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Breaking Free from Nicotine: Developing and Evaluating a Smoking and Vaping Cessation Module for Pharmacy Students

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Abstract

As vaping becomes an increasing public health issue, training for pharmacists must cover cessation support for both smoking and vaping. Student pharmacists, as emerging healthcare providers, need education aligned with current clinical guidelines and incorporating behavior change techniques. This study sought to create and assess an educational module targeting critical knowledge and skill deficiencies in smoking and vaping among student pharmacists. An educational module titled No-to-Nicotine was delivered to second-year undergraduate student pharmacists at The University of Sydney. It included two lectures on smoking and vaping, plus a 2.5-hour interactive workshop promoting active learning via practical applications of the material. Changes in knowledge and attitudes were evaluated using a pre- and post-module questionnaire.

Knowledge scores improved significantly (pre-module mean total: 18.9 ± 5.6; post-module mean total: 25.4 ± 5.0; $p < .001$), indicating better comprehension of smoking and vaping topics. Changes in attitudes reflected heightened recognition of pharmacists' responsibilities in managing nicotine dependence. Student feedback highlighted the module's relevance and practical value for future pharmacy roles. A pedagogically grounded educational module for student pharmacists can strengthen their contributions to smoking and vaping cessation in clinical practice. Integrating up-to-date knowledge and skills on smoking and vaping services is vital within pharmacy education programs.

Keywords: Education, Nicotine, Pharmacy, Smoking, Vaping

Introduction

A core aspect of pharmacists' professional responsibilities across various healthcare environments is guiding patients in altering health-damaging behaviors. Techniques for behavior change are essential in addressing substance use issues, including nicotine addiction. During the past century, mass-produced cigarettes became widely accessible, and aggressive marketing campaigns influenced societal norms, normalizing smoking as a common practice [1]. Once the dangers of nicotine addiction and the health risks of smoking and secondhand smoke were established, governments globally implemented tobacco control measures in recent decades [2]. These measures have lowered smoking prevalence in certain nations, yet the last few years have witnessed a surge in nicotine-containing electronic cigarettes, known as nicotine vaping products (NVPs). Vaping rates are rising worldwide, with estimates at 5.9% in the United States and 3.5% in Australia [3, 4], underscoring the spread of this alternative nicotine delivery method. This increase is likely fueled by marketing that presents vaping as appealing and comparatively harmless [5, 6]. In Australia, surveys show many young people view vaping as socially acceptable and useful for managing stress, indicating diminished perceived risks [7, 8]. Additionally, emerging evidence on NVPs' potential role in smoking cessation has contributed to confusion and the

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misconception that vaping is relatively safer than smoking [9]. However, while NVPs can serve as nicotine replacement to alleviate cravings for nicotine-dependent smokers, they can also sustain dependence and cause various harms [10–12]. Thus, although NVPs may have therapeutic value in supporting smoking cessation, they present ongoing clinical challenges related to nicotine dependence and other adverse effects [9].

Pharmacists have long participated in smoking cessation programs, with studies showing high success rates from pharmacist-led efforts [13, 14]. Their roles should now extend to vaping services, as some evidence supports NVPs as aids for quitting smoking when standard treatments like nicotine replacement therapy (NRT) and behavioral support are ineffective [15]. Since NVPs can contribute to nicotine dependence, pharmacists also need to develop vaping cessation support for those wishing to quit vaping [10]. Pharmacists may thus engage in vaping-related services for both smoking cessation and standalone vaping cessation, requiring them to handle therapeutic NVPs through stocking, dispensing, or supply. In the US, state laws vary on NVP supply by retailers, including pharmacies, but federal law sets a minimum age of 21 [16]. Many pharmacies globally sell NVPs, though US professional bodies like the American Pharmacists Association have opposed this due to insufficient evidence [17]. In Australia, recent regulations have made NVPs prescription-only or pharmacist-only (over-the-counter for concentrations ≤ 20 mg/mL nicotine, with higher concentrations requiring a prescription) [18, 19]. These evolving regulations, combined with limited evidence on NVPs for cessation and few guidelines for vaping cessation, impose challenges on primary care providers [20]. Australian pharmacists, alongside physicians, must comply with these rules when dispensing or prescribing appropriate NVPs.

To fulfill these duties, pharmacists require knowledge of NVP use, harms of smoking and vaping, clinical details on NVPs, approved cessation therapies, and skills for supporting behavioral change [13]. Concerns exist about limited coverage of NVPs in pharmacy curricula in countries like the US and Australia [21, 22]. Vaping prevention education has mostly targeted US secondary schools [23]. Although global data are limited, a systematic review by Barrett and Aldamkhi noted that US student pharmacists lack confidence in NVP counseling compared to traditional smoking cessation [24, 25]. In Australia, a Queensland survey found 91% of pharmacy staff felt underinformed and needed more training on this topic [26]. A recent poll also showed Australian pharmacists' discomfort with new regulations allowing pharmacist-supplied NVPs without prescription [27].

Educating future pharmacists is a practical way to bridge these knowledge and skill gaps amid rising vaping inquiries and NVP availability in pharmacies. Pharmacy training should cover nicotine pharmacology, nicotine dependence treatment, NVP formulations, alternatives, referral options, and behavioral change facilitation skills. Studies show that students exposed to NVP education hold more accurate views on long-term vaping harms [28]. Previous work indicates that comprehensive, pedagogically sound programs improve knowledge, attitudes, and confidence in smoking cessation among student pharmacists, suggesting similar benefits for vaping-inclusive modules [29]. This study, therefore, aimed to develop and evaluate an educational module to address awareness and skill deficits in undergraduate student pharmacists concerning the health impacts of smoking and vaping, effective communication, and evidence-based cessation approaches for patients who smoke and/or vape.

Materials and Methods

A constructivist framework guided the pedagogical design of the “No-to-Nicotine” (N2N) module [30]. The research team, comprising members with substantial expertise in developing and implementing innovative teaching methods, clinical pharmacy practice, and research on smoking and vaping cessation services, created and refined the N2N educational module.

Pedagogical principles

Drawing on established effective educational programs for traditional smoking cessation training [31], the N2N module adopted a flipped classroom model for its design and implementation. Beyond standard smoking cessation topics, the content tailored for vaping-related services covered patterns of NVP use, their potential therapeutic role (as an aid in smoking cessation), the balance of benefits versus risks of NVPs, and approaches to vaping cessation. Delivery started with interactive lectures to introduce core concepts, laying the groundwork for deeper learning in the subsequent 2.5-hour workshop. Active participation was promoted through realistic case studies, recognized for improving student outcomes by bridging theory and practice to promote better retention

of clinical information [32, 33]. Skills development included practical hands-on exercises, such as demonstrating the use of placebo nicotine replacement therapies (NRTs), assessing carbon monoxide levels using a Bedfont Smokerlyzer monitor, and exploring various vaping devices. Activities fostering creativity and reflection involved group work (5–7 students) to create arts-based posters, practicing refusal skills, completing self-evaluations through pre- and post-N2N questionnaires, and summarizing key takeaways at the workshop's end. These elements allowed students to process the material, encourage teamwork, apply concepts to real-world scenarios, and increase overall engagement [34]. The module's learning outcomes were structured according to Bloom's Taxonomy of Learning Outcomes **(Table 1)** [35]. The figure illustrates the content and structure of the activities in the N2N module.

Figure 1. Content and format of the N2N module [36]. CO= carbon monoxide; HONC= hooked on nicotine checklist; N2N, No-to-Nicotine; NRT= nicotine replacement therapy.

Table 1. Learning objectives and constructive alignment of N2N workshop

Learning Category [a]	Learning Objective	Learning Activity	Assessment Approach
Knowledge	Comprehend the pharmacology of nicotine and the pathophysiology underlying nicotine dependence	Lectures, pre-work videos, and class discussions	Formative assessment through observation of student involvement in workshop discussions; scores on the knowledge items in the post-module questionnaire
Knowledge, Attitudes, and Skills	Build the competencies required to manage various elements of smoking and vaping cessation, including abilities in: • evaluating level of dependence • gauging readiness to quit • tailoring pharmacotherapy to the individual • suggesting non-pharmacological strategies • identifying appropriate referral pathways	Clinical case discussions in the workshop, lectures, and hands-on demonstrations of NRT/ENDS/NVP devices	Formative assessment of student engagement and contributions during workshop discussions; performance on the knowledge section of the post-module questionnaire
Attitudes	Acknowledge the important contribution of pharmacists in delivering contemporary smoking and vaping cessation interventions	Lectures, clinical cases, and class activities	Formative assessment of student engagement and participation in workshop discussions; scores on relevant items in the post-module questionnaire
Attitudes and Skills	Cultivate awareness of reliable and authoritative sources of information on clinical topics related to smoking and vaping	Class discussions, group poster creation activity, and end-of-workshop reflection	Formative evaluation of participation in discussions during the workshop; tutor review of poster content/themes and observations of student reflections at the conclusion of the session

Abbreviations: ENDS= electronic nicotine delivery systems; N2N= No-to-Nicotine; NRT= nicotine replacement therapy; NVP= nicotine vaping products. [a] Based on Bloom's Taxonomy of Educational Objectives [35].

Study setting

The N2N module was developed for students in the second year of the Doctor of Pharmacy (Honors)/Master of Pharmacy Practice or the Bachelor of Pharmacy and Management (Honors)/Master of Pharmacy Practice programs, which are 5- or 6-year degree courses offered at the Sydney Pharmacy School, Faculty of Medicine and Health, The University of Sydney. The module was integrated into and aligned with the goals of the core unit 'Pharmaceutics and Professional Practice (PHAR2911)', a 12-credit-point compulsory subject. PHAR2911 addresses both pharmaceutics and professional practice elements, emphasizing scientific and laboratory principles, advanced clinical understanding, and patient counseling abilities. Topics such as communication skills, behavior change strategies, and culturally safe healthcare delivery are woven throughout the practice-oriented content of the unit (including material on smoking and vaping cessation). The unit is delivered via lectures, practical laboratory classes, online modules, tutorials, and workshops.

Study design

A pre-post intervention questionnaire was created to evaluate possible improvements in participants' knowledge and attitudes. These questionnaires functioned both as a research tool and as a means for consenting students to identify learning needs (pre-intervention) and recognize gains (post-intervention). The questionnaires included 38 True/False knowledge items (19 focused on smoking and 19 on vaping), which captured contemporary understanding relevant to student pharmacists at that time. For each knowledge item, respondents had three choices: "True," "False," or "Don't know." Both pre- and post-questionnaires contained 15 Likert-scale items (1 = Strongly Disagree to 5 = Strongly Agree) measuring attitudes toward smoking and vaping. The knowledge and attitude questions were adapted from a previously validated instrument for

smoking among student pharmacists [29]. The pre-module questionnaire also included demographic items. The post-module version added 5 Likert-scale statements evaluating the module's perceived influence (1 = No Impact to 5 = A Large Impact) and 3 open-ended feedback questions (suggested improvements, most valued activities, and relevance to PHAR2911). The questionnaires (Appendices A2 and A3) were distributed electronically via the REDCap platform (Research Electronic Data Capture). An independent REDCap administrator linked pre- and post-responses before de-identifying the data.

Participant recruitment

Students were first introduced to the study through the PHAR2911 Canvas site, the university's online learning management system accessible only to enrolled students. Completion of the N2N module was required for all students as part of the unit. However, participation in the associated research (completing questionnaires before and after the module) was entirely optional and unrelated to any grades or assessments. Dedicated time was provided during a prior PHAR2911 tutorial to complete the pre-module questionnaire, approximately one week before the smoking and vaping lectures. An email containing the REDCap link was sent to all students. Informed consent was secured via a checkbox at the start of the questionnaire, with a link to the participant information statement. After the workshop, the post-module questionnaire link was emailed only to those who had completed the pre-questionnaire. All de-identified responses were securely stored in REDCap.

Analytical methods

Data exported from REDCap were analyzed using IBM SPSS Statistics for Windows (version 29.0; IBM Corp) with descriptive statistics and repeated-measures analyses. Total knowledge scores were calculated from the 38 items, and mean pre- and post-module scores were reported as mean ± SD. Correct responses scored 1 point; incorrect or "Don't know" responses scored 0. A paired-samples t-test compared pre- and post-module results. Psychometric properties of the questionnaire were assessed through reliability (Cronbach's alpha) and educational metrics (item difficulty and discrimination indices). Student feedback on the 5 post-module Likert statements was summarized as mean ± SD. Open-ended feedback was analyzed inductively, with responses categorized into emerging themes.

Peer observation

Three independent academic healthcare professionals observed the delivery of the N2N workshop, assessing its structure and feasibility. Their feedback was collected using the university's standard peer observation form for face-to-face teaching evaluation.

Ethics approval was granted by The University of Sydney Human Research Ethics Committee (2024/271). Reporting followed the Criteria for Reporting the Development and Evaluation of Professional Training Interventions in Healthcare (CRe-DEPTH) guidelines where relevant [37].

Results and Discussion

In semester 1, 2024, 267 students were eligible for the N2N module. Of these, 175 completed the pre-module questionnaire (participation rate = 65.5%). Post-module questionnaires were automatically sent to pre-respondents after the workshop, with 147 completing it (retention rate from pre to post = 84.0%). Among the 147 matched participants, 63.9% were female (age range 18–35 years; median age = 19.6 years). Over half (59.9%) were currently employed as student pharmacists or pharmacy assistants. Most reported no prior formal training in smoking cessation (94.6%) or vaping cessation (93.2%). Twelve participants (12.9%) had previously smoked, and 41 (27.9%) had previously vaped.

Mean total knowledge scores for the 38 items rose significantly from 18.9 ± 5.6 pre-module to 25.4 ± 5.0 post-module ($p < .001$). Smoking-related items were generally more challenging than vaping-related ones, as shown by differences in subscale means **(Table 2)**. Overall item difficulty indices were 0.50 pre-intervention and 0.67 post-intervention; discrimination indices were 0.35 pre-module and 0.27 post-module (individual item values in **(Table 3)**). Cronbach's alpha for knowledge items was 0.83 pre-module and 0.79 post-module. After reversing negatively worded items, mean attitude scores across the 15 statements increased from 3.9 ± 0.5 to 4.0 ± 0.6 ($p = .053$).

Table 2. Knowledge and attitudes scores pre- and post-N2N educational module.

Areas of assessment (score)	Pre-N2N scores, mean (SD)	Post-N2N scores, mean (SD)	*p*-Value
Total knowledge /38	**18.9 (5.6)**	**25.4 (2.7)**	<.001
1. *Total smoking knowledge score /19*	**7.6 (3.0)**	**11.2 (2.8)**	<.001
2. *Total vaping knowledge score /19*	**11.3 (3.1)**	**14.1 (2.7)**	<.001
Total attitude /5	**3.9 (0.5)**	**4.0 (0.6)**	.0053
Comparison of knowledge pre/post difference smoking/vaping related items			
Knowledge area	**Pre-N2N scores, average (SD)**	**Post-N2N scores, average (SD)**	**Mean pre/post N2N score difference (SD)**
A. General knowledge			
Smoking			
(I # 2,4)	1.37 (0.65)	1.59 (0.59)	0.12 (0.78)
Possible score range 0–2			
Vaping			
(I # 1,3) *Possible score range 0–2*	1.74 (0.53)	1.86 (0.40)	0.08 (0.56)
B. Device related knowledge			
Smoking			
(I # 11,14,22)	0.78 (0.77)	1.15 (0.94)	0.27 (1.03)
Possible score range 0–3			
Vaping			
(I # 10,12,13,15,16) *Possible score range 0–5*	3.06 (1.45)	4.17 (1.11)	0.74 (1.43)
C. Pharmacology			
Smoking			
(I # 7,9,18,19,21)	3.24 (1.24)	3.9 (0.88)	0.35 (1.16)
Possible score range 0–5			
Vaping			
(I # 5,6,8,17,20,23) *Possible score range 0–6*	4.46 (1.18)	4.88 (1.00)	0.10(1.09)
D. Pharmacotherapy			
Smoking			
(I # 24,26,28,30,31,33,35,37,38)	2.20 (1.6)	4.57 (1.94)	2.10 (1.74)
Possible score range 0–9			
Vaping			
(I # 25,27,29) *Possible score range 0–3*	1.02 (0.68)	1.25 (0.66)	0.14 (0.83)
E. Regulation			
Vaping			
(I # 32,34,36) *Possible score range 0–3*	1.01 (0.85)	1.96 (0.85)	0.85 (1.07)

Abbreviations: I, Item Number on N2N Study Questionnaire; N2N, No-to-Nicotine.

Table 3. Performance characteristics of knowledge assessment items before and after the No-to-Nicotine (N2N) module

Item ID	Content Area	Difficulty Index (Post-N2N)	Difficulty Index (Pre-N2N)	Discrimination Index (Post-N2N)	Discrimination Index (Pre-N2N)

1	Vaping	0.87	0.83	0.17	0.27
2	Smoking	0.90	0.84	0.32	0.24
3	Vaping	0.97	0.91	0.05	0.24
4	Smoking	0.69	0.53	0.27	0.45
5	Vaping	0.95	0.85	0.10	0.29
6	Vaping	0.99	0.98	0.00	0.06
7	Smoking	0.91	0.87	0.17	0.37
8	Vaping	0.84	0.83	0.34	0.24
9	Smoking	0.28	0.16	−0.22	0.10
10	Vaping	0.88	0.79	0.12	0.35
11	Smoking	0.54	0.51	0.41	0.53
12	Vaping	0.84	0.59	0.24	0.51
13	Vaping	0.84	0.59	0.37	0.63
14	Smoking	0.34	0.17	0.37	0.33
15	Vaping	0.74	0.45	0.10	0.45
16	Vaping	0.88	0.64	0.34	0.71
17	Vaping	0.33	0.26	0.39	0.39
18	Smoking	0.86	0.75	0.24	0.51
19	Smoking	0.95	0.77	0.15	0.53
20	Vaping	0.95	0.82	0.15	0.43
21	Smoking	0.91	0.70	0.12	0.57
22	Smoking	0.27	0.11	0.37	0.16
23	Vaping	0.82	0.72	0.20	0.47
24	Smoking	0.91	0.77	0.15	0.49
25	Vaping	0.36	0.26	0.59	0.39
26	Smoking	0.27	0.12	0.29	0.14
27	Vaping	0.83	0.73	0.02	0.43
28	Smoking	0.10	0.07	0.17	0.10
29	Vaping	0.06	0.03	0.00	0.06
30	Smoking	0.42	0.15	0.63	0.29
31	Smoking	0.65	0.05	0.56	0.10
32	Vaping	0.85	0.48	0.15	0.37
33	Smoking	0.70	0.13	0.66	0.20
34	Vaping	0.64	0.42	0.56	0.39
35	Smoking	0.58	0.27	0.59	0.49
36	Vaping	0.47	0.11	0.51	0.22
37	Smoking	0.50	0.38	0.05	0.59
38	Smoking	0.45	0.25	0.54	0.37

Abbreviation: N2N, No-to-Nicotine.

Questionnaire items in the N2N assessment were organized into five main thematic categories **(Table 2)**. Knowledge gains were limited between pre- and post-module for general knowledge questions on smoking (items 2 and 4) and vaping (items 1 and 3), probably because students already had fairly good baseline understanding in these areas. Conversely, topics covering smoking pharmacology and pharmacotherapy (items 9, 26, 28, 30, 31, and 33) were more difficult initially, with pre-module scores revealing particular gaps in

knowledge about nicotine replacement therapy (NRT), which correspondingly showed the largest improvements. Notably, there were stronger post-module increases in knowledge of vaping devices and the regulations governing pharmacists' supply of nicotine vaping products (NVPs).

Students generally gave positive feedback on the educational benefits of the N2N module. On the Likert-scale items, most indicated that the module positively affected: (1) their recognition of the public health effects of smoking and vaping (4.18 ± 0.86), (2) their clinical expertise in cessation services for smoking and vaping (4.41 ± 0.79), (3) their confidence when handling smoking- and vaping-related matters in pharmacy practice (4.24 ± 0.84), (4) their assurance in performing nicotine prescription dosage checks (3.78 ± 1.08), and (5) their competence in advising patients on quitting smoking and vaping to support respiratory and overall health (4.20 ± 0.83). This sentiment was reinforced by the fact that 89.1% of students (131 out of 147 post-module respondents) believed the N2N module should remain part of the pharmacy curriculum for upcoming cohorts. Thematic analysis of open-ended feedback revealed four primary themes: applicability to professional practice, improvements in knowledge, overall effectiveness of the module, and recommendations for refinement. Some illustrative quotes are provided below.

"I really liked the practical experience with trying out the NRT products. That kind of hands-on knowledge will definitely help when counseling patients who have questions."

"I appreciated how it addressed areas we might not cover in regular practice settings (like contraindications or proper patch application). The short role-plays also kept things engaging and fun."

"Overall, the session was well-organized, interactive, and still managed to be highly informative and valuable."

During the N2N training week, student groups across all workshops produced a total of 46 posters, classified as addressing smoking (24), vaping (11), or both topics (11). Recurring themes in the posters included communicating risks, motivational messages, strategies for refusing offers, support for at-risk groups, and collaboration across healthcare providers. These creative works effectively reflected students' comprehension of the health dangers posed by smoking and vaping. Tutors noted considerable teamwork within groups and high levels of enthusiasm for the poster activity.

From the open-ended comments, most students found the N2N module highly relevant to their future roles and reported that it significantly boosted their knowledge and insight, highlighting its tangible educational value. Informal student feedback shared with tutors and the unit coordinator pointed out that the workshops overlapped with the oral examination week for PHAR2911—a particularly hectic and stressful period—which might explain the drop-off in completion rates from pre- to post-module questionnaires. Additionally, students suggested incorporating more interactive components, such as extra role-plays, because the clinical case discussions felt rather extended. These points were supported by the three independent observers, who advised adjustments to classroom setup and logistics to encourage even greater active participation.

Pharmacists, positioned at the frontline of primary healthcare, are ideally suited to support smoking and vaping cessation efforts, although this role presents ongoing challenges. Various exploratory studies have identified pharmacists' expressed needs for training in managing nicotine dependence. To our knowledge, this study is the first published investigation evaluating the effectiveness of a pedagogically robust educational intervention designed to prepare future pharmacists in Australia for delivering smoking and vaping cessation services. The N2N module resulted in substantial improvements in student pharmacists' knowledge of both smoking and vaping, along with greater clinical insight. Although attitude shifts did not reach statistical significance, participants reported high levels of satisfaction and engagement with the module. Given the fast-changing landscape of vaping in Australia, pedagogically grounded initiatives like N2N can equip emerging pharmacists with the expertise needed to tackle vaping from both public health and individual patient-care angles.

Examination of knowledge improvements from the N2N questionnaire revealed that smoking-related items were generally more challenging than vaping-related ones, particularly in pharmacology and pharmacotherapy sections **(Tables 2 and 3)**. These findings align with the demographic context, as participants belonged to an age group experiencing the highest rates of vaping uptake. Evidence indicates that vaping is often perceived as socially appealing and less harmful, while smoking rates in this cohort have declined [5, 38]. It is therefore unsurprising that our students were more familiar with vaping than traditional smoking. Despite greater baseline

awareness of broad vaping issues, pre-module knowledge of critical harms—such as nicotine concentrations, e-liquid ingredients, device specifics, and regulatory requirements—was limited. The N2N intervention effectively addressed these gaps, with post-module scores showing marked gains in clinical understanding. This was evidenced by increased mean item difficulty and reduced mean discrimination indices after the intervention, as more students provided correct responses. A comparable study by Chaplin and colleagues [39] among high school students similarly found that educational sessions boosted awareness of vaping risks and harms. Across all knowledge domains, post-N2N results demonstrated clear improvements, underscoring participants' deeper comprehension following the module.

Attitude scores showed a trend toward stronger alignment with evidence on the harms of smoking and vaping, though the change was not statistically significant. This may stem from the long-established risks of smoking and widespread anti-smoking public health campaigns that have rendered smoking socially undesirable, leading to already favorable baseline attitudes [40]. Attitudes toward vaping, however, remained varied regarding NVP harms and benefits, emphasizing the need for additional public health efforts [5]. Similar to broader societal views, the recognition of NVPs' potential therapeutic role in smoking cessation might foster perceptions of relative safety compared to cigarettes. Future versions of the N2N module should more explicitly address this nuance [9].

Overall, the pedagogically designed module achieved its objectives, with many students valuing the interactive workshop components that reinforced core learning goals. Strategies such as flipped classrooms, realistic clinical cases, practical skills training, and creative/reflective exercises promoted active participation. A systematic review by Akçayır and Akçayır [41] on flipped classrooms reported enhanced student performance, increased confidence, and more positive attitudes toward the material. In N2N, this approach was strengthened through hands-on engagement, where authentic cases built essential skills and self-assurance [42, 43]. Creative elements further enriched the experience via activities like refusal strategies, cessation clinic design, and poster creation. These allowed students to innovatively explore solutions to nicotine dependence, as reflection is recognized for helping learners develop personal attitudes and views [44]. Employing these educational principles clearly supported student learning and involvement, demonstrating the robustness of the N2N module.

Teaching refusal skills has long been a common approach in school-based smoking prevention programs [45]. This activity illustrated the social difficulty of declining a vape or cigarette from a peer [46]. Incorporating it into the N2N workshop enabled students to contemplate this issue, observe peer strategies, and consider applications for countering vaping-related social influences. Given the students' proximity in age to adolescents and the self-reported smoking or vaping history among some participants, the activity may have also reinforced personal refusal techniques. Collectively, these reflective opportunities helped students internalize the content, fostering skill development and favorable attitudes [47].

The topic's relevance to our cohort was confirmed by the strong pre-intervention response rate, which exceeded those in prior single-institution surveys of student pharmacists on vaping [25, 28, 48, 49]. Continued research in this area is vital, as numerous studies have shown that pharmacist-led smoking cessation interventions significantly boost quit rates [50, 51]. Our module was informed by earlier exploratory work revealing Australian pharmacists' explicit calls for training amid uncertainty, reluctance, and low confidence [19].

Although considerable time and effort were devoted to developing this intervention, the detailed descriptions provided enable other educators to adopt or adapt N2N locally. The approach could extend to undergraduate students in other health professions. The global impact of vaping demands targeted education, where allied health trainees would gain from nicotine-related knowledge and primary care skills [52]. Tailored workshops addressing emerging public health issues prepare students across disciplines to support at-risk patients. For example, incorporating vaping content into a postgraduate public health program promoted learning and reflection, building requisite attitudes, knowledge, and competencies [53].

This study has several limitations. Smoking items were drawn from a validated instrument, but the newly developed vaping items lacked formal validity testing (e.g., via factor analysis). Nonetheless, their utility was supported by item difficulty and discrimination metrics. Using identical questions pre- and post-module introduced potential test-retest bias. As this was the initial rollout of N2N, participant and observer feedback

on delivery and structure will inform refinements, especially since the module will continue in the unit based on its demonstrated value. Finally, knowledge improvements may not directly translate to clinical behavior; longitudinal evaluation in real-world settings is needed to assess whether N2N-trained students or pharmacists can drive actual cessation outcomes.

Conclusion

Nicotine dependence has long been part of health education curricula; however, student pharmacists—and health professional students broadly—must cultivate the adaptability, confidence, and competencies to address emerging issues like vaping. The N2N intervention offers preliminary evidence that an interactive, pedagogically sound module can markedly improve student pharmacists' knowledge and readiness to manage nicotine dependence. It also underscores the value of equipping learners with clinical proficiency and communication abilities for professional practice. As an innovative pilot educational resource, N2N holds potential for integration into diverse pharmacy programs. Ongoing refinement, incorporating advancing evidence on NVPs in cessation, will better prepare graduates for evolving roles. With pharmacists assuming greater responsibility in tobacco harm reduction and public health efforts, investments in initiatives like N2N are both timely and critical.

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References

1. Gilmore, A.B. · van den Akker, A. Protecting future generations from commercially driven health harms: lessons from tobacco control Lancet. 2024; 404:221-223
2. Wilson, L.M. · Avila Tang, E. · Chander, G. Impact of tobacco control interventions on smoking initiation, cessation, and prevalence: a systematic review. J Environ Public Health. 2012; 2012, 961724
3. Results from the annual national youth tobacco survey. United States Food and Drug Administration. ⟨https://www.fda.gov/tobacco-products/youth-and-tobacco/results-annual-national-youth-tobacco-survey⟩ Accessed October 30, 2024.
4. Electronic cigarette use (vaping) in Australia in 2022–2023. Australian Institute of Health and Welfare. ⟨https://www.aihw.gov.au/reports/australias-health/vaping-e-cigarettes⟩ Accessed November 2, 2024.
5. Sharma, A. McCausland, K. · Jancey, J. Adolescent's health perceptions of E-cigarettes: a systematic review. Am J Prev Med. 2021; 60:716-725
6. Jongenelis, M.I. · McCausland, K. · Bode, S. Impact of product-based e-cigarette marketing on the attitudes and behavioural intentions of young Australians: an experimental study Tob Control. 2024;
7. Thoonen, K.A.H.J. · Jongenelis, M.I. Perceptions of e-cigarettes among Australian adolescents, young adults, and adults Addict Behav. 2023; 144, 107741
8. Yazidjoglou, A. · Watts, C. · Joshy, G. Electronic cigarette social norms among adolescents in New South Wales, Australia Health Promot Int. 2024; 39, daae018
9. Yong, H.H. · Gravely, S. · Borland, R. Do smokers' perceptions of the harmfulness of nicotine replacement therapy and nicotine vaping products as compared to cigarettes influence their use as an aid for Smoking Cessation? Findings from the ITC four country smoking and vaping surveys Nicotine Tob Res. 2022; 24:1413-1421
10. Young, R.P. · Scott, R.J. · Pattemore, P.K. E-cigarettes as a Smoking Cessation aid - has ASH made a HASH of its stance on nicotine-based vaping? Am J Respir Crit Care Med. 2024; 209:759-760
11. Gotts, J.E. · Jordt, S.-E. · McConnell, R. What are the respiratory effects of e-cigarettes? BMJ. 2019; 366:l5275
12. Tommasi, S. · Blumenfeld, H. · Besaratinia, A. Vaping dose, device type, and E-liquid flavor are determinants of DNA damage in electronic cigarette users. Nicotine Tob Res. 2023; 25:1145-1154

13. Saba, M. · Diep, J. · Saini, B. Meta-analysis of the effectiveness of smoking cessation interventions in community pharmacy .J Clin Pharm Ther. 2014; 39:240-247
14. Dent, L.A. · Harris, K.J. · Noonan, C.W. Randomized trial assessing the effectiveness of a pharmacist-delivered program for Smoking Cessation. Ann Pharmacother. 2009; 43:194-201
15. Supporting smoking cessation: a guide for health professionals – guidance updates on smoking and vaping cessation support related to changes in Australia's vaping regulation. The Royal Australian College of General Practitioners. ⟨https://www.racgp.org.au/getmedia/2f8ffac1-8751-41aa-906f-f0ec7feca048/RACGP-NVP-and-Vaping-Cessation-Consultation-provisional-draft-Dec2023.pdf.aspx⟩ Accessed December 2023.
16. O'Connell, M. · Kephart, L. Local and state policy action taken in the United States to address the emergence of E-cigarettes and vaping: a scoping review of literature. Health Promot Pract. 2022; 23:51-63
17. Hudmon, K.S. Elkhadragy, N. Kusynová, Z. Global sale of tobacco products and electronic nicotine delivery systems in community pharmacies. Tob Control. 2017; 26:e127-e129
18. Changes to the regulation of vapes. Therapeutic Goods Administration. ⟨https://www.tga.gov.au/products/unapproved-therapeutic-goods/vaping-hub/changes-regulation-vapes⟩ Accessed October 1, 2024.
19. Le, D. · Saba, M. · Bhurawala, H. Pharmacists' perspectives on nicotine vaping products (NVPs) for smoking cessation in Australia: a qualitative analysis Pharmacy. 2025; 13:11
20. Morphett, K. · Holland, A. · Ward, S. Evaluating the implementation of a prescription only regulatory model for nicotine vaping products: a qualitative study on the experiences and views of healthcare professionals. Int J Drug Policy. 2024; 125, 104353
21. Mitchell, T.B. · Shah, S. · Zink, L. The need for nationwide electronic cigarette Smoking Cessation curricula across the healthcare spectrum. Am J Pharm Educ. 2021; 85, 8212
22. Marti, K.M. · Marti, K.E. · Salvo, M.C. A call for student pharmacist education on vaping and vaping device use. Curr Pharm Teach Learn. 2021; 13:203-205
23. Jongenelis, M.I. Robinson, A. Educators' perceptions of e-cigarettes in Australian secondary schools. Tob Induc Dis. 2023; 21:41
24. Barrett, R. · Aldamkhi, H. An evaluation of the knowledge and perceptions of pharmacy staff and pre-registration students of E-cigarettes use: a systematic review. Tob Use Insights. 2021; 14, 1179173X211016867
25. Nduaguba, S.O. · Ford, K.H. · Bamgbade, B.A. Comparison of student pharmacists' self-efficacy to address cessation counseling needs for traditional and electronic cigarette use
Curr Pharm Teach Learn. 2018; 10:955-963
26. Erku, D. Gartner, C.E. Morphett, K. Nicotine vaping products as a harm reduction tool among smokers: review of evidence and implications for pharmacy practice. Res Soc Adm Pharm. 2020; 16:1272-1278
27. Haggan, M. Vapour trails: are pharmacists now tobacconists? AJP Aust J Pharm. 2024; 105:21-27
28. Kelsh, S. · Young, M. · Ottney, A. Impact of tobacco education on student pharmacists' perceptions of electronic nicotine delivery systems. Curr Pharm Teach Learn. 2024; 16, 102158
29. Saba, M. · Bittoun, R. · Saini, B. A workshop on smoking cessation for student pharmacists. Am J Pharm Educ. 2013; 77, 198
30. Von Glasersfeld, E. A Constructivist Approach to Teaching Routledge, 2012
31. O'Flaherty, J. Phillips, C. The use of flipped classrooms in higher education: a scoping review. Internet High Educ. 2015; 25:85-95
32. Lucas K.H, Testman, J.A. Hoyland, M.N. Correlation between active-learning coursework and student retention of core content during advanced pharmacy practice experiences. Am J Pharm Educ. 2013; 77, 171
33. Alioon, Y. Delialioğlu, Ö. The effect of authentic m-learning activities on student engagement and motivation .Br J Educ Technol. 2019; 50:655-668
34. Haidet, P.·Jarecke, J. Adams, N.E. A guiding framework to maximise the power of the arts in medical education: a systematic review and metasynthesis. Med Educ. 2016; 50:320-331
35. Taxonomy of educational objectives: McKay D. Company; 1956. https://eclass.uoa.gr/modules/document/file.php/PPP242/Benjamin%20S.%20Bloom%20-%20Taxonomy%20of%20Educational%20Objectives%2C%20Handbook%201_%20Cognitive%20Do

main-Addison%20Wesley%20Publishing%20Company%20%281956%29.pdf.
Google Scholar

36. Wellman, R.J. · Savageau, J.A. · Godiwala, S. A comparison of the Hooked on Nicotine Checklist and the Fagerström Test for Nicotine Dependence in Adult Smokers. Nicotine Tob Res. 2006; 8:575-580
37. Van Hecke, A. · Duprez, V. · Pype, P. Criteria for describing and evaluating training interventions in healthcare professions – CRe-DEPTH. Nurse Educ Today. 2020; 84, 104254
38. Lockett, C. Shah, S. · Rizzo Liu, K. Unpacking vaping in schools: voices from the school community. Health Educ J. 2024; 83:453-466
39. Chaplin, M.D. · Brogie, J. · Burch, A. Effectiveness of an educational intervention on health risks of vaping for high school–aged adolescents. J Am Pharm Assoc (2003). 2020; 60:e158-e161
40. Dono, J. Miller, C. · Ettridge, K. The role of social norms in the relationship between anti-smoking advertising campaigns and smoking cessation: a scoping review. Health Educ Res. 2020; 35:179-194
41. Akçayır, G. · Akçayır, M. The flipped classroom: a review of its advantages and challenges. Comput Educ. 2018; 126:334-345
42. Willems, P.P. · Gonzalez-DeHass, A.R. · Powers, J.R. The role of authentic teaching cases and mastery approach goals in online pre-service teachers' self-regulated learning. Educ Technol Res Dev. 2021; 69:1003-1023
43. Lamb, D. Learning about events through involvement and participation. Int J Event Festiv Manag. 2015; 6:73-91
44. Davies, D. · Jindal-Snape, D. · Collier, C. Creative learning environments in education—a systematic literature review. Think Skills Creat. 2013; 8:80-91
45. Anuar, N. Idris, N.S. · Mohd Zin, F. The effectiveness of smoking prevention module towards knowledge and smoking refusal skills among adolescents in Kota Bharu, Kelantan, Malaysia. Asian Pac J Cancer Prev. 2019; 20:3353-3359
46. Kelder, S.H. · Mantey, D.S. · Van Dusen, D. A middle school program to prevent E-cigarette use: a pilot study of "CATCH my breath". Public Health Rep. 2020; 135:220-229
47. Colomer, J. · Serra, T. · Cañabate, D. Reflective learning in higher education: active methodologies for transformative practices. Sustainability. 2020; 12:3827
48. Alfayoumi, I. · Aqel, O. · Axon, D.R. An assessment of student pharmacists' knowledge of electronic cigarettes or vapes—a cross sectional study at one College of Pharmacy. Pharmacy. 2022; 10:131
49. Sahr, M. · Kelsh, S. · Ottney, A. Student pharmacists' perceptions of electronic nicotine delivery systems as compared to those of other health care students. Am J Pharm Educ. 2020; 84, ajpe7690
50. Sinclair, H.K. · Bond, C.M. · Lennox, A.S. Training pharmacists and pharmacy assistants in the stage-of-change model of smoking cessation: a randomised controlled trial in Scotland. Tob Control. 1998; 7:253-261
51. Joyce, A.W. · Sunderland, V.B. · Burrows, S. Community pharmacy's role in promoting healthy behaviours. J Pharm Pract Res. 2007; 37:42-44
52. Metcalf, M. · Rossie, K. · Stokes, K. Health care professionals' clinical skills to address vaping and e-cigarette use by patients: needs and interest questionnaire study. JMIR Form Res. 2022; 6, e32242
53. Sibbald, S. · El-Aloul, L. · Shelley, J. Education of future public health professionals through integrated workshops. Pedagog Health Promot. 2022; 8:297-308