Published in final edited form as:
J Sch Health. 2019 July ; 89(7): 549–559. doi:10.1111/josh.12781.

Using a Modified Theory of Planned Behavior to Examine Teachers' Intention to Implement a Work Safety and Health Curriculum

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Abstract

BACKGROUND: Workplace safety and health is a major public health concern, but largely absent from the school health curriculum. Little is known about teachers' perceptions of teaching workplace safety and health topics.

METHODS: We administered a 41-item questionnaire reflecting the theory of planned behavior, modified to measure knowledge, to 242 middle and high school teachers in career and technical education and academic subjects. We conducted confirmatory factor analysis to assess the measures' psychometric properties and factorial ANOVAs to compare differences among participants' knowledge, attitude toward, self-efficacy, and intention (to teach) workplace safety and health by sex, prior work injury, and main subject taught.

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DISCLAIMER
The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

RESULTS: Confirmatory factor analyses indicated the measures reflected the theory. Factorial ANOVAs suggested female teachers had statistically significantly lower mean self-efficacy scores than did male teachers to teach workplace safety and health. Male occupational career and technical education teachers demonstrated higher mean knowledge scores than male teachers in other subjects. Participants not injured at work had higher knowledge scores than those who had been injured.

CONCLUSION: Self-efficacy (influenced by sex) and knowledge (influenced by subject taught and previous workplace injury) revealed factors that may affect teachers' provision of workplace safety and health education, a critical yet overlooked component of school health.

Keywords

workplace safety and health; theory of planned behavior; teacher training; occupational safety and health education; curriculum adoption; career and technical education

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In the United States, school health programs and curricula have been shown to be effective at reducing adolescent risk behaviors.[1] One important but overlooked area for health education in middle schools and high schools is workplace safety and health, despite it being an accepted health education topic.[2–4] This is a critical gap in adolescents' life skills training and acquisition, as more than 80% of young people will work while in high school,[5] and most will enter the workplace unprepared for the hazards they encounter. In 2016, adolescent workers ages 16 to 19 had the third highest incidence rate among all age groups (101.9/10,000 full-time equivalents) of nonfatal occupational injuries and illnesses involving days away from work.[6]

Multiple risk factors contribute to the high burden of injury on young workers, including inexperience,[7,8] lack of supervision and training,[9,10] minority status,[11,12] and employment in jobs with exposure to physical hazards, even despite the existence of federal and state child labor laws meant to protect them.[13–15] These incidents have a long-term impact on adolescents' health and well-being.[16,17] Employers are responsible by law for providing job-specific training, but foundational, work safety education delivered in school may be protective against work-related injuries among youth.[18] Teachers play a critical role in ensuring the effective transfer of information on health and risk topics,[19,20] including workplace safety and health.[21] Thus, it is imperative to understand the factors influencing teachers' perceptions and knowledge concerning the implementation of school health curricula/programs,[22,23] including on the topic of workplace safety and health.

Health behavior theories, such as the theory of planned behavior,[24] may be useful in guiding interventions to change the perceptions of people within organizations that are adopting new programs.[25] The theory of planned behavior proposes that attitude, subjective norms, and perceived behavioral control influence a person's intention to act.[24] The theory has been used to explain teachers' adoption of new teaching methods and curricula.[26,27] Specifically, teachers' attitude[23,28] and intention[26,29] have been shown to play a role, either as barriers or facilitators, to the successful uptake of new practices. Moreover, self-efficacy—confidence in one's ability to take action and successfully execute a behavior to produce a desired result[30]—is often used interchangeably with perceived behavioral control[31] and is a key facilitator to teachers' effective implementation of new health programs.[22,32–34] Although not explicitly included in the theory of planned behavior, knowledge has also been shown as an important predictor of teachers' acceptance of new programs.[35–37]

Currently, evidence is lacking on how educators perceive the teaching of workplace safety and health to their students. Increased recognition of the importance of and need for workplace safety and health education may result in an increased delivery of these programs in schools to teens entering the workforce.[21]

For this research, we used constructs from a modified theory of planned behavior to assess teachers' knowledge and attitude about, and self-efficacy and behavioral intention to teach, *Youth@Work—Talking Safety*,[38] a free, workplace safety and health curriculum for middle schools and high schools developed by the National Institute for Occupational Safety and Health (NIOSH) and its partners. The theory of planned behavior model was modified to include knowledge and exclude subjective norms, as the evaluation was given before teachers implemented the curriculum. *Talking Safety* contains 6, 45-minute lessons that deliver foundational competencies (listed in Table 1) that delineate essential knowledge, skills, and abilities that pertain to: hazard recognition and control in the workplace; employer responsibilities and worker rights and roles; actions to take in a work-related emergency; and communication with others when feeling unsafe or threatened.[39] *Talking Safety* is aligned with the National Health Education Standards[40] and includes common instructional strategies for actively engaging students in the acquisition and retention of health and safety skills.[41] *Talking Safety* compliments school health, career readiness, and traditional academic curricula. The NIOSH curriculum is also highly relevant to career and technical schools and programs, which focus on the skills and knowledge required for specific jobs or occupational fields (such as construction and repair, agriculture, manufacturing, and health sciences).[42] Teachers in career and technical education programs are a diverse group specializing in academic subjects (such as math and science), non-occupational career and technical education subjects (such as family and consumer sciences), and occupational education (such as auto repair, culinary arts, and construction).[43]

The purpose of the current study was two-fold: to confirm whether scores on the new questionnaire developed for this research reflect the modified, theory of planned behavior model that also includes a knowledge construct; and to compare a diverse group of traditional and career and technical education programs teachers' knowledge about, attitude toward, self-efficacy, and intention to teach the NIOSH *Talking Safety* curriculum.[38] Several research questions were posited: Do scores on the questionnaire reflect a 3-factor structure that represent the constructs of attitude, perceived behavioral control/self-efficacy, and behavioral intention and a single factor to represent knowledge? To what extent do teachers differ on outcomes by their subject area? Are these differences dependent on teachers' sex and having experienced a prior, work-related injury?[44–46]

METHODS

Participants

During the 2015–2016 academic year, a total of 242 teachers from approximately 98 schools in 3 large school districts in urban areas in the Southeast, Central, and Northeastern United States completed the NIOSH questionnaire before participating in NIOSH-led trainings on the *Talking Safety* curriculum. Decisions as to which classes/tracks and at what grade level to implement the curriculum were made by administrators at the district level, prior to engagement with NIOSH. To help teachers become familiarized with the *Talking Safety* curriculum, they were recruited by department administrators to attend NIOSH training sessions conducted during regularly scheduled professional development days. Participants in the Southeastern school district who were selected to deliver the curriculum taught an academic subject (science) in traditional, comprehensive schools; in the Northeast, participants taught both technical/occupational and academic subjects as well as other career and technical education subjects (such as family and consumer science and health), within a large, state-wide system of career and technical schools; and participants in the central US district taught non-occupational career and technical education (business and technology) courses in comprehensive schools.

For the full sample (N = 242) used to confirm whether the questionnaire developed for the study reflects the modified, theory of planned behavior model, approximately 28% (N = 67) of teachers reported their main subject to be occupational career and technical education (such as construction, manufacturing, or culinary arts), 40% (N = 98) taught an academic subject (such as science) in a comprehensive school, and 32% (N = 77) taught non-occupational career and technical education in comprehensive schools and academic subjects (such as English or math) in a career and technical school.

Of the 242 participants, 54 individuals were excluded from further analysis because they were non-teachers, such as guidance counselors (N = 39) or teachers who did not provide any demographic information (N = 15) necessary for the statistical comparisons. Therefore, a subsample of 188 teachers who taught subjects where the curriculum was being considered for implementation were included in the ANOVAs (occupational career and technical education teachers in technical schools, N = 67; academic teachers in comprehensive schools, N = 98; and non-occupational career and technical education [business and technology teachers] in comprehensive schools, N = 23). Descriptive statistics for the subsample are reported in Table 2. The largest proportion of teachers in the subsample (26%) reported length of time teaching at more than 20 years. Approximately one-fourth of teachers in the subsample reported having experienced a work-related injury severe enough to require time off work, and roughly equal numbers of women and men were present.

Instrumentation

Before the questionnaire was administered, content validity was established by having 3 teachers in one of the study districts and 2 school administrators review and provide feedback on all items with regards to clarity, readability, and item content. Minor revisions were suggested, mainly to clarify instructions.

Attitude.—To measure attitude related to teaching the *Talking Safety* curriculum, participants indicated their perceived importance of teaching specific workplace safety content (eg, *How important do you feel it is to teach your students how to identify hazards at work?*). The 8-item attitude measure used a 5-point response format ranging from 1 (*not important at all*) to 5 (*extremely important*).

Self-efficacy.—To measure self-efficacy to teach workplace safety and health, participants indicated their perceived certainty/confidence in their ability to successfully deliver to students information on 8 specific workplace safety skills related to the NIOSH Core Competencies and taught through *Talking Safety* (eg, *How confident are you that you can teach your students to evaluate hazards at work that could injure them?*). The 8-item measure used a 5-point response format ranging from 1 (*not at all confident*) to 5 (*extremely confident*).

Behavioral intention.—To measure behavioral intention, participants indicated their perceived likelihood to teach to their students 8 specific workplace safety skills related to the NIOSH Core Competencies taught within the NIOSH curriculum (eg, *How likely is it that you will teach your students to report problems to people in charge when the workplace is unsafe?*). The 8-item intention measure used a 5-point scale ranging from 1 (*not at all likely*) to 5 (*extremely likely*).

Knowledge.—The 13-item dichotomously scored *Knowledge* measure was taken from a 50-item assessment for the curriculum that was developed, piloted separately, and described elsewhere.[47] The assessment includes items that gauge both factual and applied knowledge learned through the *Talking Safety* program (eg, *Question: Who is most responsible for keeping a workplace safe? A. the union; B. OSHA; C. the employer; D. the Department of Labor. Answer: C. the employer*). Because of time constraints, the complete assessment was not used in this study, but 20 items covering the NIOSH Core Competencies (Table 1) were selected for inclusion on the questionnaire, of which an additional 7 were removed after item analyses.

Demographic questions.—Demographic items asked respondents whether they had ever experienced a work-related injury severe enough to require time off work (yes/no), main subject taught (categorized as academic, non-occupational and occupational career and technical education);[43] sex (female/male), and number of years teaching (< 5, 6–10, 11–15, 16–20, >20).

Procedure

Participants were administered the paper questionnaire before attending a NIOSH training on the *Talking Safety* curriculum, held during a regularly scheduled, professional development day in the district. Participants took about 15 to 20 minutes to complete the questionnaire. Data were deidentified and collected for analysis.

Data Analysis

Prior to analysis, data were examined for missing values. Item level missing data ranged from 5.1% to 10.6%. To handle missing data, single imputation was conducted in M*plus* (version 8)[48] using the Markov Chain Monte Carlo algorithm[49] to account for ordinal indicators and included several auxiliary variables (ie, teacher sex, years teaching, main subject taught, and injured at work).

A confirmatory factor analysis was conducted on the full teacher sample (N = 242) to assess the fit of the 3 correlated factors that measured the latent constructs of attitude, self-efficacy, and behavioral intention related to teaching workplace safety and health. A separate analysis was conducted to provide evidence that the knowledge measure reflected a single factor. The models were estimated in M*plus* with weighted least squares with mean and variance correction (WLSMV) estimation. Model fit was assessed with the χ^2_{WLSMV} statistic and its associated p value (good fit was indicated by an insignificant result, $p > .05$);[50] root mean square error of approximation (RMSEA), comparative fit index, (CFI), Tucker-Lewis Index (TLI), and the weighted root mean residual (WRMR). The following fit criteria and cutoff values were used: for good fit,[51,52] RMSEA ≤ 0.06, CFI ≥ 0.95, TLI ≥ 0.95, and WRMR values close to 1. Because of the way that the chi-square statistic is calculated, it is unlikely to be able to obtain a non-significant test result, but it is commonly reported despite serious limitations.[52] Finally, internal consistency of reliability was estimated with coefficient omega (ω).[53]

Mean comparisons on outcomes.—To examine teacher subject area differences, data were analyzed for each outcome variable using a 2 (main subject) × 2 (sex) × 2 (prior work-related injury) ANOVA. Only teachers who had classes of students where the NIOSH curriculum was considered for implementation and who provided demographic data on the questionnaire (N = 188) were included in the ANOVAs.

To avoid small cell counts that may generate unstable variance estimates, the variable *main subject* taught was collapsed into 2 categories: (1) occupational career and technical education in career and technical schools; and (2) academic/non-occupational career and technical education in comprehensive schools. Cohen's *d* was used to gauge the effect size for mean comparisons and interpreted with Cohen's benchmarks: d = 0.2, small effect size, d = 0.5, medium effect size, d ≥ 0.8, large effect size.[54] Effect sizes for interactions and main effects were estimated by partial eta squared, η^2_{partial}, and interpreted with Cohen's benchmarks: 0.01 = small effect size, 0.06 = medium effect size, 0.14 = large effect size.[55,56]

RESULTS

Psychometric Properties of the Measures

Consistent with the theory of planned behavior, a 3-factor model consisting of attitude, self-efficacy, and intention factors adequately fit the data: $\chi^2_{\text{WLSMV}}(249) = 565.638$, $p < .001$, RMSEA = 0.072, RMSEA 90% CI [0.064, 0.080], CFI = 0.995, TLI = 0.994, WRMR = 1.082. All standardized factor loadings were statistically significant ($p < .05$) and ranged from 0.85 to 0.98. An examination of structure coefficients indicated that no items were misspecified (Table 3). Residual correlations were all less than |0.10|, which suggested acceptable local fit.[57] Factor correlations were 0.40 between attitude and intention, 0.43 between attitude and self-efficacy, and 0.62 between intention and self-efficacy. Sample reliability (ω) were, for attitude = 0.97, for self-efficacy = 0.98, and intention = 0.99 (Table 3).

Results for the 13-item knowledge measure indicated a one-factor model adequately fit the data: χ^2_{WLSMV} (65) = 66.522, p = .42, RMSEA = 0.010, RMSEA 90% CI [0.000, 0.040], CFI = 0.993, TLI = 0.991, WRMR = 0.673. All standardized factor loadings were statistically significant (p < .01) and ranged from .50 to .91. Residual correlations were all less than |0.10|. Sample reliability (ω) was 0.90.

Teacher Comparisons

Estimated marginal means, standard errors, and confidence intervals for the theory of planned behavior and knowledge measures related to teaching workplace safety and health are reported in Table 4. Although no statistically significant main or interaction effects were found for attitude, all participants had high scores on the measure, with occupational career and technical education teachers demonstrating a more positive attitude toward teaching this topic (M = 4.76, SE = 0.08) when compared to the other respondents (M = 4.55, SE = 0.09).

A statistically significant main effect was observed for *sex* on self-efficacy, F(1, 177) = 4.99, p = .03, $\eta^2_{Partial}$ = 0.03 (small effect size), d = 0.34 (small effect size), indicating that on average male teachers (M = 4.24, SE = 0.13, N = 85) had higher self-efficacy scores to teach workplace safety and health than female teachers (M = 3.81, SE = 0.14, N = 100). No other main or interaction effects were observed for self-efficacy scores.

Moreover, although no statistically significant main or interaction effects were found for the behavioral intention measure, the injured at work variable approached significance on the intention outcome (p = .07), with those teachers having experienced a previous work-related injury demonstrating higher mean scores on average (M = 4.30, SE = 0.19, N = 44) when compared to the other sample teachers who had not been injured (M = 3.90, SE = 0.101, N = 144). It should also be noted that average scores (Table 4) were lower on this outcome than might be expected—especially for the non-occupational career and technical education and academic teachers (M = 3.90, SE = 0.16)—given district-wide buy-in for the program.

For the knowledge measure, a statistically significant interaction effect was found between the variables *main subject taught* and *sex*, F(1, 177) = 4.37, p = .04, $\eta^2_{Partial}$ = 0.02 (small effect size), d = 0.31 (small effect size). Simple pairwise comparison tests were conducted to examine the effects of *main subject* (occupational versus non-occupational career and technical education and academic) and *sex* on knowledge scores. Statistically significantly higher mean knowledge scores were found for male occupational career and technical education teachers (M = 12.05, SE = 0.256, N = 49) versus male non-occupational career and technical education and academic teachers (M = 10.33, SE = 0.48, N = 36), t(177) = 3.18, p = .002, d = 0.48 (medium effect size). Finally, teachers indicating a previous workplace injury had lower knowledge scores (M = 10.87, SE = 0.32, N = 44) than those who reported having no previous injury at work requiring time off work (M = 11.67, SE = 0.183, N = 141), $F(1, 177) = 4.40$, $p = .04$, $\eta^2_{Partial} = 0.02$ (small effect size).

DISCUSSION

The purpose of our study was to confirm whether scores on the new outcome measures developed for the study reflect the modified, theory of planned behavior model that also includes a knowledge construct and to compare a diverse group of traditional and CTE teachers' knowledge about, attitude toward, self-efficacy, and intention to teach a foundational curriculum in workplace safety and health for adolescents (*Talking Safety*). The confirmatory factor analysis results provided initial evidence that the data from the NIOSH questionnaire designed for this study generated reliable scores and represented distinct theory of planned behavior constructs. Moreover, the knowledge measure was shown to capture the single construct of foundational workplace safety and health knowledge. Self-efficacy (influenced by *sex*) and knowledge (by *main subject taught* and *previous workplace injury)* revealed insights into the factors that may affect teachers' implementation of a foundational, work safety curriculum.

Female teachers showed statistically significantly lower self-efficacy to teach workplace safety and health than did male teachers, a result that supports previous research on teacher self-efficacy and sex differences.[44,45] Findings should be interpreted with caution, however, given the cross-sectional design and the small effect size for differences. Research from Sy and Glanz[34] suggests that teachers generally with high self-efficacy were more likely to fully implement a smoking prevention curriculum, providing support for the importance of increasing all teachers' confidence in their ability to fully implement school health programs and curricula, such as *Talking Safety*.

Furthermore, the statistically significant interaction effect for the knowledge measure suggests that associations between teachers' subject area and their sex were not uniform across participants: male occupational career and technical education teachers had higher knowledge scores than male non-occupational career and technical education and academic teachers. This result is not surprising as safety is already integrated into most career and technical curricula. However, it is interesting to note that there were no statistically significant differences detected between female occupational and the non-occupational career and technical education and academic teachers. Broadly speaking, more research is needed to understand the myriad individual and organizational factors involved in the adoption and implementation of health innovations in schools,[34,58] including related to the adoption/implementation of the NIOSH curriculum.

No significant main or interaction effects for attitude to teach workplace safety and health were revealed. However, use of factorial ANOVAs resulted in lower degrees of freedom and may have led to fewer significant findings. All participants had high scores on the attitude measure, with occupational career-technical teachers showing a more positive attitude toward teaching work safety topics when compared to the other respondents (Table 4). Previous research suggests that attitude is an important predictor of teachers' uptake of new practices and programs.[23,28] Conversely, teachers' negative perceptions of classroom-based interventions may be associated with lower levels of implementation.[59] The positive scores on the attitude measure are encouraging in terms of future and ongoing implementation of *Talking Safety* among the sample teachers.

Furthermore, we found no significant differences between the 188 teachers on their intention to teach workplace safety and health—not surprising given that these teachers were selected by their districts to implement the curriculum. However, average scores were lower on this outcome than might be expected, especially for the non-occupational career and technical and academic teachers (Table 4) given district-wide buy-in for the program. Even when interventions are adopted at the organizational level, the success and sustainability of new programs, such as *Talking Safety*, may ultimately reside with the teachers.[60] Thus, it is important to understand the factors that enhance (and the barriers that impede) teachers' implementation of health programs.[23,61] Given the lower, mean scores overall on self-efficacy and intention when compared to attitude (Table 4), additional research is needed to investigate whether scores on these outcomes—which are critical to ultimate behavior change (such as curriculum implementation) —increase after teachers receive intensive training on *Talking Safety* delivery. It is also worth noting that teachers who had a previous workplace injury that required time off work were found to have higher levels of intention toward teaching safety and health at work compared with those teachers who had not experienced a previous work-related injury (Table 4) and the association approached significance ($p = .07$). Findings from Rauscher et al.[46] suggested that high school teachers with a prior work injury were less likely to adopt the NIOSH *Talking Safety* curriculum. More research is needed to understand how teachers who have experienced a work-related injury perceive of delivering workplace safety and health education to their students.

Limitations

A number of limitations of the current research should be noted. First, the cross-sectional research design limits the generalizability of results and the ability to make causal inferences. Future research should explore differences across a larger and more representative sample of teachers. Moreover, although factorial ANOVAs have advantages over other linear techniques, they result in lower degrees of freedom, which can limit the number of statistically significant findings.

Finally, not all of the theory of planned behavior constructs were measured, including subjective norms and behavior. Although it is suggested that interventions based on the theory include simultaneous attention to all model dimensions, it is not unusual for researchers to modify the model on the basis of the intervention population.[31] Moreover, the model elements included in this study were measured as unitary constructs rather than capturing all sub-domains of the construct, a limitation noted in previous research that uses the theory of planned behavior.[62]

Despite these limitations, the current research provides novel insights into factors that may affect the implementation of a workplace safety and health program delivered by teachers as part of the school health curriculum.

Conclusions

Schools provide important contexts for preparing adolescents with a foundation of risk-based, health education, including in the area of workplace safety and health.[21,39] Teachers are gatekeepers to the success of school health programs, and therefore, play an important role in efforts to prepare youth for successful and safe entry into the labor force.[4,17] This study provides initial evidence that self-efficacy (influenced by sex) and knowledge (by main subject taught and previous workplace injury) are important factors that may affect teachers' implementation of a work safety and health curriculum in their classrooms. This research also supports the use of the theory of planned behavior to measure middle and high school teachers' knowledge, attitude toward, self-efficacy, and behavioral intention to teach workplace safety and health. More research is needed to explore teachers' —especially those from academic and non-occupational career and technical fields who may not be exposed to workplace safety topics—awareness and perceptions of the importance of teaching this subject. In this way, professional education and training can be developed to increase buy-in for workplace safety and health programs, such as *Talking Safety*. Further evidence is also needed to understand how the application of health behavior/promotion theory to classroom interventions may promote the health and well-being of the future workforce.

IMPLICATIONS FOR SCHOOL HEALTH

According the US Centers for Disease Control and Prevention, 24% to 98% (median = 82%) of large, urban school districts include injury prevention, and safety as part health education instruction.[19] Risk reduction of work-related injuries among adolescents is a sub-area of injury prevention and safety,[2] but the extent to which students are being taught this topic, if at all, is unknown. The majority of teens work before completing high school,[5] and many are injured due to a lack of inadequate preparation for the hazards and risks they encounter on the job.[6–14] These injuries can be life-altering, and are all the more tragic because most can be predicted and prevented. Increased recognition of the importance of and need for work safety education may result in an increased delivery of these programs in schools to teens entering the workforce.[21] In France, Boini et al.[18] found that young workers who had received workplace safety and health education at school reported 2 times fewer injuries on the job than young workers who had not received this preparation (incidence rate ratio [IRR] 0.51, 0.00–0.98). For widespread adoption of this important topic as part of health education curriculum, decision makers within the school system will need to gain awareness of the public health impact of young worker injuries and the need to prepare young people for safe and healthy work. A champion,[63] whether a school administrator, teacher, or parent, can be instrumental in raising awareness about the importance of occupational safety and health may facilitate the adoption of youth education in this area. School districts must also evaluate the appropriate fit, in terms of curricular area and grade level, for occupational safety and health education. For example, the *Youth@Work—Talking Safety* curriculum,[38] discussed previously, was originally developed for use in high schools. However, *Talking Safety* is currently being implemented in a number of settings, including in eighth grade Science (Human Growth and Development) classes, in one of the largest US public school districts.[64] Previous research suggests the need to enhance the integration of health education topics into core curriculum classrooms[65] and have shown that those health education programs integrated into normal school activities are implemented more successfully.[66] Moreover, earlier introduction of these essential life skills creates a foundation of workplace safety and health knowledge and skills before youth enter the labor force and before they are ever exposed to their first job hazard in a formal work environment.

Evidence from the public health literature suggests teachers play a critical role in ensuring the effective transfer of information on health topics,[19,20] including workplace safety and health,[21] and that professional development/training for teachers may enhance self-efficacy and generally facilitates the successful and sustainable implementation of evidence-based, health education programs.[23,32,61,67,68] Buy-in for new curricula should be sought and teachers provided training on new health education programs. The school districts included in this study arranged for training on the *Talking Safety* curriculum to be included as part of a regularly scheduled professional development day. Moreover, to achieve the long-term sustainability of new programs, it is necessary to build internal capacity to support its on-going implementation. One way to achieve this is through a training-of-the-trainer (TOT) model, which has been used to varying extents in the districts included in this study.

Institutional support, including principal support,[61,66,69] is also necessary to ensure the successful, sustainable implementation of new health education programs. Moreover, adoption of new health education programs requires there be a good fit between the innovation and local needs,[63] and that the innovation is adaptable to new practices, or easily integrated into current practices. Research from Parcel et al.[70] indicates that school districts able to adapt to new practices, or able to see how a new program could be integrated into current practices, were more likely to adopt an innovation. The free and widely-used NIOSH *Talking Safety* curriculum[38] may be immediately adopted by US school districts as part of existing school health education programs or easily adaptable to fit into other classes where health education topics are presented. The curriculum, customized for all US states, Puerto Rico, and the U.S. Virgin Islands, is available for free download, and is also available in Spanish. The curriculum may be used by middle school and high schools to help to prepare all young people for a lifetime of safe and healthy work.

Human Subjects Approval Statement

The NIOSH Institutional Review Board (IRB)/Human Research Protection Program (HRPP) issued a research exempt determination for this project (16-EID-02XM and 14-EID-07XM) under 45 CFR 46.101(b)(1). This research was conducted in accordance with the ethical standards of the NIOSH IRB/NIOSH HRPP and with the 1975 Helsinki declaration as revised in 2000.

Acknowledgments

We thank Jim Emshoff, PhD, Michelle DiMeo-Ediger, PhD and John P. Barile, PhD, for providing their expertise on data cleaning and analysis. We also thank Beth Miller, PhD, RD, LD, and Zijia Li, PhD, for their thoughtful reviews of the manuscript, and Seleen Collins, NIOSH, for editing assistance.

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Table 1.

The NIOSH 8 Core Competencies for Workplace Safety and Health

Competency	Description
1	Recognize that, while work has benefits, all workers can be injured, become sick, or even be killed on the job. Workers need to know how workplace risks can affect their lives and their families.
2	Recognize that work-related injuries and illnesses are predictable and can be prevented.
3	Identify hazards at work, evaluate the risks, and predict how workers can be injured or made sick.
4	Recognize how to prevent injury and illness. Describe the best ways to address workplace hazards and apply these concepts to specific workplace problems.
5	Identify emergencies at work and decide on the best ways to address them.
6	Recognize that employers are responsible for, and workers have the right to, safe and healthy work. Workers also have the responsibility for keeping themselves and coworkers safe.
7	Find resources that help keep workers safe and healthy on the job.
8	Demonstrate how workers can communicate with others—including people in authority roles—to ask questions or report problems or concerns when they feel unsafe or threatened.

Table 2.

Participant Demographic Characteristics for Factorial Analysis of Variance (N=188)

Variable	%	N
Main subject area taught (N = 188)*		
Academic	52.1	98
Non-occupational CTE	12.2	23
Occupational CTE	35.6	67
Sex (N = 185)		
Male	45.9	85
Female	54.1	100
Injured at work severely enough to required time off work? (N = 188)		
Yes	23.4	44
No	76.6	144
Number of years teaching† (N = 187)		
<5	15.5	29
6–10	22.5	42
11–15	18.2	34
16–20	18.2	34
>20	25.7	48

*For this study, academic included science taught in comprehensive schools; non-occupational career and technical education (CTE) included CTE business and technology delivered in comprehensive schools; and occupational CTE included construction manufacturing, health sciences, culinary arts, auto repair, and other technical topics delivered in career and technical schools.

†Due to small cell counts, this variable was not included in the factorial ANOVA analyses but is reported for descriptive purposes.

Table 3.

Standardized Confirmatory Factor Analysis Results for the Theory of Planned Behavior Measures Related to Teaching Occupational Safety and Health (N = 242)

	ATT		SE		BI	
Item	**λ**	**r_{st}**	**λ**	**r_{st}**	**λ**	**r_{st}**
ATT1	0.86	0.86	—	0.34	—	0.71
ATT2	0.88	0.88	—	0.34	—	0.73
ATT3	0.92	0.92	—	0.36	—	0.76
ATT4	0.95	0.95	—	0.37	—	0.79
ATT5	0.93	0.93	—	0.36	—	0.77
ATT6	0.89	0.89	—	0.35	—	0.74
ATT7	0.85	0.85	—	0.33	—	0.70
ATT8	0.88	0.88	—	0.34	—	0.73
SE1	—	0.34	0.87	0.87	—	0.54
SE2	—	0.37	0.94	0.94	—	0.58
SE3	—	0.37	0.94	0.94	—	0.58
SE4	—	0.38	0.96	0.96	—	0.60
SE5	—	0.37	0.95	0.95	—	0.59
SE6	—	0.38	0.96	0.96	—	0.60
SE7	—	0.37	0.95	0.95	—	0.59
SE8	—	0.36	0.92	0.92	—	0.57
BI1	—	0.41	—	0.59	0.95	0.95
BI2	—	0.42	—	0.61	0.98	0.98
BI3	—	0.42	—	0.61	0.98	0.98
BI4	—	0.42	—	0.60	0.96	0.96
BI5	—	0.42	—	0.61	0.98	0.98
BI6	—	0.42	—	0.60	0.97	0.97
BI7	—	0.41	—	0.60	0.96	0.96
BI8	—	0.41	—	0.59	0.95	0.95
Correlations						
ATT with SE			0.40			
ATT with BI			0.43			
SE with BI			0.62			
Reliability estimates (*ω*)						
ATT			0.97			
SE			0.98			
BI			0.99			

ATT, attitude; BI, behavioral intention; SE, self-efficacy; WLSMV, weighted least squares with mean and variance correction estimation used; λ, pattern coefficient; r_{st}, structure coefficient; *ω*, coefficient omega reliability estimate.

Dashes represent pattern coefficients constrained to zero and not estimated in the model. Results were generated using single imputation for missing at random (MAR) data.

Table 4.

Estimated Marginal Means, Standard Errors, and Confidence Intervals for the Theory of Planned Behavior and Knowledge Measures Related to Teaching Occupational Safety and Health (N = 188)

				95% Confidence Interval	
	N	**M**	**SE**	**Lower Bound**	**Upper Bound**
Attitude					
Main subject taught					
Non-occupational CTE and academic	118	4.55	0.09	4.60	4.91
Occupational CTE	67	4.76	0.08	4.38	4.72
Sex					
Female	100	4.67	0.08	4.52	4.85
Male	85	4.62	0.08	4.46	4.79
Injured at work					
No	141	4.64	0.06	4.53	4.75
Yes	44	4.67	0.10	4.47	4.87
Self-efficacy					
Main subject taught					
Non-occupational CTE and academic	118	3.85	0.14	3.56	4.13
Occupational CTE	67	4.20	0.13	3.94	4.52
Sex					
Female	100	3.81	0.13	3.54	4.07
Male	85	4.24	0.14	3.97	4.52
Injured at work					
No	141	3.97	0.09	3.79	4.16
Yes	44	4.07	0.17	3.74	4.41
Intention					
Main subject taught					
Non-occupational CTE and academic	118	3.91	0.16	3.59	4.22
Occupational CTE	67	4.29	0.15	4.00	4.59
Sex					
Female	100	3.96	0.15	3.66	4.26

	N	M	SE	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Male	85	4.24	0.16	3.93	4.55
Injured at work					
No	141	3.90	0.11	3.69	4.11
Yes	44	4.30	0.190	3.92	4.67
Knowledge					
Main subject taught					
Non-occupational CTE and academic	118	10.80	0.28	10.26	11.35
Occupational CTE	67	11.73	0.26	11.22	12.24
Sex					
Female	100	11.35	0.27	10.83	11.87
Male	85	11.19	0.27	10.65	11.72
Injured at work					
No	141	11.67	0.18	11.30	12.03
Yes	44	10.87	0.33	10.22	11.53

CTE, career and technical education.

Academic included science taught in comprehensive schools; non-occupational CTE included CTE business and technology in comprehensive schools; and occupational CTE included construction manufacturing, health sciences, culinary arts, auto repair, and other technical topics in career and technical schools.