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The impact of teachers' modifications of an evidenced-based HIV prevention intervention on program outcomes

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Abstract

The degree to which evidence-based program outcomes are affected by modifications is a significant concern in the implementation of interventions. The ongoing national implementation of an evidence-based HIV prevention program targeting grade six students in The Bahamas [Focus on Youth in The Caribbean (FOYC)] offers an opportunity to explore factors associated with teachers' modification of FOYC lessons and to examine the impact of types and degrees of modifications on student outcomes. Data were collected in 2012 from 155 teachers and 3646 students in 77 government elementary schools. Results indicate that teachers taught 16 of 30 core activities, 24.5 of 46 total activities and 4.7 of 8 sessions. Over one-half of the teachers made modifications to FOYC core activities; one-fourth of the teachers modified 25% or more core activities that they taught (heavily modified FOYC). Omitting core activities was the most common content modification, followed by lengthening FOYC lessons with reading, writing assignments or role-play games, shortening core activities or adding educational videos. Mixed-effects modeling revealed that omitting core activities had negative impacts on all four student outcomes. Shortening core activities and adding videos into lessons had negative impacts on HIV/AIDS knowledge and/or intention to use condom protection. Heavy modifications (>1/4 core activities) were associated with diminished program effectiveness. Heavy modifications and omitting or shortening core activities were negatively related to teachers' level of implementation. We conclude that poorer student outcomes were associated with heavy modifications.

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Compliance with Ethical Standards

Informed consent: Informed consent was obtained from all participants included in the study.

Keywords

Implementation; HIV prevention; modification of the intervention; fidelity of implementation; adolescents; The Bahamas

Introduction

Over the past quarter-century, public health researchers and institutions have invested substantial resources into developing and evaluating HIV prevention interventions, yielding multiple efficacious behavioral HIV prevention programs. Despite their potential, such programs contribute little to HIV prevention efforts until they are widely put into practice (Rebhook et al., 2006). Recognizing this need, the Centers for Disease Control and Prevention (CDC) has established mechanisms to identify, package and disseminate effective behavioral interventions to community settings as part of the Diffusion of Effective Behavioral Interventions (DEBI) initiative (Lyles et al., 2007). DEBI and related efforts supporting evidence-based practice have resulted in an increasing number of evidence-based interventions being implemented among expanded audiences in the past decade (Stirman et al., 2012).

Despite these successes, emerging evidence indicates that implementation efforts face multiple challenges in real world settings (Solomon et al., 2006). A systematic review of 39 studies utilizing the original 30 DEBIs programs reveals intervention decay or a lack of any intervention effect in several adapted version of the DEBIs (Feldman et al., 2014). Evidence-based interventions are frequently modified during implementation (Lundgren et al., 2011). Community-based providers often selectively implement program components (Galbraith et al., 2009) and/or significantly modify the interventions (Rebhook et al., 2006). For example, the Mpowerment Project (MP), an evidence-based intervention for young men having sex with men, was implemented by 69 Community-based organizations (CBOs) throughout the USA (Rebhook et al., 2006). Evaluation results revealed that each of the nine core elements was dropped by 20 to 45% of CBOs and modified by 30 to 50% of the CBOs (Rebhook et al., 2006). Focus on Kids, an efficacious HIV prevention program for high-risk adolescents, has been disseminated both nationally in the USA and internationally. A telephone survey among community providers revealed that on average only half of the core elements were being implemented (Galbraith et al., 2009). An adolescent sexual and reproductive health intervention (MEMA kwa Vijana) was implemented in 62 schools in Tanzania, but, this high coverage was associated with significant changes in program content and delivery (Renju et al., 2011).

The degree to which program outcomes are affected by modifications is a significant concern in the implementation of evidence-based interventions (Dusenbury et al., 2003). Despite this recognition, little research has been conducted to examine the impact of modifications on desired outcomes of interventions and has yielded inconsistent findings. Kalichman et al. (1993) reported enhanced outcomes (e.g., promoting HIV-antibody testing) after modifying a brief HIV risk-reduction video intervention to match presenter and participant ethnicity and sex. Effectiveness of an HIV risk-reduction intervention (Be Proud!

Be Responsible!) was retained after it had been modified to fit the needs of target audiences in four different communities in the US (Kennedy et al., 2000). Desired outcomes were also preserved when an intervention for post-traumatic stress disorder was delivered with modifications but at high levels of fidelity (retaining critical elements) (Levitt et al., 2007). Modifications to enhance local acceptance appeared to compromise intervention effect in other studies. Stanton et al. (2005) adapted a sexual risk reduction intervention that had originally been designed for urban adolescents to accommodate the needs of rural adolescents, but found that the culturally altered intervention was less effective (especially with regard to condom use perceptions) in the new setting than the original intervention had been in the original setting. Cultural adaptations of the Strengthening Families Program by practitioners that reduced dosage or eliminated core elements increased retention but reduced positive outcomes (Kumpfer et al., 2002). Adaptations that fail to preserve the “core elements” of an intervention [defined herein as those aspects of an intervention judged by the developers to be essential to the success of the program (Dusenbury et al., 2003)] may result in failure to achieve previous program outcomes (Stirman et al., 2012). For example, a study found that when core elements are omitted during implementation, the intervention outcomes tend to be less positive or even produce negative effects (Mowbray et al., 2003).

Descriptions of community-based organizations’ experiences adapting programs and factors associated with modification of intervention curriculum presented in the HIV prevention literature are scant. Ringwalt et al. (2003) conducted a survey of a nationally representative sample of substance use prevention teachers in middle schools and found that teachers’ beliefs about program effectiveness and organizational support were significant predictors of program fidelity and adaptations; a majority of these teacher (80%) adapted their prevention curricula in response to students’ special needs and problems (e.g., youth violence) (Ringwalt et al., 2004). Hill et al. (2007) interviewed 42 program facilitators involved in a large-scale implementation of a community-based prevention program and found that a few types of modifications (30%) accounted for the majority (70%) of all reported program changes. Qualitative studies report that the most common reasons for program facilitators to modify evidence-based interventions include “meeting the needs of a specific target audience” and “running out of time” (Lundgren et al., 2011; Hill et al., 2007).

A few studies described types and frequencies of modifications that occur during the implementation process (Lundgren et al., 2011; Stirman et al., 2013) and explored factors influencing program adaptations (Hill et al., 2007). These studies failed to report the impact of these modifications on desired outcomes by program recipients. Lundgren et al. (2011) identified a broad range of modification but adding or deleting intervention sessions are the most common changes made by 100 CBOs. Hill et al. (2007) reported that program facilitators frequently deleted or added program material and changed program’s games, specific content, and activities. Fasula et al. (2013) described major adaptations of an evidence-based HIV prevention (Project Safe) among incarcerated women including shorter, more frequent intervention sessions, booster sessions and new videos. Stirman et al. (2013) systematically characterized the types of modifications of evidence-based interventions and identified 12 types of content modifications (e.g., tailoring/tweaking/refining, adding elements, removing elements, shortening, lengthening, substituting elements). The number of published studies assessing the impact of implementation on program outcomes is

increasing (see for example Durlak and DuPre, 2008; Wang et al., 2015), but these studies do not provide data on modifications to evidence-based interventions. Overall, there is limited research describing the range of adaptations made by program implementers, quantifying the levels of these modifications and understanding the reasons for these changes and assessing the potential impact of these modifications on program outcomes.

An opportunity to address some of these questions is presented by the ongoing national implementation of an evidence-based HIV prevention program targeting grade six students in The Bahamas [Focus on Youth in The Caribbean (FOYC)]. From 2011 to 2013, all 80 government elementary schools in The Commonwealth of The Bahamas (“The Bahamas”) engaged in the national implementation of FOYC. Previously we have described that on average, teachers taught 15.6 out of 30 core activities and 24 out of the 46 total activities (Wang et al., 2015). We conducted cluster analysis to identify teachers’ implementation patterns based on implementation dose (i.e., number of core activities completed) and fidelity of implementation (i.e., percentage of core activities being changed during the implementation). Three teacher implementation groups were identified: 1) High Implementation Group (one-third of the teachers), characterized by high levels of implementation dose and fidelity of implementation; 2) Moderate Implementation Group (one-half of the teachers) showing moderate levels of implementation dose but high levels of fidelity of implementation; and 3) Low Implementation Group (one-sixth of the teachers), with low levels of implementation dose and fidelity of implementation. Low Implementation Group teachers had received less training in interactive teaching, incomplete attendance at FOYC training workshops and low levels of comfort in teaching FOYC lessons. Students taught by teachers in this group had poorer outcomes relevant to HIV/AIDS knowledge, preventive reproductive health skills and intention to use protection if they were to have sex (Wang et al., 2015). This prior analysis did not address: 1) the frequencies and types of curricular changes; 2) the association of different levels and types of curricular changes with teachers’ level of implementation; 3) the impact of different levels and types of curricular changes on student outcomes; and 4) teacher-level factors associated with modification of intervention curriculum. The present study explores these questions in the context of a nationwide dissemination of a single evidence-based program (FOYC).

Methods

Study site

From 2012 to 2013, 77 government elementary schools in The Bahamas participated in the second wave of the national implementation of FOYC including the research component described herein. The 77 schools are located on 14 of the 15 major islands constituting The Bahamas, where more than 98% of the population resides. Forty-five schools were located on the three most populated islands: 25 schools on Island #1 (I-1), 10 schools on Island #2 (I-2), and 8 schools on Island #3 (I-3). The remaining 34 schools were located in 11 small islands. The 77 participating schools housed 155 grade six classes and teachers: I-1 housed 89 (57.4% of the total) teachers; I-2, 18 (11.6%) teachers; I-3, twelve (7.7%) teachers; and the 11 small islands housed 36 (23.2%) teachers. The research protocol was approved by the

Wayne State University Human Investigation Committee and the Institutional Review Board of the Bahamian Princess Margaret Hospital, Public Hospitals Authority.

HIV-Prevention Program

FOYC was adapted from Focus on Youth (FOY), a 10-session sexual risk reduction program targeting mid-adolescents. FOY and Informed Parents and Children Together (CImPACT) were included in the CDC's "Diffusion of Effective Behavioral Interventions (DEBI)" Portfolio. The intervention components include role-playing games, interactive discussions, stories, lectures, homework activities and exercises to reinforce main messages and to increase knowledge and skills regarding sexual risk avoidance, effective communication, negotiation and condom use. An ongoing story throughout the sessions focuses on a fictional family story to contextualize decision-making and the importance of considering long-term consequences of actions (Deveaux et al., 2007). A decision-making model illustrating the steps that should guide a child in making appropriate choices is applied throughout the sessions. Multiple exercises in communication emphasize listening and effective delivery of a message. Longitudinal evaluations of the randomized controlled trial of the FOYC intervention showed that the intervention significantly increased Bahamian youth's HIV/AIDS knowledge, perceptions of their ability to use condoms and condom use intention (Gong et al., 2009) with evidence of increased condom use (Chen et al., 2010).

Teacher Training

The Ministry of Education (MOE) launched 11 teacher training workshops following the protocol used by the DEBI program to train grade six teachers in the delivery of FOYC throughout The Bahamas. Among the 11 workshops offered, two were four days in length; eight were two days in length and one was one-day in length. Duration was based on available time in the MOE workshop training schedules. Regardless of the length of the workshop, the teacher training covered: 1) review of the need for HIV prevention in The Bahamas; 2) overview of FOYC including the research showing its effectiveness; 3) a walk-through of each FOYC sessions with participation and "role-play" of the core activities, considered to be critical to the success of FOYC; and 4) a didactic question-and-answer period regarding contraception and condom-use. The longer workshops (four days compared to two days compared to one day) provided a more detailed curriculum experience, longer didactic session and teacher participation. The major points of emphasis were consistent across the three types of workshops. All 155 teachers (regardless of attendance at a workshop) were given a copy of the FOYC teacher training manual.

Nearly half of the teachers (49.3%) attended some or all aspects of a FOYC training workshop in 2011/2012; 31.8% completed the workshop. In addition, 20 (13%) teachers reported that they had attended a prior FOYC workshop before 2010 when they participated in the original FOYC intervention effectiveness trial. Overall, 62.3% of the teachers received training supporting their delivery of the FOYC curriculum.

Measures

Level of implementation and curricular changes—To assess implementation, all teachers were asked to complete a Teacher Implementation Checklist specific for each of the sessions of FOYC after they had taught the session. The checklist includes all 46 activities in the FOYC curriculum, 30 of which were identified by the developers as “core activities”. The teachers indicated which activities they had and had not taught in each session. For those core activities that they taught, the teachers recorded whether they had modified the format of the activity as outlined in the manual; what types of changes they had made on each core activity; and whether they had added material to the standardized curriculum, deleted program components or changed program content. Teachers also recorded the total number of all activities (from among 46) or core activities (from among 30) that they taught. The number of sessions taught was calculated by summing the sessions in which a teacher taught one or more core activities. Teachers’ level of modification was calculated as the percentage of core activities being changed during implementation.

Factors associated with implementation—Both before (pre-) and after (post-) intervention delivery, all participating teachers were asked to complete brief questionnaires assessing factors described in the prior research as influencing fidelity of intervention implementation. Both pre-implementation and post-implementation questionnaires assessed: teachers’ perceptions of the importance of HIV prevention programs in general and the FOYC intervention specifically (very, somewhat or not important) for grade six students in their community or schools; teacher’s confidence in teaching the FOYC intervention; teacher’s sense of “ownership” of the curriculum (i.e., perceiving it as a “Bahamian intervention”); and the relative importance of their time spent in teaching FOYC compared to the time spent teaching reading skills in grade six (less important, about the same, more important) (Beets et al., 2008; Dusenbury et al., 2003).

The *pre-implementation* questionnaire also collected information regarding teacher’s level of formal education, years as a teacher, teacher’s attendance at FOYC training workshop, training in interactive teaching, and prior experience of teaching FOYC or other HIV prevention programs. The *post-implementation* questionnaire assessed the role of competing priorities as a reason for not being able to complete delivering the FOYC curriculum, perceived student benefits from the intervention (very much, somewhat/not at all) and how many students (most, some, few) appeared to be engaged in the lesson.

In bivariate analyses, responses were grouped into two or three collapsed categories due to low frequencies in some categories: years as a teacher/guidance counselor (1–5 years, 6–10 years, >10 years); training in interactive teaching (a lot/some, a little/none); perceptions of the importance of HIV prevention (very important and somewhat/not important); and confidence in teaching FOYC (very comfortable and somewhat/not comfortable).

Student outcomes—An anonymous curricular assessment instrument (with identifying information only at the level of the school and teacher), adapted from a version of the Bahamian Youth Health Risk Behavioral Inventory (BYHRBI) (Deveaux et al., 2007) was administered by the MOE to grade six students at the beginning of grade six before receipt

of FOYC and at the end of grade six. At baseline, 3646 students completed the curriculum assessment; 3474 students completed the follow-up assessment. The brief assessment was designed to assess the impact of FOYC as part of the grade-six Health Family Life Education (HFLE) curriculum. The questions were read out loud while the students marked their responses on the questionnaires. The instrument assessed HIV/AIDS knowledge, preventive reproductive health skills, self-efficacy, intentions and self-reported behaviors. A 15-item scale including true and false statements was used to assess level of *HIV/AIDS knowledge*. The internal consistency of the scale was high (Cronbach's $\alpha=0.86$). Correct responses were scored 1 and incorrect 0, resulting in a summary score of 0 to 15 for each participant. *Preventive reproductive health skills* were assessed through an adaptation of the Condom-use Skills Checklist (Stanton et al., 2009). The validated scale includes true and false statements describing the steps of correct condom use. This six-item scale demonstrated adequate internal consistency (Cronbach's $\alpha=0.84$). Correct responses were scored 1 and incorrect 0, resulting in a summary score of 0 to 6 for each participant. A three-item scale was used to assess *self-efficacy* for using pregnancy/STI prevention methods. All three items employed a yes/no response scale, with 1 point assigned for each "yes" response. Individual item scores were added to yield a summary score (range 0 to 3). The internal consistency of the scale was 0.81. *Intention to use condom protection* was measured using the question, "if you were to have sex in the next six months, how likely is it that you would use a condom (to prevent yourself from getting HIV)?" Youth rated the likelihood on a five-point Likert scale ranging from 1 (very unlikely) through 5 (very likely).

Analysis

To quantify the levels of teachers' modifications to FOYC lessons, we first calculated the percentage of core activities being changed during the implementation. The distribution of percentage of core activities being changed is skewed and about half of the teachers did not change any core activities. The 50th percentile of the distribution as the cut-off was used to create two groups of teachers who modified the FOYC curriculum (50th percentile corresponds to 25% of core activities being changed). Teachers who changed 25% or more of the core activities that they taught formed a single category (labeled "heavily modified FOYC") while teachers who changed less than 25% of core activities formed another collapsed category ("slightly modified FOYC"). Teachers who did not make any changes on FOYC curriculum formed a separate category (labeled "no change") which served as the reference group in analyses.

To assess the association of different levels of modification (no change, slightly modified, heavily modified) with teachers' degree of implementation, the number of core activities (from among a possible total of 30), the number of all activities (from among a possible total of 46, including core and non-core activities) and the number of sessions taught (from among a possible total of eight) by teachers were compared according to teachers' levels of modification using ANOVA with the Tukey honestly significant difference (HSD) post hoc tests. Number of core activities, all activities and sessions completed by teachers were also compared according to different types of modifications (including screening of video, shortening, lengthening, and omitting core activities) using Student's *t* test or ANOVA.

The associations of teachers' levels of modification of the intervention curriculum (no change, slightly modified, heavily modified) with teachers' characteristics, teaching and training experience, attitudes towards HIV prevention, perceptions of student benefits and program ownership, and level of comfort in teaching FOYC were examined using chi-square test (for categorical variables) and ANOVA (for continuous variables).

To examine the impact of different levels of modification and types of modifications on student outcomes (HIV/AIDS knowledge, preventive reproductive health skills, self-efficacy, and intention to use condom protection), the change from baseline to follow-up within each group of students, as well as the differences in change scores between the groups, were compared using Student's t test and ANOVA with the Tukey HSD post hoc tests. The association of types and degrees of teacher modification with student outcomes was assessed using mixed-effects modeling, adjusting for clustering effects of classroom and/or school and the dependence of repeated measures. Independent variables included teachers' levels of modifications or types of modifications (adding video, shortening, lengthening, omitting core activities, and no change), student's age, sex, and baseline student outcomes. School and class were included as random effect variables in the model. Regression coefficients were calculated for all variables. All the analyses were performed using the SAS 9.3 statistical software package (SAS Institute Inc., Cary, NC, USA).

Results

Association of teachers' level and types of modifications with their degree of implementation

Teachers who slightly changed the FOYC curriculum (<1/4 core activities) taught the greatest numbers of activities and sessions of FOYC, followed by teachers who did not change the intervention curriculum, with teachers who heavily changed the FOYC curriculum (≥ 1/4 core activities) having taught the lowest number of activities and sessions (core activities: 18.1 vs. 16.5 vs. 12.8, $F=6.49$, $p<0.01$; all activities: 28.0 vs. 25.4 vs. 19.5, $F=6.71$, $p<0.01$; sessions: 5.2 vs. 4.6 vs. 4.2, $F=2.91$, $p<0.0578$) (The differences between teachers who slightly modified FOYC and those who did not change the curriculum did not reach statistical significance in post-hoc analysis of paired comparisons).

Teachers who *did not change* core activities taught the greatest numbers of activities and sessions of FOYC, followed by teachers who *added videos* or *lengthened* FOYC lessons with reading/writing assignments or role-play games or *shortened* core activities, with the teachers who *omitted* core activities having taught the lowest number of activities and sessions (core activities: 22.4 vs. 19.6 vs. 18.5 vs. 14.1 vs. 8.7, $F=45.96$, $p<0.001$; all activities: 34.5 vs. 29.8 vs. 28.7 vs. 21.6 vs. 13.2, $F=44.77$, $p<0.001$; sessions: 6.1 vs. 5.8 vs. 5.4 vs. 4.5 vs. 2.6, $F=37.00$, $p<0.001$). ANOVA post-hoc analysis revealed that teachers who *omitted* core activities and those who *shortened* core activities taught fewer numbers of core activities, all activities and sessions of FOYC than teachers who did not change core activities or teachers who *added videos* or *lengthened* FOYC lessons.

The associations of teachers' characteristics, training experience, pre- and post-implementation perceptions with teachers' level of modifications

Table 1 presents the differences between the three groups of teachers in terms of pre-implementation characteristics, teaching and training experience and attitudes towards HIV prevention. Attendance at the FOYC training workshop, prior experience of teaching FOYC or other HIV prevention programs, and location of the teacher significantly differed among the three groups. Higher proportions of teachers who did not change or slightly modified FOYC curriculum compared to those who heavily modified the curriculum had attended all aspects of their training workshops (36.6% vs. 17.1%, $\chi^2=4.78$, $p<0.05$; 37.2% vs. 17.1%, $\chi^2=4.28$, $p<0.05$). In contrast, a higher proportion of teachers who heavily modified the curriculum only attended part of a training workshop. A lower proportion of teachers who heavily modified the FOYC curriculum compared to those who did not change or slightly modified the curriculum reported that they had previously taught FOYC (3% vs. 11% vs. 25%, $\chi^2=7.55$, $p<0.05$). A higher proportion of teachers who heavily modified the FOYC curriculum compared to those who did not change or slightly modified the curriculum reported that they had previously taught other HIV prevention programs (47% vs. 16% vs. 14%, $\chi^2=13.84$, $p=0.001$). A higher proportion of teachers who did not change the FOYC curriculum compared to those who slightly or heavily modified the curriculum were teaching in New Providence (71% vs. 28% vs. 40%, $\chi^2=19.48$, $p<0.001$), the most populated Bahamian island where FOYC was originally adapted for The Bahamas and tested for efficacy. Duration of experience as a teacher, training in interactive teaching, teacher's level of education, program ownership, and perceptions of importance of HIV prevention for grade 6 youth were not significantly different among the three groups.

Of the eight perceptions assessed post-intervention, three differed significantly between the three groups of teachers: program priority, comfort level in teaching FOYC lessons, and student engagement. A higher proportion of teachers who heavily modified the FOYC curriculum compared to those who did not change or slightly modified the curriculum reported that they had priorities other than teaching FOYC in their daily work (49% vs. 38% vs. 23% $\chi^2=5.97$, $p=0.05$). Teachers who heavily modified the FOYC curriculum reported lower levels of comfort in teaching core activities in FOYC curriculum and lower student engagement in FOYC lessons than teachers who did not change or slightly modified the curriculum. Teachers' perceptions regarding the importance of HIV prevention or FOYC for grade six youth, perceived student benefits, ownership of the FOYC curriculum, relative importance of the time spent in teaching FOYC and teaching reading skills were not associated with teachers' level of modifications to FOYC curriculum.

The impact of teachers' level of modifications on student outcomes

Table 2 shows the change in HIV/AIDS knowledge, preventive reproductive health skills, self-efficacy and intention to use condom protection from baseline to follow-up among students according to their teachers' level of modifications to FOYC curriculum. All student outcomes increased significantly among all three teacher groups over the 12 months follow-up. At baseline, intention was comparable across the three groups while knowledge, reproductive health skills and self-efficacy were higher among students whose teachers did not change or slightly modified the curriculum (knowledge: 8.2 vs. 8.1 vs. 7.7, $F=9.46$,

$p < 0.001$; skills: 3.4 vs. 3.2 vs. 3.0, $F = 14.82$, $p < 0.001$; and self-efficacy: 0.9 vs. 1.0 vs. 0.7, $F = 16.71$, $p < 0.001$). At follow-up, all four outcomes were consistently higher among students whose teachers did not change or slightly modified the curriculum compared with students whose teachers heavily modified the curriculum (knowledge: 9.9 vs. 9.9 vs. 9.5, $F = 8.71$, $p < 0.001$; skills: 3.9 vs. 3.8 vs. 3.7, $F = 5.25$, $p < 0.01$; self-efficacy: 1.3 vs. 1.2 vs. 1.1, $F = 10.52$, $p < 0.001$; and intention: 3.5 vs. 3.5 vs. 3.1, $F = 10.17$, $p < 0.001$). Students whose teachers did not change the curriculum demonstrated greater increases in self-efficacy and intention than students whose teachers slightly or heavily modified the curriculum.

The results of the mixed-effects models indicate that teachers' level of modifications was significantly related to changes in three of the four student outcome measures; changes in reproductive health skills were not correlated with teachers' level of modifications. Compared to students whose teachers did not change the FOYC curriculum, students whose teachers heavily modified the curriculum demonstrated lower levels of HIV/AIDS knowledge, self-efficacy and intention to use protection at 12 months follow-up after controlling for age, gender, baseline difference and clustering effects of school and classroom. Older age was associated with improvement in reproductive health skills and self-efficacy. Male gender was associated with increased reproductive health skills, self-efficacy and intention to use condom protection. Classroom random effects were significant in all four models, indicating significant variation among classrooms with regard to students' knowledge of HIV/AIDS, reproductive health skills, self-efficacy and intention to use condom protection (Table 3).

The impact of types of modifications on student outcomes

Table 4 displays the change in HIV/AIDS knowledge, reproductive health skills, self-efficacy and intention to use protection from baseline to follow-up among students according to their teachers' types of modifications to the FOYC curriculum. The most common modifications were adding one or more videos, shortening core activities, lengthening FOYC lessons by adding reading/writing assignments or role-play games, and omitting core activities. At baseline, self-efficacy was comparable across the five groups while knowledge and reproductive health skills were higher among students whose teachers did not change the curriculum and intention was higher among students whose teachers added videos to FOYC lessons. At follow-up, all four outcomes were consistently higher among students whose teachers did not change or lengthened FOYC lessons than students whose teachers omitted or shortened core activities or added videos to FOYC lessons. Students whose teachers did not change the curriculum or lengthened FOYC lessons demonstrated greater increases in knowledge, skills and intention than students whose teachers made other modifications to FOYC lessons.

The results of the mixed-effects models indicate that types of modifications [i.e., adding videos, shortening FOYC lessons or changing most of the work, lengthening FOYC lessons with reading and writing assignment or role-play games, omitting core activities] were significantly related to changes in all four student outcomes. Compared to students whose teachers did not change the FOYC curriculum, students whose teachers *omitted* core activities demonstrated lower levels of HIV/AIDS knowledge, reproductive health skills,

self-efficacy and intention to use protection at 12 months follow-up after controlling for age, gender, baseline difference and clustering effects of school and classroom. Students whose teachers reported that they had used other *videos* in FOYC lessons demonstrated lower levels of HIV/AIDS knowledge and intention to use protection. Students whose teachers reported that they *shortened* core activities or *changed most of the activities* in the sessions demonstrated lower levels of intention to use protection. Students whose teachers *lengthened* FOYC lessons demonstrated similar levels of knowledge, skills, self-efficacy and intention with those students whose teachers did not change FOYC curriculum. Older age was associated with improvement in reproductive health skills and self-efficacy. Male gender was associated with increased reproductive health skills, self-efficacy and intention to use condom protection. Classroom random effects were significant in all four models, indicating significant variation among classrooms (Table 5).

Discussion

The present study expands upon previous research by identifying the types and extent of modifications that may occur when implementing interventions and examining the impact of the quantity and types of modifications on implementation and program outcomes of interest. The findings reveal that approximately one half of the teachers made modifications to FOYC core activities. *Omitting* core activities had negative impacts on all four student outcomes. *Shortening* core activities and *adding* videos into FOYC lessons had negative impacts on one or two student outcomes (HIV/AIDS knowledge or intention to use condom protection). *Lengthening* FOYC lessons seems not to have compromised the student outcomes. A high degree of modifications to the FOYC curriculum (1/4 core activities) regardless of what types of changes made were associated with diminished program effectiveness. This may result from degradation of implementation fidelity to an unacceptable degree. In addition, a high degree of modifications, *omitting* or *shortening* core activities are negatively related to teachers' level of implementation (i.e., number of core activities, all activities or sessions taught). These findings add to our current understanding of implementation and adaptation of evidence-based interventions and provide evidence that different types and degrees of modifications may have different impacts on implementation and program outcomes.

Our study identified several factors that are associated with intervention modifications, including lack of FOYC training, low levels of comfort in teaching FOYC lessons and other competing priorities. Not receiving training or attending only part of the assigned workshop may reflect a lack of interest or competing responsibilities. Incomplete training may also result in low levels of comfort in teaching FOYC during implementation. When teachers lack confidence in teaching FOYC lessons, their effort and persistence in the delivery of the intervention curriculum may diminish, especially when they are facing additional implementation challenges (including other competing priorities in their daily work). Teaching location is also associated with teachers' degree of modifications; nearly three-quarters of teachers who heavily modified FOYC lessons were teaching in the more rural setting of the Family Islands. By contrast, the majority of the teachers who were teaching on the capital island on which the program was originally introduced did not change or only made minor changes to FOYC lessons, suggesting that FOYC may be more culturally

acceptable and the school environment more supportive of HIV prevention programs in this setting. Somewhat surprisingly, teacher's education, teaching experience, their perceptions of the importance of HIV prevention, perceived student benefit and program ownership were not significantly associated with teacher's degree of modification, which may indicate the complexity of teacher decision-making during implementation.

Omitting core activities is the most commonly identified content modification, followed by lengthening lessons with reading, writing assignments or role-play games, shortening core activities or adding educational videos. Omitting or shortening core activities may constitute disruptions of core elements, and thus have significant negative impacts on program outcomes. By contrast, it is possible that lengthening core activities does not compromise program effectiveness because core elements of the intervention program are maintained during the implementation.

There are several limitations in this study. First, our findings are based on teachers' self-reports of their extent of implementation and modifications of the FOYC intervention. It is possible that teachers misreported their implementation and modifications of FOYC activity. We attempted to decrease this bias by using a checklist completed by each teacher for each session documenting whether and how each core activity in each session were changed; the checklists were collected shortly after the teacher completed teaching a session. Moreover, trained observers independently observed and assessed approximately 20% of each teacher's classes in the current study. The teacher and observer reports on activities covered in these sessions were compared to determine the level of agreement; in general observer-teacher agreement was high (over 80%), indicating that teacher's self-reports are reliable (Wang et al., 2015). Second, data regarding reasons as to why teachers modified the intervention activities were not collected in the present study. Future studies should probe explanations for these changes. Third, consistent with DEBI practices (Galbraith et al., 2009), the identification of "core activities" was done by the program developers in collaboration with the DEBI program staff; these delineations of "core" activities were not determined empirically. Fourth, the students were not assigned an identification number. Thus, student baseline data could not be linked with individual follow-up data. However, each classroom teacher was assigned a unique identification number and student data were identifiable at the classroom level. Given the very low attrition rate at the grade 6 follow-up (4.7%) which did not differ across teachers' modification groups, our results regarding teachers' modifications and student outcomes are valid. It is possible that other extraneous factors (e.g., HIV prevention programs delivered outside of the school system) might have impacted student outcomes.

Despite these limitations, this study makes an important contribution to the investigation of factors influencing implementation of evidence-based interventions in school settings. This study reveals that a small group of teachers made relatively major modifications to the intervention curriculum, to the point where fidelity and program effectiveness appear to have been compromised.

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Table 1
Teachers' modification of FOYC core activities and pre-implementation characteristics, teaching and training experience and post-implementation perception

Variables	Overall	Modification of FOYC			χ^2	p
		No change (71)	Changed <1/4 core activities (43)	Changed 1/4 core activities (41)		
Sample size (n)						
<i>Pre-implementation characteristics</i>						
Education level						
Associate degree/teaching certificate	11.7%	11.3%	17.1%	6.5%	3.79	0.4347
Bachelor degree	75.0%	72.6%	77.1%	77.4%		
Master degree	13.3%	16.1%	5.7%	16.1%		
Attendance of training workshop						
Did not attend training workshop	51.0%	52.1%	51.2%	48.8%	12.74	0.0126
Attended part of a workshop	17.4%	11.3%	11.6%	34.1%		
Fully attended a training workshop	31.6%	36.6%	37.2%	17.1%		
Total years as a teacher or guidance counselor						
1–5 years	18.3%	11.1%	25.0%	25.0%	4.30	0.3673
6–10 years	26.0%	28.6%	22.2%	25.0%		
>10 years	55.7%	60.3%	52.8%	50.0%		
Prior experience of teaching FOYC						
No	87.0%	88.9%	75.0%	96.9%	7.55	0.0229
Yes	13.0%	11.1%	25.0%	3.1%		
Prior experience of teaching other HIV prevention programs						
No	77.1%	84.1%	86.1%	53.1%	13.84	0.0010
Yes	22.9%	15.9%	13.9%	46.9%		
Islands						
New providence	57.4%	71.8%	60.5%	29.3%	19.48	<.0001
Other family islands	42.6%	28.2%	39.5%	70.7%		
<i>Post-implementation perceptions</i>						
Having other priorities (than teaching FOYC)						
No	63.2%	62.0%	76.7%	51.2%	5.97	0.0505

Variables	Overall	Modification of FOYC			χ^2	p
		No change	Changed <1/4 core activities	Changed 1/4 core activities		
Yes	36.8%	38.0%	23.3%	48.8%		
Perceived benefits of FOYC curriculum for Grade 6 students						
Somewhat/not at all	23.2%	20.6%	21.4%	29.7%	1.19	0.5514
Very much	76.8%	79.4%	78.6%	70.3%		
Student engagement in core activities (range 1–3 points) [‡]	2.90 (0.17)	2.93 (0.15)	2.93 (0.10)	2.82 (0.24)	6.44	0.0021
Comfort level in teaching core activities (range 1–3 points) [‡]	2.87 (0.20)	2.88 (0.21)	2.92 (0.14)	2.81 (0.22)	3.66	0.0280

Note:

[‡] F test was used

Table 2

Teachers' levels of modification of FOYC core activities and student outcomes

Variables	Modification of FOYC				F	p	Post-hoc comparisons
	Overall	No change (1)	Changed 1/4 core activities (2)	Changed >1/4 core activities (3)			
Student sample size (n)	3646	1645	1008	993			
HIV/AIDS knowledge (range 0–15 points)							
Baseline	8.03 (2.79)	8.19 (2.67)	8.10 (2.78)	7.70 (2.97)	9.46	<.0001	(1,3) (2,3)
Follow-up	9.82 (2.45)	9.92 (2.34)	9.93 (2.40)	9.51 (2.66)	8.71	0.0002	(1,3) (2,3)
Increase (follow-up-baseline)	1.79 (2.63)	1.73 (2.51)	1.83 (2.60)	1.81 (2.83)	0.49	0.612	
Preventive reproductive health skills (range 0–6 points)							
Baseline	3.23 (1.37)	3.36 (1.33)	3.18 (1.38)	3.04 (1.40)	14.82	<.0001	(1,2) (1,3)
Follow-up	3.83 (1.28)	3.89 (1.26)	3.83 (1.26)	3.71 (1.33)	5.25	0.0053	(1,3)
Increase (follow-up-baseline)	0.60 (1.32)	0.54 (1.29)	0.65 (1.32)	0.66 (1.36)	2.91	0.054	
Self-efficacy (range 0–3 points)							
Baseline	0.87 (1.09)	0.88 (1.06)	1.00 (1.14)	0.71 (1.07)	16.71	<.0001	(1,2) (1,3) (2,3)
Follow-up	1.24 (1.14)	1.32 (1.17)	1.24 (1.12)	1.09 (1.09)	10.52	<.0001	(1,3) (2,3)
Increase (follow-up-baseline)	0.37 (1.11)	0.44 (1.12)	0.24 (1.13)	0.38 (1.08)	9.02	<.0001	(1,2) (2,3)
Intention to use condom protection (range 1–5 points)							
Baseline	2.48 (1.67)	2.48 (1.67)	2.55 (1.67)	2.42 (1.68)	1.18	0.3064	
Follow-up	3.40 (1.78)	3.49 (1.77)	3.48 (1.77)	3.15 (1.78)	10.17	<.0001	(1,3) (2,3)
Increase (follow-up-baseline)	0.92 (1.73)	1.01 (1.72)	0.93 (1.72)	0.73 (1.73)	6.66	0.001	(1,3) (2,3)

Note: Two decimal numbers in parentheses are standard deviations.

Table 3
Mixed-effects models assessing the association between teacher's degrees of modification and student outcomes

Variables	Estimated models											
	HIV/AIDS knowledge			Preventive reproductive health skills			Self-efficacy			Intention to use protection		
	B	SE	t	β	SE	t	β	SE	t	β	SE	t
<i>Fixed effect</i>												
Intercept	9.074	0.545	16.65***	2.858	0.296	9.64***	0.574	0.247	2.32*	3.313	0.427	7.75***
Age	0.079	0.047	1.68	0.077	0.026	3.00**	0.143	0.022	6.51***	-0.012	0.038	-0.31
Male gender ^a	0.080	0.084	0.96	0.177	0.047	3.77***	0.536	0.040	13.51***	0.570	0.067	8.46***
Baseline student outcome	-0.016	0.015	-1.02	0.020	0.017	1.14	0.022	0.018	1.22	-0.009	0.020	-0.43
Teacher's level of modifications ^b												
Slightly changed FOYC lessons (<1/4 core activities)	-0.010	0.207	-0.05	-0.074	0.097	-0.76	-0.091	0.072	-1.27	0.003	0.131	0.02
Heavily changed FOYC lessons (1/4 core activities)	-0.399	0.210	-1.90*	-0.107	0.105	-1.03	-0.201	0.075	-2.66**	-0.328	0.136	-2.42*
<i>Random effect</i>												
School [†]	-	-	-	0.037	0.025	1.51 [#]	0.009	0.013	0.70	0.022	0.038	0.57
Class (nested within school) [‡]	0.796	0.126	6.31***	0.110	0.028	3.95***	0.058	0.018	3.27***	0.224	0.056	3.98***

[#] P<0.10;

* P<0.05;

** P<0.01;

*** P<0.001.

[†] z test.

^a Female gender is the reference.

^b "Did not change FOYC lessons" is the reference.

Table 4

Teachers' types of modification of FOYC core activities and student outcomes

Variables	Overall	Types of modifications to FOYC					F	p
		Adding video	Shortening	Lengthening	Omitting	No change		
Student sample size (n) [†]	3033	346	531	436	792	928		
HIV/AIDS knowledge (range 0–15 points)								
Baseline	8.12 (2.72)	8.23 (2.62)	7.98 (2.80)	7.94 (2.95)	7.99 (2.68)	8.37 (2.63)	3.30	0.0105
Follow-up	9.84 (2.45)	9.32 (2.49)	9.74 (2.52)	10.29 (2.40)	9.55 (2.48)	10.09 (2.33)	12.82	<.0001
Increase (follow-up-baseline)	1.71 (2.59)	1.09 (2.56)	1.77 (2.68)	2.35 (2.69)	1.56 (2.58)	1.72 (2.48)	12.27	<.0001
Preventive reproductive health skills (range 0–6 points)								
Baseline	3.25 (1.35)	3.04 (1.27)	3.16 (1.35)	3.29 (1.48)	3.26 (1.34)	3.37 (1.32)	4.38	0.0016
Follow-up	3.83 (1.28)	3.68 (1.28)	3.84 (1.20)	3.90 (1.34)	3.68 (1.33)	3.97 (1.23)	6.66	<.0001
Increase (follow-up-baseline)	0.58 (1.32)	0.64 (1.28)	0.68 (1.28)	0.61 (1.41)	0.42 (1.34)	0.59 (1.27)	3.49	0.008
Self-efficacy (range 0–3 points)								
Baseline	0.88 (1.09)	0.91 (1.10)	0.85 (1.10)	0.91 (1.09)	0.83 (1.07)	0.92 (1.10)	0.94	0.4385
Follow-up	1.25 (1.14)	1.25 (1.14)	1.19 (1.07)	1.22 (1.12)	1.16 (1.16)	1.35 (1.15)	3.39	0.0090
Increase (follow-up-baseline)	0.37 (1.12)	0.33 (1.12)	0.35 (1.09)	0.30 (1.11)	0.33 (1.12)	0.44 (1.13)	1.67	0.155
Intention to use protection (range 1–5 points)								
Baseline	2.49 (1.68)	2.68 (1.69)	2.51 (1.73)	2.60 (1.70)	2.35 (1.63)	2.47 (1.67)	2.68	0.0299
Follow-up	3.41 (1.78)	3.04 (1.78)	3.18 (1.82)	3.80 (1.63)	3.22 (1.81)	3.64 (1.74)	15.69	<.0001
Increase (follow-up-baseline)	0.92 (1.73)	0.36 (1.73)	0.67 (1.78)	1.19 (1.67)	0.86 (1.72)	1.16 (1.70)	17.62	<.0001

Note: 15 teachers reported that they made changes on core activities but did not indicate what types of changes that they had made; those teachers and their 613 students were excluded from this analysis. Numbers in parentheses are standard deviations.

Table 5
Mixed-effects models assessing the association between types of modifications and students' outcomes

Variables	Estimated models											
	HIV/AIDS knowledge			Preventive reproductive health skills			Self-efficacy			Intention to use protection		
	β	SE	t	β	SE	t	β	SE	t	β	SE	t
<i>Fixed effect</i>												
Intercept	9.244	0.577	16.03***	2.901	0.312	9.30***	0.621	0.260	2.39*	3.321	0.447	7.44***
Age	0.071	0.049	1.46	0.078	0.027	2.93**	0.150	0.023	6.54***	-0.000	0.039	-0.00
Male gender ^a	0.056	0.088	0.64	0.164	0.049	3.32***	0.538	0.042	12.90***	0.554	0.071	7.81***
Baseline student outcome	-0.005	0.017	-0.30	0.022	0.019	1.20	0.022	0.019	1.13	-0.002	0.021	-0.11
Teacher's types of modifications ^b												
Adding video	-0.750	0.313	-2.40*	-0.247	0.157	-1.57	-0.058	0.116	-0.50	-0.592	0.189	-3.13**
Shortening core activities or changing most of the work	-0.390	0.277	-1.41	-0.120	0.140	-0.85	-0.116	0.104	-1.12	-0.410	0.172	-2.39*
Reading/writing/skit/lengthening	0.214	0.275	0.78	-0.031	0.134	-0.23	-0.154	0.101	-1.53	0.171	0.170	1.00
Omitting	-0.520	0.236	-2.20*	-0.247	0.114	-2.16*	-0.164	0.086	-1.91*	-0.408	0.145	-2.81**
No change (ref)												
<i>Random effect</i>												
School [†]	-	-		0.046	0.029	1.61	0.015	0.015	0.97	0.001	0.032	0.04
Class (nested within school) [‡]	0.747	0.128	5.82***	0.108	0.030	3.62***	0.059	0.019	3.15***	0.213	0.057	3.70***

P<0.10;

* P<0.05;

** P<0.01;

*** P<0.001.

[†] z test.^a Female gender is the reference.^b "No change" is the reference.