



Vaping—Know the Truth: Evaluation of an Online Vaping Prevention Curriculum

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Background. Unacceptably high levels of e-cigarette use among youth paired with growing research about the dangers of vaping demonstrate a critical need to develop interventions that educate young people to reject e-cigarette use and promote cessation for current users. Vaping: Know the Truth (VKT) is a free digital learning experience prioritizing middle and high school students that aims to improve students' knowledge about the dangers of using e-cigarettes and provide quitting resources for those who already vape. The current study was designed to evaluate whether students receiving the curriculum increased knowledge of the dangers of vaping. **Methods.** The outcome measures were calculated as the change in the number of correct responses from the pre- to post-module assessments among middle and high school students who completed four modules of the VKT curriculum ($N = 103,522$). Linear regression was performed to determine the association between the student's pre-module assessment score and the knowledge change score after completion of the four modules. **Results.** Students' e-cigarette knowledge significantly improved by an average of 3.24 points ($SD: 3.54$), following implementation of the VKT curriculum. This indicates that participants answered more than 3 additional questions correctly, on average, after the intervention. **Conclusion.** Findings demonstrate that the Vaping:

Know the Truth curriculum is an effective resource for increasing knowledge among youth about the harms associated with e-cigarette use. Further research is needed to evaluate whether the intervention is associated with behavioral outcomes over time.

Keywords: child/adolescent health; tobacco prevention and control; curriculum; outcome evaluation; internet/electronic interventions; behavior change

► INTRODUCTION

Despite recent declines in cigarette use, youth e-cigarette use (or “vaping”) remains at unacceptably high levels. In 2022, 14.1% of high school students and 3.3% of

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middle school students reported current e-cigarette use. Among these users, 42.3% reported frequent use and 27.6% reported daily use (Cooper et al., 2022). Several studies have found that nicotine naïve youth who use e-cigarettes have a higher likelihood of using cigarettes and cigars, little cigars, and cigarillos (Hair, Barton, et al., 2021; Hair, Kreslake, et al., 2021). In addition, e-cigarette-only users are more likely than nonsmokers to have engaged in use of different substances such as alcohol, marijuana, and amphetamines (Kristjansson et al., 2015).

E-cigarette use has been associated with other negative physical and psychological health effects. For example, the odds of developing a chronic cough, phlegm, bronchitis, and asthma are higher among e-cigarette users. Vaping has been implicated in the development of e-cigarette or vaping use-associated lung injury (EVALI) (Gotts et al., 2019; Krishnasamy et al., 2020). Adolescents who use e-cigarettes frequently have also been found to have higher levels of depression and attention deficit hyperactivity disorder (ADHD) symptoms (Bierhoff et al., 2019).

Unfortunately, many users do not know or understand the harms associated with e-cigarettes. For example, 63% of young adult users of JUUL are unaware that this popular vaping product *always* contains nicotine. This misconception may make these products seem “less harmful” to young people (Willett et al., 2019). Given the high concentrations of nicotine found in e-cigarettes, young people who experiment with vaping are at higher risk of developing a nicotine addiction (Romberg et al., 2019; Vallone et al., 2019).

There is a critical need to develop interventions that address youth e-cigarette use given the high prevalence of e-cigarette use among youth and a growing literature on the negative health effects of e-cigarette use. The acquisition of knowledge and the generation of perceptions must occur before adoption of new behaviors according to the Knowledge-Attitude-Behavior (KAB) theoretical framework (Schrader & Lawless, 2004). Therefore, increasing knowledge of empirical evidence regarding the harms of e-cigarette use can be an important educational component for preventing use.

Truth Initiative and Kaiser Permanente, in collaboration with the American Heart Association, launched a national effort to develop and disseminate a youth vaping prevention curriculum called *Vaping: Know the Truth* that was made available to schools by the leading social impact education innovator, EVERFI. This free digital learning experience reflects the youth-focused brand, tone, and tenor of Truth Initiative’s nationally recognized truth@ campaign. This curriculum is unique

in that it uses a peer-to-peer approach, which aims to appeal to students while providing educational content. The objective of the current study is to assess the impact of this curriculum by examining changes in e-cigarette knowledge before and after implementation.

► METHODS

Intervention Design

Vaping: Know the Truth (VKT) is a free digital learning experience, focused on providing students with the core information around the risks associated with using e-cigarettes, as well as the quitting resources for those who vape. The curriculum consists of four main modules: (a) KNOW, (b) UNCOVER, (c) OVERCOME, and (d) CHANGE. The KNOW module includes a brief history of tobacco and nicotine use and invites learners to reflect on the topic. UNCOVER provides facts about e-cigarette companies’ marketing and advertising tactics and debunks myths about the safety and risks of vaping relative to cigarette smoking. The OVERCOME module challenges learners to consider the dangers of nicotine addiction, reinforces the idea that addiction is a potential consequence of e-cigarette use, and lays the framework for quitting. The CHANGE module examines positive social norms that e-cigarettes contradict or oppose, focusing on alternative behaviors and reinforcing facts about vaping. Each of these individual modules takes approximately 30 min to complete and includes optional supplemental learning content. All knowledge items are listed in the supplementary table.

This web-based curriculum was designed to be flexible by giving students the opportunity to progress through the modules at their own pace and access the content from any internet-connected computer, tablet, or smartphone. Instruments were originally developed by EVERFI and revised by the authors. All resources are available for free, online at <https://everfi.com/courses/k-12/vaping-programs-for-high-school-students/>.

Eligibility Criteria and Study Sample

To be eligible to participate, individuals had to be students residing in the United States, enrolled in Grades 5 to 12, and in classes of teachers who consented to administer the curriculum. Any student missing more than 25% of responses to the knowledge items were excluded from analyses. The study sample consisted of 103,522 students who completed all four modules of the intervention.

Data Collection Procedures

The VKT curriculum was implemented in schools through a partnership with EVERFI. Once a school enrolled, teachers could access all curriculum materials through the EVERFI digital platform, available through the EVERFI website. This platform enables the teachers to offer it to students as an in-class or at-home assignment. Each teacher has a class-specific account that is shared with students and parents (if desired). Implementation of the entire curriculum is not required, as each teacher decides how to assign the materials based on their needs. However, to assess the impact of the entire curriculum, this study only includes data from students who completed all four modules.

This online curriculum provides interactive lessons with real-world scenarios to help students develop simple, actionable strategies for rejecting e-cigarette use. Student testimonials were collected at the end of the four modules as open-ended responses. Data collection was done entirely by EVERFI and then deidentified. EVERFI generated monthly reports detailing the number of students who were actively engaged with the curriculum, completed each module and the course, and the number of teachers and schools enrolled.

The curriculum was implemented primarily in 9th, 10th, 11th, and 12th grades, but approximately one-third of schools were middle schools. Most schools implemented the course in a Physical Education or Health class (75%), while others implemented the content in a Family or Consumer Science course (11%), Tech Education (9%), or some other course (9%).

Evaluation Design

Students completed a baseline, pre-intervention survey to collect information on demographic characteristics. To assess knowledge change, students were asked to complete assessments before and after each of the four modules presented in the curriculum, referred to as pre-module assessments and post-module assessments.

Statistical Analysis

Demographic characteristics of the study participants were analyzed using descriptive statistics. Cumulative scores were calculated for pre- and post-module assessments; with five questions in each pre- and post-assessment for all four modules, cumulative scores at each time point had a possible range of 0 to 20. The cumulative score for the pre-module assessments across all four modules was categorized into quartiles and used as the main predictor variable. The primary outcome measure was the knowledge change score, calculated

as the difference between the pre-module assessment score and the post-module assessment score, resulting in a possible range of -20 to +20.

A linear regression analysis was used to assess the association between pre-module assessment quartiles and the mean of the calculated knowledge change score. This analysis determined the impact of the curriculum on students with varying levels of baseline knowledge. Covariates included participant characteristics (e.g., gender, race, year in school, academic grades, parental education, whether school was virtual or in-person) and an indicator of low-to-middle income status for the school (e.g., 50% of students receiving free or reduced lunch). Analysis was conducted using SAS/STAT version 9.4 (SAS Institute Inc., Cary, NC).

► RESULTS

Characteristics of Study Participants

Individual-level characteristics of the 103,522 participants in the analytic sample are shown in Table 1. Among the study sample, 14% had ever tried e-cigarettes and 5% had used e-cigarettes in the past 30 days. Less than half were male (46.8%), and the majority were enrolled in high school (73.5%) and received mostly A's (50.3%). Nearly half (47.6%) had parents who graduated from college. The four largest race/ethnicity groups represented in the sample were as follows: non-Hispanic White (54.2%), Hispanic or Latino (18.2%), Black or African American (15.0%), and Asian (7.9%). One-third of participants attended schools where 50% or more of the student population was eligible for free or reduced lunch. Participants came from 49 states (none from Utah), the District of Columbia, Puerto Rico, and Ontario (data not shown).

Knowledge Module Assessment Results

The overall change in knowledge score from pre- to post-assessments ranged from -14 to 19 with a mean of 3.24 and standard deviation of 3.54. On average, participants answered more than 3 additional questions correctly in the post-module assessments than in the pre-module assessments. Regression results from unadjusted and adjusted statistical models are shown in Table 2. Both models used the knowledge change score from pre- to post-assessments as the outcome variable and the pre-assessment score quartile as a predictor. The adjusted model includes the effect of covariates. Both models show an association between the pre-module knowledge quartiles and the knowledge change score ($p < .001$). Students in all quartiles showed an increase in the knowledge change score, and the students with the lowest initial knowledge

TABLE 1
Participant Characteristics, N = 103,522

<i>Characteristic</i>	<i>n (%)</i>
Gender identity	
Male	43,197 (46.8)
Female	47,059 (50.9)
Not listed (please specify)	2,118 (2.3)
Grade in school	
Fifth—Seventh grade	6,607 (7.0)
Eighth grade	18,035 (19.0)
Freshman in high school	34,679 (36.5)
Sophomore in high school	20,482 (21.6)
Junior in high school	7,826 (8.2)
Senior in high school	6,854 (7.2)
Other/None of the above	479 (0.5)
Academic grades	
Mostly A's	44,679 (50.3)
Mostly B's	27,674 (31.1)
Mostly C's	11,501 (12.9)
Mostly D's	2,866 (3.2)
Mostly below D's	2,158 (2.4)
Education of parents/guardians	
All of my parents/guardians/caregivers graduated from college	38,066 (47.6)
One of my parents/guardians/caregivers graduated from college	24,431 (30.6)
None of my parents/guardians/caregivers graduated from college	17,477 (21.9)
Self-selected race/ethnicity (can select more than one)	
American Indian or Alaska Native	3,789 (3.7)
Asian	8,202 (7.9)
Black or African American	15,489 (15.0)
Hispanic or Latino/a	18,867 (18.2)
Middle Eastern or North African	1,830 (1.1)
Native Hawaiian or Pacific Islander	1,180 (1.1)
White	56,123 (54.2)
Not listed	2,824 (2.7)
School classroom environment	
Only online/virtually	33,779 (36.4)
Only in-person	24,387 (26.3)
Mix of online/virtually and in-person	34,158 (36.8)
Homeschool	472 (0.5)
More than 50% of school's students are eligible for free or reduced lunch program	
Yes	32,165 (32.8)
No	65,879 (67.2)
Have you ever tried an e-cigarette—even 1 or 2 puffs?	
Yes	13,170 (14.2)
No	79,411 (85.8)
In the past 30 days, have you used e-cigarettes—even 1 or 2 puffs?	
Yes	4,509 (4.8)
No	89,750 (95.2)

TABLE 2
Linear Regression Results: Pre-Module Score Quartiles as Predictors of Change Score

<i>Predictors</i>	<i>Linear regression model (N)</i>					
	<i>Unadjusted model (103,522)</i>			<i>Adjusted model (103,522)</i>		
	β	<i>SE</i>	<i>p-value</i>	β	<i>SE</i>	<i>p-value</i>
Overall R^2	.293			.336		
Intercept	0.82	0.02	<.001	1.92	0.05	<.001
Pre-assessment score						
Lowest quartile	5.33	0.03	<.001	5.84	0.03	<.001
Second quartile	2.82	0.03	<.001	3.28	0.03	<.001
Third quartile	1.48	0.03	<.001	1.72	0.03	<.001
Fourth quartile		REF			REF	
Gender						
Female				-0.10	0.05	<.0001
Male					REF	
Not listed				0.28	0.02	<.0001
Missing				0.47	0.05	<.0001
Race						
Asian				0.01	0.04	0.771
Black/African American				-0.33	0.03	<.0001
Hispanic				-0.38	0.03	<.0001
White					REF	
Some other race				-0.57	0.05	<.0001
More than one race				-0.14	0.03	<.0001
Missing				0.16	0.07	0.022
School Year						
Seventh grade or younger				-1.09	0.05	<.0001
Eighth grade				-0.63	0.04	<.0001
Ninth grade				-0.35	0.04	<.0001
Tenth grade				-0.13	0.04	0.002
Eleventh grade				-0.10	0.05	0.028
Twelfth grade					REF	
Missing				0.69	0.09	<.0001
Academic grades						
Mostly A's					REF	
Mostly B's				-0.72	0.02	<.0001
Mostly C's				-1.21	0.03	<.0001
Mostly D's				-1.43	0.06	<.0001
Mostly below D's				-1.50	0.06	<.0001
Missing/Don't know				-1.19	0.04	<.0001
Parents attending college						
All					REF	
One				-0.09	0.02	.000
None				-0.02	0.03	0.545
Missing				-0.29	0.03	<.0001

(continued)

TABLE 2. (CONTINUED)

	β	SE	p-value	β	SE	p-value
School past year						
In-person only				-0.46	0.03	<.0001
Online only					REF	
Mix of in-person and online				-0.17	0.02	<.0001
Missing or homeschooled				-0.76	0.06	<.0001
School has 50% or more students in free and reduced lunch program						
Yes				-0.42	0.02	<.0001
No					REF	
Missing				-0.07	0.04	0.099

Note. The unadjusted model demonstrates the association between pre-assessment score quartile and change in knowledge score. The adjusted model is similar, but also includes the effect of covariates that control for participant characteristics such as gender, race, year in school, academic grades, parents' college status, online or in-person school, and schools' free and reduced lunch status. An indicator of low-to-middle income status of the school was obtained from the National Center for Education Statistics and was assigned to each participant attending a school where more than 50% of students receive free and reduced lunch.

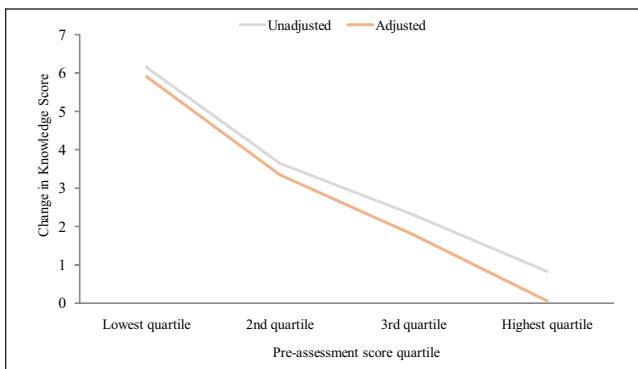


FIGURE 1 Change in Knowledge Score by Pre-Assessment Score Quartiles

Note. The unadjusted model demonstrates the association between pre-assessment score quartile and change in knowledge score. The adjusted model is similar, but also includes the effect of covariates that control for participant characteristics such as gender, race, year in school, academic grades, parents' college status, online or in-person school, and schools' free and reduced lunch status.

(lowest quartile) showed the largest increase in the knowledge change score when compared to the students with the highest initial knowledge (highest quartile; $\beta = 5.84$, $SE = 0.03$). Figure 1 shows the unadjusted and adjusted change in knowledge scores by pre-assessment quartiles.

DISCUSSION

Findings indicate that the VKT digital curriculum can prompt increased knowledge about e-cigarette use

among youth, a key group that is at risk for uptake and long-term use. This educational tool can be instrumental in educating young people about e-cigarettes to help them make more informed choices. In addition, knowledge acquisition is the first step toward behavior change (Schrader & Lawless, 2004). By offering the flexibility of digital content within multiple modules, a peer-to-peer voice, and a focus on relevant issues, VKT engages young people with factual content about e-cigarette use.

The VKT digital curriculum is a universal program, meaning it can be implemented and effective for students regardless of risk status. Universal programs can be a more cost-effective choice for schools, and research has shown they can be more effective at reducing tobacco use (Shamblen & Derzon, 2009). This online program can be implemented as an in-class or take-home assignment, expanding its reach and potential impact. Our study findings reinforce the decision to deliver the program to a broad population, reaching many students while having a significantly positive impact on those with the highest need. Importantly, since mean scores increased among all four quartiles, there was no evidence of a negative impact for any students.

One innovative feature of the VKT curriculum is its use of a peer-to-peer voice, which has also been proven effective in other settings and in recent research (Thompson & Nigg, 2020). We used this strategy to increase receptivity among students, while presenting a standardized, empirically based online curriculum on the harms associated with e-cigarette use. When high school students were asked what they wanted from a vaping curriculum, they reported preferences for relatable personal anecdotes

from other youth (Bold et al., 2022). *Vaping: Know the Truth's* curriculum combines all of these features to create a program that appeals to students.

► LIMITATIONS

The main limitation to this study is the lack of a control group, which would further isolate the effect of the curriculum and control for other potential confounding variables. In addition, examining a longer follow-up period of 6 to 12 months would help identify whether students sustained their knowledge acquisition.

► CONCLUSION

Results provide evidence that *Vaping: Know the Truth* is a successful school-based intervention to educate youth about the harms associated with vaping and ways to quit. By using an innovative peer-to-peer approach delivered online, VKT can be implemented throughout schools with extensive reach to youth, a priority population at risk for e-cigarette use.

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SUPPLEMENTAL MATERIAL

Supplemental material for this article is available at <https://journals.sagepub.com/home/hpp>.

REFERENCES

- Bierhoff, J., Haardörfer, R., Windle, M., & Berg, C. J. (2019). Psychological risk factors for alcohol, cannabis, and various tobacco use among young adults: A longitudinal analysis. *Substance Use & Misuse, 54*(8), 1365–1375. <https://doi.org/10.1080/10826084.2019.1581220>
- Bold, K., Kong, G., Cavallo, D., Davis, D., Jackson, A., & Krishnan-Sarin, S. (2022). School-based e-cigarette cessation programs: What do youth want? *Addictive Behaviors, 125*, Article 107167. <https://doi.org/10.1016/j.addbeh.2021.107167>
- Cooper, M., Park-Lee, E., Ren, C., Cornelius, M., Jamal, A., & Cullen, K. A. (2022). Notes from the field: E-cigarette use among middle and high school students—United States, 2022. *MMWR Morbidity and Mortality Weekly Report, 71*, 1283–1285. <https://doi.org/10.15585/mmwr.mm7140a3>
- Gotts, J. E., Jordt, S.-E., McConnell, R., & Tarran, R. (2019). What are the respiratory effects of e-cigarettes? *BMJ, 366*, Article 15275. <https://doi.org/10.1136/bmj.15275>
- Hair, E. C., Barton, A. A., Perks, S. N., Kreslake, J., Xiao, H., Pitzer, L., Leventhal, A. M., & Vallone, D. M. (2021). Association between e-cigarette use and future combustible cigarette use: Evidence from a prospective cohort of youth and young adults, 2017-2019. *Addictive Behaviors, 112*, Article 106593. <https://doi.org/10.1016/j.addbeh.2020.106593>
- Hair, E. C., Kreslake, J. M., Mowery, P., Pitzer, L., Schillo, B., & Vallone, D. M. (2021). A longitudinal analysis of e-cigarette use and cigar, little cigar or cigarillo initiation among youth and young adults: 2017–2019. *Drug and Alcohol Dependence, 226*, Article 108821. <https://doi.org/10.1016/j.drugalcdep.2021.108821>
- Krishnasamy, V. P., Hallowell, B. D., Ko, J. Y., Board, A., Hartnett, K. P., Salvatore, P. P., Danielson, M., Kite-Powell, A., Twentyman, E., Kim, L., Cyrus, A., Wallace, M., Melstrom, P., Haag, B., King, B. A., Briss, P., Jones, C. M., Pollack, L. A., & Ellington, S. (2020). Update: Characteristics of a nationwide outbreak of e-cigarette, or vaping, product use—associated lung injury—United States, August 2019–January 2020. *MMWR Morbidity and Mortality Weekly Report, 69*(3), 90–94. <https://doi.org/10.15585/mmwr.mm6903e2>
- Kristjansson, A. L., Mann, M. J., & Sigfusdottir, I. D. (2015). Licit and illicit substance use by adolescent e-cigarette users compared with conventional cigarette smokers, dual users, and nonusers. *The Journal of Adolescent Health, 57*(5), 562–564. <https://doi.org/10.1016/j.jadohealth.2015.07.014>
- Romberg, A. R., Miller Lo, E. J., Cuccia, A. F., Willett, J. G., Xiao, H., Hair, E. C., Vallone, D. M., Marynak, K., & King, B. A. (2019). Patterns of nicotine concentrations in electronic cigarettes sold in the United States, 2013-2018. *Drug and Alcohol Dependence, 203*, 1–7. <https://doi.org/10.1016/j.drugalcdep.2019.05.029>
- Schrader, P. G., & Lawless, K. A. (2004). The knowledge, attitudes, & behaviors approach how to evaluate performance and learning in complex environments. *Performance Improvement, 43*(9), 8–15. <https://doi.org/10.1002/pfi.4140430905>
- Shamblen, S. R., & Derzon, J. H. (2009). A preliminary study of the population-adjusted effectiveness of substance abuse prevention programming: Towards making IOM program types comparable. *The Journal of Primary Prevention, 30*(2), 89–107. <https://doi.org/10.1007/s10935-009-0168-x>
- Thompson, M. A., & Nigg, C. R. (2020). Effect of an adolescent peer-led health curriculum on peer educators and participants. *Health Education Journal, 80*(3), 337–350. <https://doi.org/10.1177/0017896920977903>
- Vallone, D. M., Bennett, M., Xiao, H., Pitzer, L., & Hair, E. C. (2019). Prevalence and correlates of JUUL use among a national sample of youth and young adults. *Tobacco Control, 28*(6), 603–609. <https://doi.org/10.1136/tobaccocontrol-2018-054693>
- Willett, J. G., Bennett, M., Hair, E. C., Xiao, H., Greenberg, M. S., Harvey, E., Cantrell, J., & Vallone, D. (2019). Recognition, use and perceptions of JUUL among youth and young adults. *Tobacco Control, 28*(1), 115–116. <https://doi.org/10.1136/tobaccocontrol-2018-054273>