT-Haiti Initiative began, there were no online materials or digital learning tools in Kreyòl for university-level science and mathematics. For the first time in the history of Haiti, Kreyòl-language materials for science and mathematics have been developed for higher education. The quality of these materials has been tested in our MIT-Haiti workshops, and they are ready to be spread throughout the country, with, hopefully, the much-awaited support of the Ministry of National Education and Vocational Training. We have now started sharing these materials as online OPEN EDUCATIONAL RESOURCES. These resources will help to spread science and mathematics in Kreyòl to all since they are freely accessible online, or on USB drives for remote areas that do not yet have Internet access. To date, the MIT-Haiti Initiative has collaborated with several partners in the United States and in Haiti, including Haiti's Ministry of National Education and Vocational Training, whose

¹⁴ <http://www.refworld.org/cgi-bin/texis/vtx/rwmain?docid=3ae6b36c0>

¹⁵ <http://www.ohchr.org/en/professionalinterest/pages/crc.aspx>

agenda includes the sort of curricular reform that will promote active learning with the help of digital tools in Kreyòl as well.

Opportunities for long-term sustainability for this Initiative do depend on Haitian stakeholders—such as the Ministry of National Education and other state institutions, alongside local civil society—taking ownership of the objectives and methods of the MIT-Haiti Initiative and making it go fully ‘native’. One fundamental desideratum that was made explicit to workshop participants is that they share what they learn, along with the tools and materials they acquire or develop at the workshops. Participants quite early on were eager to contribute to such a knowledge-sharing campaign: the first effort toward local dissemination of workshop information by a workshop participant took place at the École Normale Supérieure of Haiti’s State University, which is the main teacher-training college in Haiti.

More recently, a group of six Haitian faculty, who named themselves the ‘Konbit MIT-Haiti’, has provided workshops at various locations near Port-au-Prince. The term *konbit* means working together pro bono to complete a task, and these individuals have demonstrated such collaborative spirit by working together to disseminate information from the MIT-Haiti Initiative to their peers. Due to their interest and participation in most of the MIT-Haiti workshops to date, the members of the group were chosen for a two-week fellowship at MIT in September 2015, during which they received in-depth training and support for developing curricular materials using active learning, and technology where appropriate. Following their return to Haiti, they have provided, to date, five workshops for their Haitian peers, and they are planning more such workshops throughout the country (Miller 2016).

As with the launching of any attempt at deep systemic change, the challenges initially seem to outweigh the opportunities, and our Initiative is not unusual in that regard. What are those challenges? The first is how to produce and share more materials in Kreyòl for science and mathematics, with adequate technical vocabularies. Many of the Kreyòl terms that are needed in these fields do not yet exist at the most advanced levels, given that the language had not, until now, been put to formal use at these levels of STEM. There has never been a national policy that encourages scholars, professors, and publishing companies to produce materials in Kreyòl. As a consequence, scientific documents in Kreyòl are relatively rare, and those that do exist often suffer in their quality, due to limitations in support, logistics, and so forth. As compared to the major presses, which publish most of their books in French, the small presses working on Kreyòl materials have, in the past, not gotten substantial subsidies from the Haitian government or from major donors.

Meanwhile, one way to convert this challenge into an opportunity for progress on the lexical and terminological fronts is for a critical mass of educators, together with their students, to engage in this Initiative and contribute to the creation of the needed technical vocabularies in the course of developing and using pedagogical materials for STEM in Kreyòl. But such massive engagement toward a large-scale production of Kreyòl materials may itself require a greater and more widespread change in attitude toward Kreyòl than we evidenced in the MIT-Haiti workshops. The good news is that, as we mentioned above, the MIT-Haiti Initiative is already showing that there is no intrinsic barrier to lexical expansion in Kreyòl. On the contrary, it has shown that in a relatively short amount of time, and with the right level of linguistic expertise and political will, new technical terms can easily be created in Kreyòl. And now we have a Kreyòl glossary of some 850 technical terms that have been used in the MIT-Haiti workshops,¹⁶ and it is available to users worldwide via Google Translate (Dizikes 2017, LOOP 2017).

¹⁶ <https://haiti.mit.edu/glossaryglose/>

This Kreyòl glossary of technical scientific terms begins to answer another and deeper challenge that has traditionally been leveled against the use of Kreyòl in education, namely the recurring question posed, even by well-meaning educators and intellectuals, of whether it is possible to express complex concepts in a so-called ‘vernacular’ language like Kreyòl. Such a question would probably have been familiar to René Descartes as well when, back in the seventeenth century, he was switching from writing in Latin to writing in his own ‘vernacular’ French (we return to the important rationale of Descartes’s linguistic choices below). Such a question was most familiar to Cheikh Anta Diop, who translated into his native Wolof a variety of scientific materials in mathematics, physics, and chemistry, including Einstein’s theory of relativity, in order to prove that local languages like Wolof do have the capacity to express science and can help promote science education in Africa (Diop 1975).

Our Kreyòl glossary, as part of the MIT-Haiti Initiative’s efforts, mirrors the paths taken by Descartes, Diop, and others who have shown that ‘vernacular’ languages too have the capacity to express science. The vocabulary of Kreyòl, like the vocabulary of any other language, is like a muscle: the vocabulary develops as one uses it—adapting itself to the various domains in which it is applied. The more the language is used by a community for its diverse needs, the more versatile the language becomes, especially the lexicon and various norms associated with writing—these writing conventions evolve especially when languages are put to use in formal education, research, administration, justice, professional trades, and so forth. This is typically how languages grow to fulfill the various functions that they need to as they are put to use in more contexts. This is what has happened to French, Italian, English, and other languages in the course of history, and this is what is already happening in Kreyòl as it is put to use in academic arenas for the teaching of STEM at the highest levels in the MIT-Haiti Initiative. Kreyòl is a full-fledged language that, in terms of its development, structure, and expressive capacity, is on a par with any other language, including international languages such as French, English, and Spanish (DeGraff 2005, 2009, Aboh & DeGraff 2017).

We must also acknowledge that one reason for the apparently endless controversy over whether Kreyòl can or should be used in education stems from the neocolonial chains (or *habitus*, as Bourdieu would call it) that still exist in many Haitian minds and that influence Haitian perspectives on Haiti’s national language. Haitians have been led to accept as *fait accompli* the proposition that Kreyòl is deprived of what Bourdieu has called ‘cultural capital’ (see DeGraff 2005, 2015a, Tontongi 2007, Saint-Fort 2014, and Charles 2015 for an overview of these and related attitudes toward Haitian Creole and other Creole languages). Bourdieu’s concepts of ‘*habitus*’ and ‘cultural capital’ are central to understanding why there are so many people in Haiti and throughout the world—intellectuals, policy makers, educators, linguists, parents, and so on—who seem convinced that Creole languages are unfit for STEM and other academic disciplines.

In the case of Kreyòl in Haiti, the naysayers believe that it is only French that is sophisticated enough to teach complex concepts and to open up global knowledge and opportunities to Haiti’s children. As a counterargument, it is imperative to recall the time in history when scholars in Europe wrote mostly in Latin or Greek, while Europe’s vernacular languages such as French, Italian, and English were rarely used to write about science. In the Middle Ages, a language like French, akin to Kreyòl today, lacked many terms for mathematics and science and was judged inappropriate for scholarly writing. René Descartes helped dispel this myth that had kept French outside of science, and he helped make it a scholarly language when he published his *Discourse on the method* in French instead of Latin (see e.g. Descartes 2006 [1637]). Descartes’s choice was motivated by his ardent desire to ‘vulgarize’ his scientific methods so that more people in

France could learn from his work. Descartes purposefully chose to write his book in the language he felt would be as clear as possible to his readers in France, a language that his compatriots would understand more easily than Latin. He did so because he wanted to spread his scientific methods and findings beyond the small elite of scholars who knew Latin. The rest is history: by the eighteenth century, French had already long left its status of ‘vulgar’ language and become the ‘universal’ language of European elites, and now the French language is at the bedrock of France’s cultural, political, and economic stature.

In some ways, the MIT-Haiti Initiative is helping to do for Kreyòl what Descartes helped to do for French: the use of Kreyòl in STEM education will help the language develop a richer vocabulary and a larger set of linguistic conventions, which will further promote the use of Kreyòl in all fields of knowledge, as it should. That is how French, too, developed new words for science and other types of knowledge, as scholars like Descartes began to write in French instead of continuing to write solely in Latin or Greek. The MIT-Haiti Initiative is assisting with this process of developing new vocabularies and new tools, and modernizing methods for STEM education in Kreyòl, alongside a new culture of deep thinking and deep learning in Kreyòl at all academic levels.

There is another, more difficult challenge, one that touches on a deeply entrenched set of pedagogical practices and concomitant beliefs and attitudes in Haiti’s academic culture: How can we change the habits of faculty and students who have become steeped in the rote-memorization tradition of French texts, which few can thoroughly understand and which are disconnected from everyday reality? Our challenge here is to help create a new set of habits, along with a culture of creativity and innovation that will promote active-learning methods and help teachers and students engage in in-depth studies and research in science, mathematics, and other subjects in Kreyòl.

The MIT-Haiti Initiative is indeed ushering in a new set of habits that will allow faculty and students alike to delve as deeply as possible into their academic disciplines through the unrestrained use of their native language. We have already taken the first steps as part of a fledgling collaboration with Haiti’s Ministry of National Education, alongside a robust collaboration with local Haitian faculty (workshop participants) from a wide range of public and private universities and high schools throughout the country. The collaboration with the Ministry has been quite a challenge, with its share of uncertainties. This is as expected, given the political situation in Haiti, the social and political dimensions of the project, and Haitian leaders’ and intellectuals’ traditional attitudes toward Kreyòl.

An impediment to collaborating with the government and, more generally, to the promotion of Kreyòl in Haiti is the geopolitical battle currently being waged by a global Francophonie movement that aims at controlling France’s former colonies, including Haiti (Gordon 1978:56) and even new and non-French-speaking territories (Vigoroux 2013). In this vein, the French government has traditionally exerted a strong influence on education in Haiti. France’s geopolitical interests in Haiti were again asserted in October 2014 at a meeting between Haitian President Michel Martelly and French President François Hollande, who explicitly stated that Francophonie is:

a major link that the French language gives us with Haiti. We’re making sure that the high schools that are being built today in Haiti offers THE MOST TEACHING IN FRENCH, BY FRENCH TEACHERS when possible, otherwise by Francophones, because WE DO NOT WANT THAT WHAT MAKES THE IDENTITY OF HAITI, THE FRENCH LANGUAGE, GET LOST. (emphases added)¹⁷

¹⁷ <http://www.boursorama.com/actualites/france-haiti-martelly-evoque-un-partenariat-pour-l-education-ae69f38cb59bf8a08f286a1949fc4165>

In light of such explicit and ongoing promotion of French in Haiti as part of official international relations between Haiti and one of the major contributors to Haiti's national budget, which is mostly financed by outside donations, one can imagine that Haiti's Ministry of Education may be ambivalent vis-à-vis the MIT-Haiti Initiative's promotion of Kreyòl as language of instruction (see Odiduro 2016). The fact that the Ministry has signed an agreement with the Kreyòl Academy in order to promote the use of Kreyòl at all levels of Haiti's school system (see Dizikes 2015, Manigat 2015, St Juste 2015) is in apparent contradiction with the agreement between France's and Haiti's presidents to promote teaching in French as primary language of instruction. (See Arthus 2014:109–15 for a sample of historical details about the French government's anti-Kreyòl and anti-development neocolonial policies in Haiti.)

Be that as it may, such collaboration between the MIT-Haiti Initiative and Haiti's Ministry of Education is indispensable for the long-term success and sustainability of the Initiative, especially its nationwide impact and its eventual influence on national curricula, state exams, and so forth. Meanwhile the most heartening collaboration is the one with the faculty who clearly and deeply understand the benefits of the Initiative for their own teaching and for their students' learning gains (DeGraff 2013, 2016b,c, Miller 2016).

5. CONCLUSION AND RECOMMENDATIONS. One of the most important possibilities that our Initiative has opened up for the future in Haiti and beyond concerns the millions of other people on Earth who speak 'local' languages like Haitian Creole and who stand to benefit most from full access to technology-enabled quality education. In many parts of the world, there are still populations who need to achieve true mastery of science, and who need access to materials in their own languages in order to learn better. The MIT-Haiti Initiative can serve as an example for them as well. We are facilitating development of better teaching methods in Haiti, and at the same time, demonstrating the basic elements of an innovative model for opening up access to quality education on a global scale. These accomplishments rest on three central principles: use of Kreyòl as the language of instruction, use of active-learning pedagogy, and use of appropriate technology (digital and nondigital).

The use of Kreyòl makes learning truly ACTIVE for Haitian students. Deep engagement in STEM learning requires a great deal of reasoning, collaboration, and communication. This cannot be done in French or English or any other language that is not spoken fluently by the majority of Haitian students. In Haiti, Kreyòl is the only language that can provide this majority with the linguistic means to fully participate in active learning. Additionally, the use of technology helps to improve STEM education through incorporation of active-learning methods. Such active learning strengthens students' understanding of a variety of complex and abstract concepts.

One of the core ambitions of the MIT-Haiti Initiative is to increase the capacity of secondary and tertiary education in Haiti. As a team, we not only share with workshop participants curricula developed at MIT and beyond, but we also teach them how to develop their own. Through this project, Haitian faculty and administrators are already becoming more knowledgeable in active-learning methodology based on modern resources, including digital technologies, in the local native language. The teachers who participate in the MIT-Haiti STEM workshops can then spread their new knowledge so that many other teachers and students can learn better—this has already started with the work done by the MIT-Haiti Konbit described earlier. These efforts are all aimed at creating, evaluating, and disseminating resources and methods for active learning throughout the country, without barriers, and having these methods and resources integrated into the country's official curricula.

A major breakthrough toward the democratization of education in Haiti happened on July 8, 2015, when as mentioned earlier, the Ministry of National Education signed an agreement with the recently founded Haitian Creole Academy (*Akademi Kreyòl Ayisyen*) whereby the use of Haitian Creole as medium of instruction would be expanded through all levels of the education system (Dizikes 2015). This was the first agreement between the Ministry and the Haitian Creole Academy. In spite of the ambivalence noted above (in terms of the Ministry's promotion of Kreyòl vs. the geopolitical pressure from Francophonie with its class correlates), the overall objective of this agreement is to promote Kreyòl as language of instruction and, more generally, for the defense of Kreyòl speakers' human rights. Such attention was obviously beneficial to the goals of the MIT-Haiti Initiative. We believe that in addition to government attention, however, the repeated modeling of active learning, consistent use of participants' native language for instruction, and access to digital-learning tools in Kreyòl in the workshops have also been instrumental in the change we evidenced in the attitudes of Haitian educators. Our intervention has implications for speakers of local languages not only in Haiti but also internationally, as two of the three components mentioned could be available at reasonable cost in multiple contexts.

These types of local efforts—led by leaders and educators in Haiti to develop local resources in Kreyòl instead of relying on foreign-based resources only—do suggest that (adapting words from Martin Luther King Jr.) 'the arc of the moral universe [of education in Haiti] may be long, but it bends toward social justice'. Indeed, recent developments in favor of the expansion of Kreyòl in education stand a chance to give deeper and more sustainable roots to any projects that, like the MIT-Haiti Initiative, are promoting quality and access for education in Haiti.

To those who are interested in facilitating changes in similar sociolinguistic contexts, we make the following recommendations:

1. Find partners who are visionaries and well integrated into the local community, power structure, educational system, culture, language, traditions, and arts—especially among those who have some degree of control over the school and university system, including the design of curricula and exams. Also important are partners who can help channel extra socioeconomic benefits into the use of the local language (e.g. Kreyòl) in the workplace and in other sectors where wealth is created and transmitted. As described earlier in the article, our Initiative started with a symposium in 2010 that brought together MIT faculty and staff interested in global education, alongside a group of Haitian leaders affiliated with well-respected NGOs, higher-education institutions (public and private, including local linguistics faculty), and entrepreneurship in information and communications technology.
2. Collaborate with well-respected and competent local institutions engaged in social-science research—institutions that can contribute to the evaluation of outcomes and that can increase the community's trust vis-à-vis the project.
3. Collaborate with political leaders and grassroots activists who have the right amount of political commitment, resources, and community buy-in. These collaborations are equally important in order to help implement the vision toward quality education for all through the communities' home languages.
4. Enlist reliable partners for long-term sustainability and success. These partners would include, at minimum, associations of teachers, parents, and students whose own success in life depends upon access to quality education. It is important that they too fully appreciate how important local languages are

for achieving such access—in spite of the sort of social anxiety that the use of local languages often entails.

5. Engage local traditional media (e.g. TV, radio, newspapers) and social media in innovative ways. Nowadays, one optimal venue to reach out en masse to students, parents, and teachers (and to the population at large) is through social media. More generally, well-orchestrated media campaigns are of utmost importance—if possible, in conjunction with local media personalities, artists, and so forth. The MIT-Haiti Initiative has recently started collaborating with socially progressive artists such as BIC, a Haitian singer/songwriter, alongside scientists with innovative ideas about language arts and computation (see Ladouceur 2017a, Montfort 2017). As an illustration of the power of artists reaching out via social media, one introductory video of BIC's concert at MIT on September 19, 2017, has garnered more than 98,000 views in less than three months¹⁸—more views than all of our academic articles combined. In a vein related to consciousness raising, the MIT-Haiti Initiative has also collaborated with the best-known global Internet platform promoting local languages, namely Google Translate (Dizikes 2017, LOOP 2017).
6. Cultivate partnerships with socially conscious linguists interested in the production of educational materials in the corresponding local languages—materials for use in kindergarten all the way up to universities. Nonlocal linguists (e.g. from North America and Europe) should contemplate win-win partnerships that integrate the production of educational materials in language-documentation/revitalization projects—in mutually respectful and enriching co-creation mode with local linguists, artists, activists, and others interested in language (re)vitalization projects. One example of such collaboration between linguists and artists is our work with Mandaly Claude Louis-Charles on the production of songs that teach the basics of the Kreyòl alphabet. Because local vernaculars typically have much shorter traditions of literacy than their European colonial counterparts, they are often perceived, often erroneously so, as being more difficult to write. Such perceived difficulty can be a bottleneck in any effort to use local languages as languages of instruction. In the case of Kreyòl, the orthography is phonemic, thus transparent and much easier than that of French, and our alphabet song facilitates the learning of the orthography (Louis-Charles et al. 2015, DeGraff 2017b).

The implementation of a radically democratic vision for education will, ideally, need to include all institutions that help create and transmit power to social groups—such as government, courts, schools and universities, research institutions, local and international funding agencies, parents, activists, artists, and civil society. Yet these stakeholders' respective degrees of political commitment to democratic change can wax and wane, especially in a context like Haiti, which has long been mired in complex class-related and geopolitical struggles (see e.g. Odiduro 2016). However, this is par for the course given the political nature of opening up education to all. It is important to note that the path to success in such endeavors rarely obeys any straight one-size-fits-all formula. Over time, allegiances, priorities, and financial support may and will change. The path will also vary case-by-case depending on the local and geopolitical contingencies. Persistence and flexibility are key characteristics to bringing such challenging paradigm shifts to fruition.

¹⁸ <https://www.facebook.com/BicFanClub/videos/931991360286441>

We conclude by returning to the objective of democratizing education by making it available to all without barriers. Specifically, we wish to call out designers and producers of education-related digital technologies and related enterprises such as telecommunications companies. It is only when we pay due attention to linguistic diversity and local languages that we will be able to realistically envisage a world where access to quality education is truly democratic. In a recent address on the role of culture in sustainable development, Irina Bokova, director of UNESCO, stressed the importance of learning in one's native language: 'Culturally sensitive curricula can improve literacy, the quality of education and ultimately education outcomes. [It is] ... particularly relevant when students are taught in their mother tongue' (May 5, 2014). We argue that the use of culturally sensitive curricula in local languages is also particularly relevant when thinking about democratizing education and promoting equal opportunity for all. The use of local languages in education can dramatically enlarge the pool of individuals with access to high-quality resources. In the case of the MIT-Haiti Initiative, this new pool now includes faculty as well as students who otherwise would have no access to the sort of state-of-the-art resources that are currently offered only in international languages such as English, French, or Spanish. We hope that this article will help ensure that technology-enabled education can, at least in principle, have truly GLOBAL reach to the extent that it makes it possible to enter into dialogue with, and learn from, linguistically and socially diverse groups, thus incorporating diverse ways of learning into methods for online learning. Such initiative promotes diversity and inclusion toward a profound transformative impact for all parties involved. This new paradigm will help educate a diverse world, as we in turn become educated by the diversity of the world we engage in.

REFERENCES

- ABOH, ENOCH, and MICHEL DEGRAFF. 2017. A null theory of Creole formation. *The Oxford handbook of universal grammar*, ed. by Ian Roberts, 401–58. New York: Oxford University Press.
- ARTHUS, WIEN WEIBERT. 2014. *Duvalier à l'ombre de la guerre froide: Les dessous de la politique étrangère d'Haïti (1957–1963)*. Port-au-Prince: Imprimeur S. A.
- BABACI-WILHITE, ZEHLIA. 2014a. E-learning science literacy as a human right in education in Africa. *Current Studies in Comparative Education, Science and Technology* 1.115–30.
- BABACI-WILHITE, ZEHLIA. 2014b. *Local language as a human right in education: Comparative cases from Africa*. (Comparative and international education: A diversity of voices 36.) Rotterdam: Sense Publishers.
- BENSON, CAROL. 2012. The role of language of instruction in promoting quality and equity in primary education. *Lessons in educational equality: Successful approaches to intractable problems around the world*, ed. by Jody Heymann and Adele Cassola, 199–221. New York: Oxford University Press. DOI: 10.1093/acprof:oso/9780199755011.003.0009.
- BOURDIEU, PIERRE. 1982. *Ce que parler veut dire: L'économie des échanges linguistiques*. Paris: Fayard. [English edition: *Language and symbolic power*, ed. and trans. by Gino Raymond and Matthew Adamson. Cambridge, MA: Harvard University Press, 1991.]
- CASIMIR, JEAN. 2011. Haiti's need for a Great South. *The Global South* 5(1).14–36. DOI: 10.2979/globalsouth.5.1.14.
- CHARLES, FABIAN. 2015. Ki sa pale vle di ann Ayiti? *AyiboPost*. Online: <http://ayibopost.com/ki-sa-pale-vle-di-ann-ayiti/>.
- DEGRAFF, MICHEL. 2005. Linguists' most dangerous myth: The fallacy of Creole exceptionalism. *Language in Society* 34(4).533–91. DOI: 10.1017/S0047404505050207.
- DEGRAFF, MICHEL. 2009. Language acquisition in creolization and, thus, language change: Some Cartesian-uniformitarian boundary conditions. *Language and Linguistics Compass* 3(4).888–971. DOI: 10.1111/j.1749-818X.2009.00135.x.

- DEGRAFF, MICHEL. 2010. Language barrier: Creole is the language of Haiti, and the education system needs to reflect that. *The Boston Globe*, June 16, 2010.
- DEGRAFF, MICHEL. 2013. MIT-Haiti Initiative uses Haitian Creole to make learning truly active, constructive, and interactive. *Educational Technology Debate*, July 2013. Online: <http://bit.ly/1HezJEL>.
- DEGRAFF, MICHEL. 2014. The ecology of language evolution in Latin America: A Haitian postscript toward a postcolonial sequel. *Iberian imperialism and language evolution in Latin America*, ed. by Salikoko Mufwene, 274–327. Chicago: University of Chicago Press.
- DEGRAFF, MICHEL. 2015a. France's misconceived 'Marshall plan' for Haiti. *Le Monde Diplomatique*, May 26, 2015. Online: <http://mondediplo.com/blogs/france-s-misconceived-marshall-plan-for-haiti>.
- DEGRAFF, MICHEL. 2015b. Kreyòl-based and technology-enhanced learning of reading, writing, math, and science in Haiti. National Science Foundation Project outcomes report. Online: <http://1.usa.gov/1JUdvt>.
- DEGRAFF, MICHEL. 2016a. Input to United Nations Office of the High Commissioner for Human Rights on the protection of the rights of the child in the implementation of the 2030 Agenda for Sustainable Development. Online: <http://www.ohchr.org/EN/Issues/Children/ThematicReports/Pages/2030Agenda.aspx>.
- DEGRAFF, MICHEL. 2016b. Lang matènèl, pedagoji entèraktif, lojisyèl edikatif nan Inisyativ MIT-Ayiti : « Twa wòch dife » pou bon jan edikasyon ak inovasyon alawonnbadè ann Ayiti. *Journal of Haitian Studies* 22(2).128–41. DOI: 10.1353/jhs.2016.0040.
- DEGRAFF, MICHEL. 2016c. La langue maternelle comme fondement du savoir: L'Initiative MIT-Haïti: Vers une éducation en créole efficace et inclusive. *Revue transatlantique d'études suisses* 6/7.177–97. Online: http://llm.umontreal.ca/fileadmin/Documents/FAS/litterature_langue_monde/RTES-6-7.pdf.
- DEGRAFF, MICHEL. 2017a. Haiti's 'linguistic apartheid' violates children's rights and hampers development. *OpenGlobalRights*, January 31, 2017. Online: <https://www.openglobalrights.org/haiti-s-linguistic-apartheid-violates-children-s-rights-and-hampers-/>.
- DEGRAFF, MICHEL. 2017b. Mother-tongue books in Haiti: The power of Kreyòl in learning to read and in reading to learn. *Prospects* 46.435–64. DOI: 10.1007/s11125-017-9389-6.
- DEGRAFF, MICHEL, and MOLLY RUGGLES. 2014. A Creole solution for Haiti's woes. *The New York Times*, August 1, 2014. Online: <https://www.nytimes.com/2014/08/02/opinion/a-creole-solution-for-haitis-woes.html>.
- DEJEAN, YVES. 2006. *Yon lekòl tèt anba nan yon peyi tèt anba*. Port-au-Prince: FOKAL.
- DEJEAN, YVES. 2010. Creole and education in Haiti. *The Haitian Creole language: History, structure, use, and education*, ed. by Arthur Spears and Carole M. Berotte Joseph, 199–216. Lanham, MD: Lexington Books.
- DESCARTES, RENÉ. 2006 [1637]. *A discourse on the method of correctly conducting one's reason and seeking truth in the sciences*, trans. by Ian Maclean. Oxford: Oxford University Press.
- DESIMONE, LAURA M. 2009. Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher* 38.181–99. DOI: 10.3102/0013189X08331140.
- DIOP, CHEIKH ANTA. 1975. Comment enracciner la science en Afrique: Exemples Walaf (Sénégal). *Bulletin de l'Institut Fondamental d'Afrique Noire B* 37(1).154–233.
- DIZIKES, PETER. 2015. 3 questions: Michel DeGraff on Haiti's new policy for teaching in Kreyòl. *MIT News*, July 20, 2015. Online: <http://newsoffice.mit.edu/2015/3-questions-michel-degraff-haiti-teaching-kreyol-0720>.
- DIZIKES, PETER. 2017. MIT-Haiti, Google team up to boost education in Kreyòl. *MIT News*, October 30, 2017. Online: <http://news.mit.edu/2017/mit-haiti-google-team-boost-education-kreyol-1031>.
- FREEMAN, SCOTT; SARAH L. EDDY; MILES McDONOUGH; MICHELLE K. SMITH; NNADOZIE OKOROAFOR; HANNAH JORDT; and MARY PAT WENDEROTH. 2014. Active learning increases student performance in science, engineering and mathematics. *Proceedings of the National Academy of Sciences of the United States of America* 111(23).8410–15. DOI: 10.1073/pnas.1319030111.

- GTEF: GROUPE DE TRAVAIL SUR L'ÉDUCATION ET LA FORMATION. 2010. *Pour un Pacte National pour l'Éducation en Haïti*. Port-au-Prince: Bibliothèque Nationale.
- HEBBLETHWAITE, BENJAMIN. 2012. French and underdevelopment, Haitian Creole and development: Educational language policy problems and solutions in Haiti. *Journal of Pidgin and Creole Languages* 27(2).255–302. DOI: 10.1075/jpcl.27.2.03heb.
- IYOSHI, TORU, and M. S. VIJAY KUMAR. 2008. *Opening up education: The collective advancement of education through open technology, open content, and open knowledge*. Cambridge, MA: MIT Press. Online: <http://mitpress.mit.edu/books/opening-education>.
- INURED. 2010. The challenge for Haitian higher education: A post-earthquake assessment of higher education institutions in the Port-au-Prince metropolitan area. Port-au-Prince: Interuniversity Institute for Research of Development (INURED). Online: http://www.inured.org/uploads/2/5/2/6/25266591/the_challenge_for_haitian_higher_education.pdf.
- JEAN BAPTISTE, JUNO. 2017. Les sénateurs mettent les bâtons dans les roues des homosexuels. *Le Nouvelliste*, August 1, 2017. Online: <http://lenouvelliste.com/article/174212/les-senateurs-mettent-les-batons-dans-les-roues-des-homosexuels>.
- JEAN-PIERRE, MARKY. 2016. *Language and learning in a post-colonial context: A critical ethnographic study in schools in Haiti*. London: Routledge.
- LADOUCEUR, ROSNY. 2017a. BIC, invité à parler dans une grande université américaine. *LOOP*, September 16, 2017. Online: <http://www.loophaiti.com/content/bic-invite-dans-une-grande-universite-americaaine-parler-du-creole>.
- LADOUCEUR, ROSNY. 2017b. Pami lang lokal yo, se kreyòl Ayiti a ki pi popilè sou Twitter. *LOOP*, October 28, 2017. Online: <http://www.loophaiti.com/content/pami-lang-lokal-yo-se-lang-kreyol-ayiti-ki-pi-popile-sou-twitter>.
- LOOP. 2017. Google et MIT s'associent pour promouvoir le créole haïtien. *LOOP*, November 3, 2017. Online: <http://www.loophaiti.com/node/267464>.
- LOUIS-CHARLES, MANDALY; BÉMOL TELFORT; and MICHEL DEGRAFF. 2015. Chante alfabè kreyòl la. [Video recording.] Online: <https://youtu.be/6F6yK1HOHWI>.
- MANIGAT, NESMY. 2015. Diskou Minis Edikasyon Nasyonal ak Fòmasyon Pwofesyonèl nan okazyon siyati akò ak Akademi Kreyòl Ayisyen an. *Le Nouvelliste*, July 13, 2015. Online: <http://lenouvelliste.com/lenouvelliste/article/147050/Diskou-Minis-Edikasyon-Nasyonal-ak-Fomasyon-Pwofesyonel-nan-okazyon-siyati-ako-ak-Akademi-Kreyol-Ayisyen-an>.
- MARTON, FERENGE, and ROGER SÄLJÖ. 1997. Approaches to learning. *The experience of learning: Implications for teaching and studying in higher education*, 2nd edn., ed. by Ference Marton, Dai Hounsell, and Noel J. Entwistle, 39–58. Edinburgh: Scottish Academic Press. Online: http://www.docs.hss.ed.ac.uk/iad/Learning_teaching/Academic_teaching/Resources/Experience_of_learning/EoLChapter3.pdf.
- MAZUR, ERIC. 1997. *Peer instruction: A user's manual*. Upper Saddle River, NJ: Prentice Hall.
- MILLER, HAYNES. 2016. The MIT-Haiti Initiative: An international engagement. *MIT Faculty Newsletter* 29(1), September/October 2016. Online: <http://web.mit.edu/fnl/volume/291/miller.html>.
- MILLER, HAYNES, and DEBORAH S. UPTON. 2008. Computer manipulatives in an ordinary differential equations course: Development, implementation, and assessment. *Journal of Science Education and Technology* 17(2).124–37. DOI: 10.1007/s10956-007-9058-2.
- MONTFORT, NICK. 2017. *Sentaniz Nimerik*, E-lit in Haitian Creole. *Post position*, 8 October 2017. Online: <http://nickm.com/post/2017/10/sentaniz-nimerik/>.
- MYERS-SCOTTON, CAROL. 1993. Elite closure as a powerful language strategy: The African case. *International Journal of the Sociology of Language* 1031.149–64. DOI: 10.1515/ijsl.1993.103.149.
- ODIDURO, SERGY. 2016. MIT-Haiti Initiative: Another broken promise? *Sergy Odiduro: Journalist and producer*, January 25, 2016. Online: <https://sergyodiduro.wordpress.com/2016/11/18/mit-haiti-initiative-another-broken-promise/>.
- OFFICE OF EDUCATIONAL INNOVATION & TECHNOLOGY. n.d. Software tools for academics and researchers. Cambridge, MA: MIT. Online: <http://star.mit.edu/index.html>.
- PERKINS, KATHERINE; WENDY ADAMS; MICHAEL DUBSON; NOAH FINKELSTEIN; SAM REID; CARL WIEMAN; and RON LEMASTER. 2006. PhET: Interactive simulations for teaching and learning physics. *The Physics Teacher* 44(1).18–23. DOI: 10.1119/1.2150754.

- PROSSER, MICHAEL; KEITH TRIGWELL; ELIZABETH HAZEL; and FIONA WATERHOUSE. 2000. Students' experiences of studying physics concepts: The effects of disintegrated perceptions and approaches. *European Journal of Psychology of Education* 15(1).61–74. DOI: 10.1007/BF03173167.
- SACCHETTI, MARIA. 2010. Much rests on Haiti elite. *The Boston Globe*, January 31, 2010. Online: http://www.boston.com/news/world/latinamerica/articles/2010/01/31/much_rests_on_haiti_elite/.
- SAINT-FORT, HUGUES. 2014. Le «marché linguistique» haïtien: Fonctionnement, idéologie, et avenir. *Potomitan: Site de promotion des cultures et des langues créoles*. Online: <http://www.potomitan.info/ayiti/saint-fort/marche.php>.
- SAINT-GERMAIN, MICHEL. 1997. Problématique linguistique en Haïti et réforme éducative: Quelques constats. *Revue des sciences de l'éducation* 23(3).611–42. DOI: 10.7202/031954ar.
- SAPIR, EDWARD. 1921. *Language: An introduction to the study of speech*. New York: Harcourt, Brace & Co.
- SCANNELL, KEVIN. 2016. Personal communication, September 23, 2016. [See Twitter and Facebook postings: <https://twitter.com/indigenoustweet/status/779818773662404608>; <http://www.facebook.com/michel.degraff/posts/10154595827738872>.]
- SKUTNABB-KANGAS, TOVE, and JIM CUMMINS (eds.) 1998. *Minority education: From shame to struggle*. Clevedon: Multilingual Matters.
- ST JUSTE, EDRID. 2015. MENFP/Académie du créole haïtien: Un accord pour faire la promotion du créole dans les écoles. *Le Nouvelliste*, July 8, 2015. Online: <http://lenouveliste.com/lenouveliste/article/147052/Un-accord-pour-faire-la-promotion-du-creole-dans-les-ecoles>.
- THORLEY, N. RICHARD, and RENÉ T. STOFFLETT. 1996. Representation of the conceptual change model in science teacher education. *Science Education* 80(3).317–39. DOI: 10.1002/(SICI)1098-237X(199606)80:3%3C317::AID-SCE3%3E3.0.CO;2-H.
- TONTONGI. 2007. *Critique de la francophonie haïtienne*. Paris: L'Harmattan.
- TROUILLOT, MICHEL ROLPH. 1994. Culture, color and politics in Haiti. *Race*, ed. by Steven Gregory and Roger Sanjek, 146–74. New Brunswick, NJ: Rutgers University Press.
- UNESCO. 2006. Haiti. *World data on education*. 6th edn. Geneva: IBE-UNESCO. Online: <http://www.ibe.unesco.org/sites/default/files/Haiti.pdf>.
- VIGOUROUX, CECILE. 2013. Francophonie. *Annual Review of Anthropology* 42.379–97. DOI: 10.1146/annurev-anthro-092611-145804.
- WALTER, STEPHEN L. 2008. The language of instruction issue: Framing an empirical perspective. *Handbook of educational linguistics*, ed. by Bernard Spolsky and Francis M. Hult, 129–46. Malden, MA: Blackwell. DOI: 10.1002/9780470694138.ch10.
- WEBB, PAUL. 2010. Science education and literacy: Imperatives for the developed and developing world. *Science* 328(5977).448–50. DOI: 10.1126/science.1182596.

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