

Capitalizing on Transitional Periods to Encourage Teen Vapers to Quit

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Abstract

This paper introduces *Nix*, a behaviour-science-driven intervention, aimed at reducing youth vape rates during the transition period from high school to university. Development of this solution used a variety of design thinking techniques such as user interviews, mind mapping and persona development. The COM-B framework is used in conjunction with principles from Self-Determination Theory to foster extrinsic and intrinsic motivations through the pillars of mentorship, incentivization, and supplementary insights. The implementation of *Nix* will consider key barriers and enablers through CFIR-ERIC analysis. Evaluation of the cessation tool will engage randomized controlled trials across university campuses to understand effectiveness after engagement. *Nix*'s impact will provide insights into the efficacy of various models and techniques on the development of future behaviour interventions.

Keywords: **Modelling, Incentivisation, COM-B, Self-determination Theory, Cessation, Addiction, Adolescents**

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Capitalizing on Transitional Periods to Encourage Teen Vapers to Quit

In the UK, 34% of 18 year olds vape (Ash, 2024). That number only falls to 28% for 16-17 year olds. Unfortunately, it is in this age group that e-cigarette usage becomes critical and daily users start to see real effects, such as developmental delays on the prefrontal cortex (Yuan et al., 2015). Curbing vape rates at this time is key, as 90% of adult daily users started before the age of 18 (Kong et al., 2017).

Peer influence is widely regarded as the primary cause for teen vape-rates (Perikleous et al., 2018). This research indicates that teens are susceptible to peer mimicry, in an attempt to find social belonging. High school environments exacerbate these issues, as vaping is central in modern social norms (Fadus et al., 2019).

Current cessation models lack youth centricity and fail to address intrinsic or extrinsic motivation for young adults (Berg et al., 2021). Additionally, the involvement of educational bodies contributes to program inefficacy (Williams et al., 2022). Williams et al. (2022) explored unintended consequences of these programs, and found a surprising uptick in e-cigarette use among high schoolers who were exposed to school-led cessation efforts. Research examining after-school programs found that overbearing structures of authority are counter effective in behaviour change efforts (Deutsch & Jones, 2008). This same research found that reducing oversight and increasing teen autonomy improves reception to change.

This is Quitting is a text vaping cessation program that has been shown to have relatively high success amongst teens, where 61% of participants were able to indicate a reduction in consumption at 90 days (21% response rate) (Graham et al., 2020). The success of this program suggests a positively reflection on mobile-based interventions.

Clinical nicotine cessation programs are shown to exhibit greater success when incentives are introduced, even at a six-month follow-up (Notley et al., 2019). Behavioural economists have found a strong connection between the incorporation of incentives and the

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success of health behaviour interventions (Vlaev et al., 2019). Further analysis of these findings show that larger future unrealized gains are much more powerful than smaller immediate gain. In a cluster randomized trial, universities offered students either £5 for participation, or entrance into a £200 lottery to partake in preventative chlamydia testing (Niza et al., 2013). Campus participation was 2.8% in the lottery groups, and 1.5% in the £5 groups. Unrealized or potential gains have a higher degree of incentive effectiveness.

Change is exceptionally difficult for young adults (Yeager et al., 2018), and the transition to university from high school is one of the most stressful changes in a young persons life (Gerdes & Mallinckrodt, 1994). Transitional periods, however, are also proven as great opportunities to introduce behaviour changes, where individuals tend to be more receptive to suggestion (Grimley, 1994).

Concept Development

The design thinking Double Diamond approach (Design Council UK, 2005) defined the developmental process for this intervention. Discovery commenced via extensive literature review, followed by demographic research and brainstorming techniques. The definition phase followed by defining of key features through the lenses of behaviour science and user insight. Development followed with concept iteration and construction, and delivery concluded this process with consideration to implementation and evaluation.

Users that aligned with target demographic were approached to participate in semi-structured interview, adding user insights to this process. Five individuals (n=5) were recruited using personal contacts. Various questions regarding vape consumption, trends, habits and cessation attempts were asked. Two users interviewed were recent university graduates, who were active vapers during high school and able to quit in university. All users noted that they usually vaped in social scenarios, with some noting that they vaped the most

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during periods of stress. Generally, device sharing and peer influence was a primary influence on respondent behaviour. Two participants noted that the desire to try new flavours, colours, and packaging. One interviewee listed their reason for quitting as removal from a vape-centric social circle, while the other noted that they experienced illness related to vape consumption.

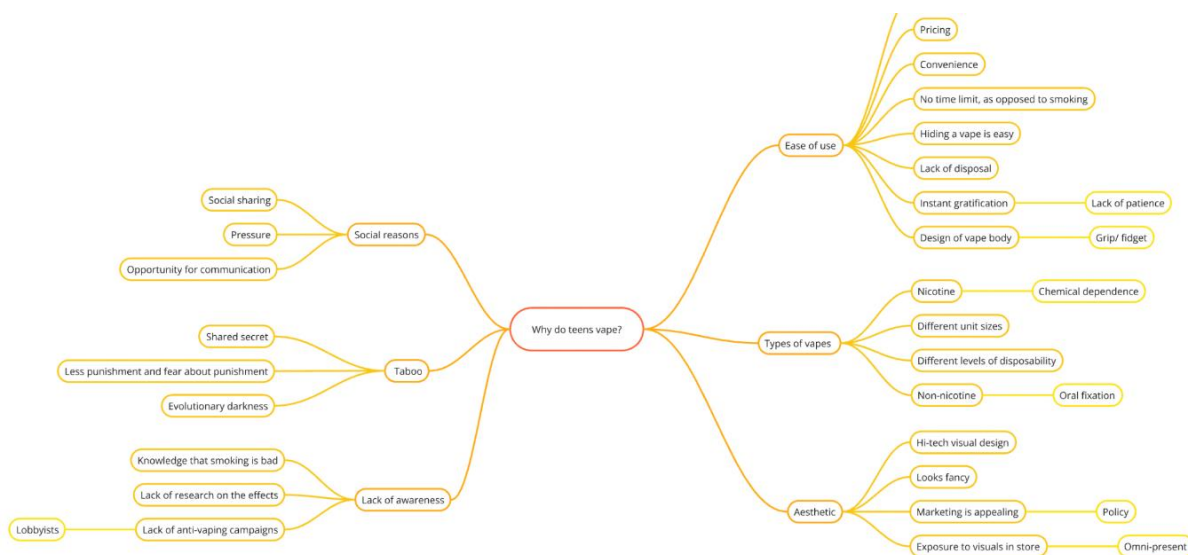


Figure 1: Mind mapping in Miro, investigating "Why do teens vape?"

These insights were combined with research insights via mind mapping (Figure 1) to explore the question of *why do teens vape?* Successful transition to the definition phase of this process began by combining the discovery phase findings with AACTT (Actor, Act, Context, Target, Time) to form a persona (Presseau et al., 2019). Figure 2 shows Jessica who is archetypal of the ideal target for this intervention.

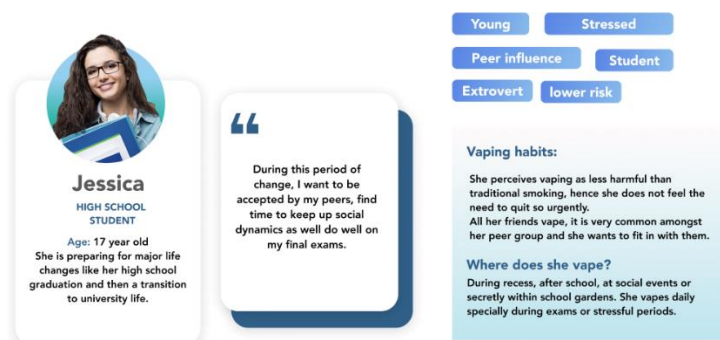


Figure 2: Persona generation of target archetype

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Intervention frameworks were important grounding tools in this process. Because this concept is centred on understanding motivation and changing health behaviour, engaging with the COM-B framework is ideal (Michie et al., 2011) (Figure 3). The COM-B framework defines various intervention functions as motivational enhancements. Modelling and incentivisation were identified on the wheel as key intervention functions. Modelling provides an example of behaviour for users to aspire to, which is linked to research outlining the effects of peer mimicry on vape-rates (Perikleous et al., 2018), and supported by user insights on the power of peers on nicotine consumption. Incentivization is supported by research outlining intervention success through incentive introduction (Notley et al., 2019), and the (Vlaev et al., 2019).

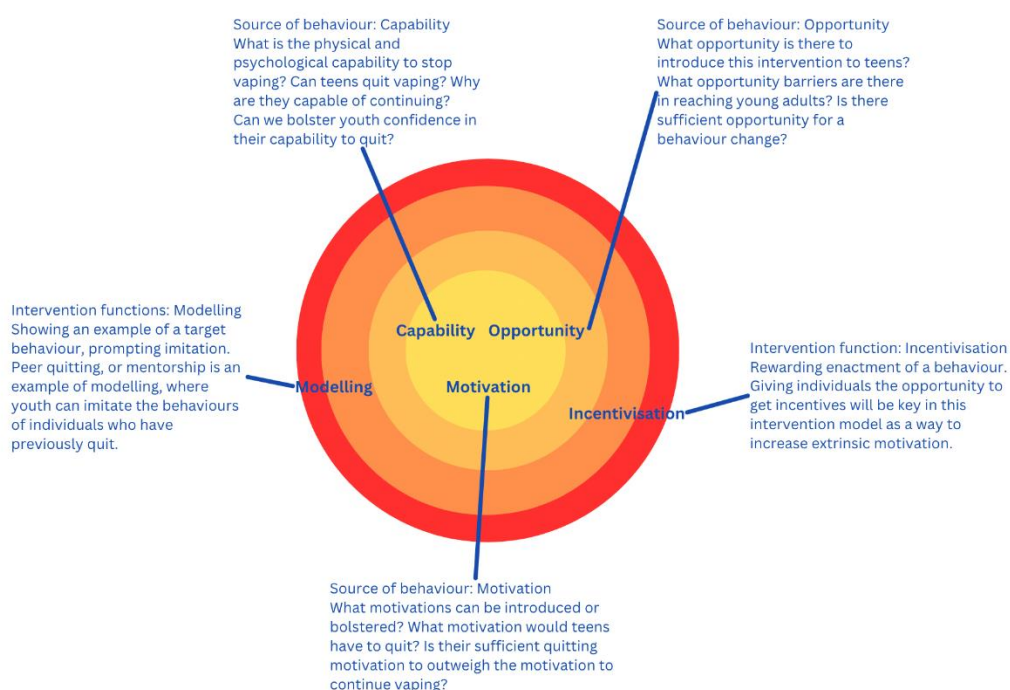


Figure 3: Defining key sources of behaviour and intervention functions with COM-B model

Self-Determination Theory (SDT) is based on three elements; autonomy, competence, and relatedness (Ryan & Deci, 2000). The inclusion of SDT is strongly influenced by background knowledge of teen's resistance to authority, and the failure of school-based

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interventions (Williams et al., 2022). Research lends validity to the inclusion of SDT principles in behaviour change (Deutsch & Jones, 2008).

Market gap exploration and competitive analysis closed the definition phase, as other vape cessation apps were analysed and compared. The current market offers a variety of interventions such as *My Life My Quit* (My Life, My Quit., 2024), *Smoke Free* (23 Ltd, 2017), and *Quit Vaping* (Kopp, 2019). Through competitive analysis, these interventions were critically examined. As seen in *Figure 4*, key insights include the lack of structure, incentives, guidance, peer support, accurate insights, and overall lack of products directed at this target audience.



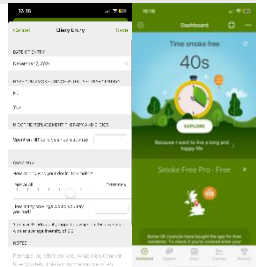
	My Life, My Quit	Smoke Free	Quit Vaping
Screenshots			
Mission statement/ Main concept	We share the truth about vaping nicotine and other tobacco products. If you want to quit, text "Start My Quit" to 855-891-9989 to get started	Quit smoking now. We will show you what you gain by giving up smoking, reward you for no smoking achievements, help you with cravings and offer tools that double your chance of success.	Join over a million users banding together to Quit Vaping. Quitting can be difficult and overwhelming, but with Quit Vaping it becomes a lot easier.
Strengths	<ul style="list-style-type: none"> -Text support to users about vaping and nicotine harmful effects -Specialized to teens - Personalization of text interventions -After completion of the program, teens receive certification 	<ul style="list-style-type: none"> -Dairy to track cravings -Chance to participate in missions -Streak timer of time since last vaped -Free advising available, as well as paying for a personalized quit coach 	<ul style="list-style-type: none"> -Community -Buddy system with your contacts -Streak of self check-ins -Future quit date/milestone setting -Shows money saved by user
Weaknesses	<ul style="list-style-type: none"> -No contact to peers -No ability for behaviour modelling -Lacking incentives -No place for streaks or milestone tracking 	<ul style="list-style-type: none"> -No contact with peers -No teen specificity -No extrinsic motivation outside of badges to earn, or no vouchers, benefits -Self check-in is unreliable 	<ul style="list-style-type: none"> -No specificity to teens -Self check-in in unreliable -Buddy system ineffective if no contacts are quitting
Other notes	Lacks the feeling of community or peer support, very simple app lacks pillars to make it successful	Feels quite basic, app lacks personalization, doesn't have engaging features or easy to use milestone tracking.	Buddy system lacks communication, app feels more about money saved then other motivations.

Figure 5: Competitive analysis of vaping apps

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Ethics

Ethics should be at the forefront of all development, especially when minors may be involved (British Psychological Society, 2018). Guided by the British Psychological Society's *Code of Ethics and Conduct*, data autonomy, anonymization and informed consent have been, and will continue to be maintained for all participants. Future testing involving minors will require the same considerations to be taken for their parent or guardians.

The proposed intervention partakes in data anonymization, and user behaviour must follow a code of conduct. Ethical considerations are taken in this intervention for students of various culture, linguistic, religious and socio-economic backgrounds.

Final Design Proposition

Nix, is a mentor-focussed vaping cessation app, grounded in the COM-B framework to deliver behaviour interventions informed by Self-Determination Theory. The final design proposition has three key interconnected features; mentorship, incentivization and insights.

Figure 9 illustrates *Nix*'s user journey, which this section dissects.

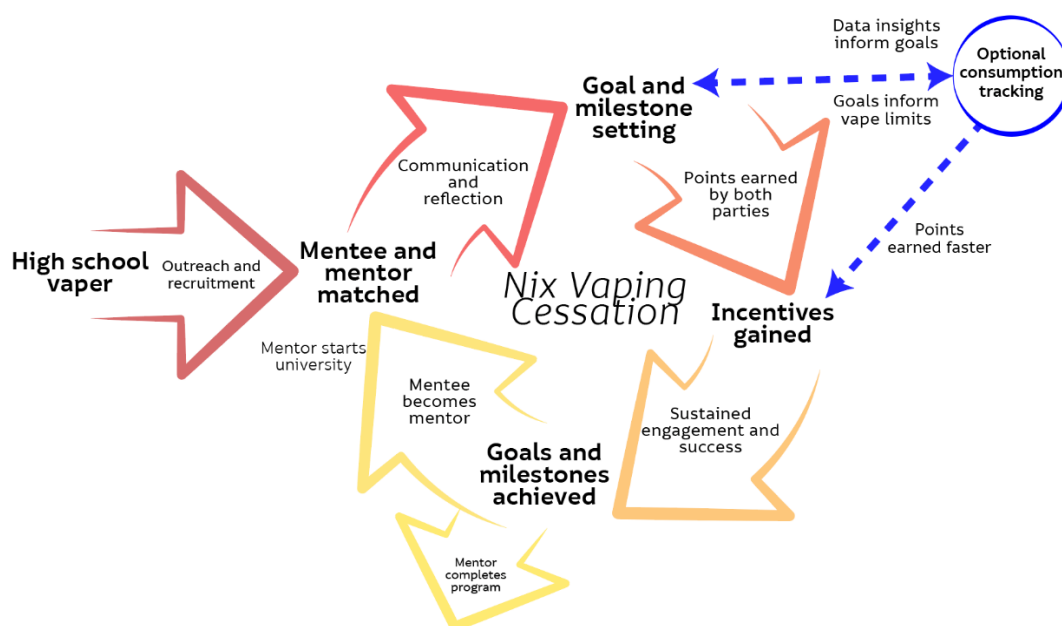


Figure 9: Nix's user journey map

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Mentorship is key in fostering intrinsic motivation through *Nix*. High schoolers in their final year of study will be recruited for the role of mentee. Through a personalized matching algorithm they will be paired with a mentor, who is an ex-mentee in their first year of university. The initial year of launch will recruit university students who are ex-vapers to act as mentors. Together, the pair will devise personalized quitting plan by working together to set goals, milestones and intentions, based on the mentee's lifestyle and mentor's lived experience. This relationship will guide mentees through their quitting journey, and onto a vape-free university career.

This feature engages students with peers that exhibit goal behaviours, to increase motivation through modelling in the form of mentorship. The goal-setting feature (Figure 11) was developed to work as an extension of the defined COM-B feature intervention of modelling, where peers work together to set realistic goals. Quitting plans will be designed to get users to slowly reduce their intake—and eventually quit. Goals and milestones can be defined by users to ensure autonomy through SDT. SDT is further satisfied by a historical view of accomplished goals, which encourages confidence in quitting through proof of competence. The third pillar of SDT is relatedness, which is fostered by bridging a relationship between peers at two separate ends of the quitting journey. An accurate and personalized algorithm will supplement the success of this pillar, as a sense of belonging and familiarity will drive motivation higher.

Mentees will be paired with mentors through a stable-marriage algorithm to ensure ideal matching (Pini et al., 2013). Ideally, mentors will be attending university where the mentee would like to attend, allowing mentors to give insights on easing into university life while avoiding nicotine. If there is no mentor available for this university or the users will not be attending university, the two parties will be matched on similar interests and hobbies. This

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is considerate of students of different socio-economic backgrounds. The algorithm will also consider religious, linguistic or other preferences.

Given the established difficulty that this transitional period exhibits, mentorship is initialized prior to transition—at the beginning of the penultimate year of high school. The mentorship will continue until students are beginning their university careers—or other endeavours. At this point, mentees can transition to a mentorship role, if their quitting journey is successful to the satisfaction of themselves and their mentor. The incentives for mentors are double that of mentees, increasing extrinsic motivation to successfully quit vaping and become a mentor. The mentors will stay in this role for the duration of their first year of university to parallel the mentee and assure a maintenance of their own abstinence. Insights from the semi-structured interviews reveal peers got some users into a quitting mindset, and some expressed inspiration from friends who had successfully quit. The combination of user research, literature reviews and integration of behaviour change models ensures a high probability of success for the mentorship component of this intervention.

Incentivization is the next pillar of this intervention and will be in the form of an in-app marketplace (Figure 10). This marketplace works on a points system, where mentors and mentees alike can earn points to buy real-life rewards. Points are earned through mentor-mentee check-ins, achieving defined goals, and hitting milestones. The points for these acts vary, and mentors earn double points every time the mentee earns. This extrinsically motivates engagement from the mentor. Incentivisation through future gains has proven effective in encouraging health related behaviour change (Niza et al., 2013).

This marketplace features partnerships with companies on and off the mentees' prospective, and mentors current university campus. This partnership allows mentors to actively benefit from the rewards as first-year university students. Mentees can use their

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points with non-campus related rewards, or save their points for their future attendance. This gives the mentee a positive outlook on the future of their quitting journey.

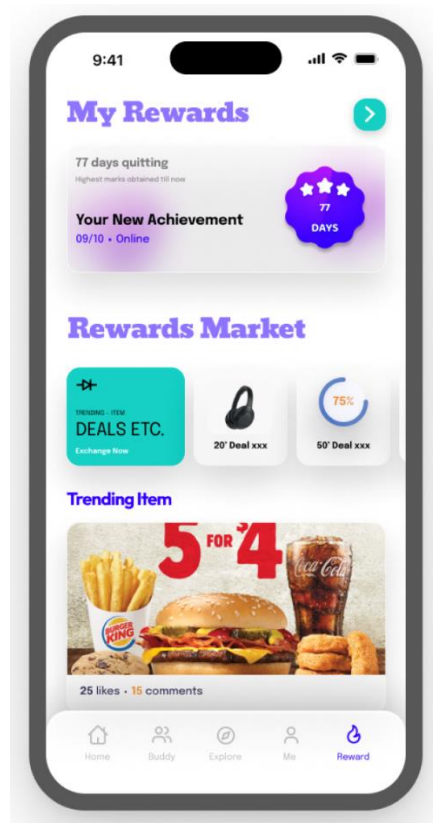


Figure 10: In-app marketplace visualization

The COM-B intervention function of incentivisation is framed by SDT to focus on growth of extrinsic motivation. The rewards marketplace was designed to allow mentors and mentees to earn points through goal-fulfilment. The users have control over the expenditure of their points, maintaining autonomy. The inclusion of incentives grows extrinsic motivation through the external validation of the SDT pillar of competence. Purchases act as a receipt to goals achieved, affirming competence in quitting. The marketplace uses algorithms to push rewards that are of interest to similar users, as well as rewards that can be realized on campus. Algorithmic design fulfils the relatedness pillar of SDT.

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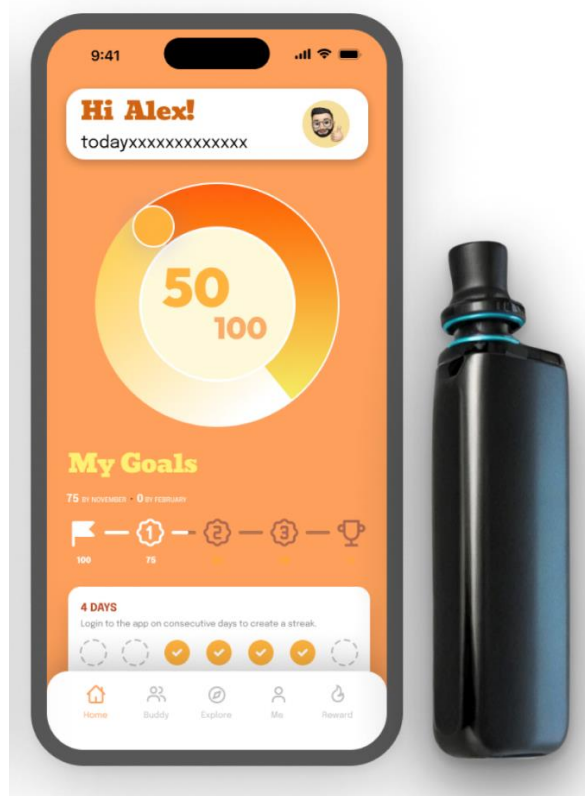


Figure 11: Goal tracking app component with accompanying optional ring hardware, visualization

Insights supplement the other two app pillars. The tracking feature acts as an optional booster to the techniques used across this intervention. The optional ring is placed on the mentee's vape, tracking the amount of times they inhale on the device. This companion will be supplementary to mentorship scheme as it will gather exact data to allow individuals to set more defined goals. The incentives scheme will also be supported, as usage of the ring will increase points earned. Once the ring is being used, the consistent tracking will help users become aware of triggers, and engage in mindfulness. Mentors will also be able to view the mentee's progress, and see when the ring is removed from the mentee's vape, allowing for guidance for the mentee to make better decisions. User research informed this decision as most interviewees did not consider themselves aware of their own patterns or levels of consumption. Additionally, interviewees found that an accountability partner was helpful. The hardware tracking component is optional to maintain the autonomy pillar of SDT, as well as resist overbearing interventions that teens will resist (Deutsch & Jones, 2008).

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To mitigate negative educational implications, the *Nix* recruitment and outreach effort will be promoted by extracurricular clubs and activities. Engagement of high school and university campuses will give a solid user base for the app to take off, but promotion by the institution will be avoided.

Positioning this intervention during a transitional period gives *Nix* the ability to capitalize on an unstable period, that teens struggle with (Gerdes & Mallinkrodt, 1994). This intervention will take place from the beginning of the penultimate year of high school, until the first year of university ends. This prevents highschoolers from carrying this habit into adulthood, and making vaping a lifelong habit (Kong et al., 2017). The user base of this intervention is cyclic, as mentees become mentors, and the users are restricted to the beginning of the last year of high school until the end of the first year of university. The pressure of time will encourage students to engage with this intervention while they have the opportunity. There are 366,000 students in the UK that go through this transition each year (UCAS, 2024), which presents a large total addressable market (TAM).

Implementation and Evaluation Plan

CFIR (Damschroder et al., 2022) sorts contextual barriers and enablers into 5 domains; intervention characteristics, outer setting, inner setting, characteristics of individuals, and implementation processes. This structure is complimented ERIC (Waltz et al., 2014), which offers 73 strategies for overcoming these barriers. All domains of CFIR were considered in this implementation plan. Three barriers stood out as top importance of consideration, which are *peer pressure and social influence*, *culture and organizational climate*, and *engaging and executing*.

The CFIR barrier of *peer pressure and social influence* comes from the *Outer Setting* domain. Given that peer mimicry keeps teens vaping (Huang et al., 2019), this barrier must

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be addressed. ERIC provides enablers that mitigate this. To reflect the use of COM-B modelling in the design solution, the ERIC enabler of *identifying and preparing a champion* will be ideal. The previous design phase identified the modelling intervention function as successful for the chosen demographic, so this ERIC enabler is ideal.

The next relevant barrier is *culture and organizational climate*. *Nix* is not an educational body but there is concern about the proposed partnership between high schools, universities and this intervention in misconstruing the intervention as school-run. This can be mitigated against with the ERIC method of *using advisory boards and workgroups*. These groups will form strategies for campus outreach and recruitment, based on stakeholder input.

Engaging and executing is a possible barrier in the process domain of CFIR, as concern for sustaining engagement is realistic in any cessation program. The design of this app addresses this barrier through the ERIC strategies of *creating incentives* through the marketplace, and *providing ongoing consultation* through the mentorship program.

The evaluation of *Nix*'s efficacy will be measured using randomized controlled effectiveness trials. In the years following the launch of *Nix*, university campuses will be selected at random to examine and determine the cause and effect of the intervention. This evaluation will measure effectiveness by analysing vape rate usage across campus. Campuses with high levels of ex-participants attending university should see a much lower rate of vape use, as opposed to other locations. This evaluation will start one and a half years after launch, to examine participants after program exit. Ideally, this study would be longitudinal to determine if abstinence is maintained through to graduation and beyond.

This intervention would benefit from scaling efforts to reach across the UK. Initially, a small amount of schools will be recruited for outreach. A successful initial evaluation study will be key in convincing *Nix* promotion at other schools.

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Discussion

Nix puts forth an evidence-based intervention to effectively reduce vaping among young people. This meets the design challenge by leveraging the COM-B framework to identify the key drivers of behaviour change; and build an intervention accordingly. Self-Determination Theory guides the student's through their cessation journey by fostering intrinsic and extrinsic motivation. *Nix* also engages in deep personalization of goal setting, reward gathering, and mentorship matching to ensure satisfaction and an inclusive platform.

The mentorship model that *Nix* uses is built on the idea peer support, pairing high school students with university students in alignment with the COM-B framework's intervention function of modelling. The rewards marketplace is also defined from the COM-B intervention function of incentivisation. An optional ring component supplements these features to boost results and bolster intrinsic and extrinsic motivation. Self-Determination Theory consideration ensures app success through maintenance of user autonomy, confirmation of user competence, and encouragement of mentee-mentor relatedness.

One of the biggest strengths of this design is the cyclic nature of the *Nix* ecosystem, where mentees can become mentors. The design of this system will allow for continued app success after participant exit, through a renewing user base. Deep personalization is another strength in this project, as a more defined quitting journey will keep users engaged, via the ability to more accurately address individual motivation differences.

There are challenges presented in the mentorship model as it may be hard to ensure competence and consistent support across all mentors, and matches will be ideal. Mitigation techniques such as mentor incentives and stable marriage algorithms are used, however assurance is hard to promise. Limitations around the ring tracker exists, as it would be impossible to know if a user uses a vape that does not have the ring on it.

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The implications of *Nix* on public health and policy could be significant, as evidence of the efficacy of various behaviour change models, providing insights in the development of future health-related behaviour change interventions. School boards could also use these insights to dissect the ways in which self-determination theory impacts cessation programs to develop effective solutions.

In conclusion, *Nix* is a compelling a multi-faceted solution to address the challenge of youth vaping. *Nix* successfully incorporates behaviour science models to create interventions, while considering ethical limitations and dilemmas. The strength of this project lies in its alignment with public health and educational objectives, and the positioning in existing time structures, to create an innovative system. By addressing the motivation, capability and opportunities of vaping cessation, *Nix* is ensured a high probability of success in empowering young people to lead healthier lives.

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