Reducing Drug-use Harms among Higher Education Students: X Contextual-Behaviour Change Digital Intervention Development Using the Behaviour Change Wheel

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Abstract

Background: Digital harm-reduction interventions typically focus on people with severe drug-use problems, yet, these interventions have a moderate effectiveness on drug-users with lower levels of risk of harm. The difference in effectiveness may be explained by differences in behavioural patterns between the two groupings. Harnessing behavioural theories to understand what is at the core of drug-use behaviours to map the content of new interventions can improve the effectiveness of interventions for lower-risk drug-users. This is the first study to systematically apply the Behaviour Change Wheel (BCW) to understand the components, influencing capabilities, opportunities, and motivations (COM-B) of higher education students to change their drug-use behaviour. This is also the first study which identifies specific patterns of behaviours likely to be most responsive to harm reduction practices through the use of the Theoretical Domain Framework (TDF).

Methods: We first conducted an online survey and a Delphi exercise to understand the factors influencing COM-B components of higher education students to change drug-use. Subsequently, we mapped all evidence onto the COM-B and the TDF to identify clusters of behaviours to target for change using a pattern-based discourse analysis. Finally, a series of multidisciplinary group meetings identified the intervention functions- the means by which the intervention change targeted behaviours and the Behavioural Change Techniques (BCTs) involved using the behaviour change technique taxonomy (v.1).

Results: Twenty nine BCTs relevant to harm-reduction practices were identified and mapped across five intervention functions (education, modelling, persuasion, incentivization, and training) and five policy categories (communication/marketing, guidelines, regulation, service provision and environmental/social planning). These BCTs were distributed across eight identified saturated clusters of behaviours this intervention attempts to change.

Conclusions: The BCTs identified will inform the development of a digitally delivered behaviour change intervention that focuses on increasing mindful decision-making with respect to drug-use and promotes alternatives to drug-use activities. The findings can also inform implementation scientists in applying context-specific harm-reduction practices in higher education. Examples of how the eight identified clusters of target behaviours are mapped across the COM-B components and the TDF are provided, along with suggestions of implementation practices for harm -reduction targeting students in higher education.

Contribution To The Literature

- Proposes a conceptual map of the influences of drug-use behaviours in higher education settings
- Suggests an implementation paradigm shift on how to address the issue of reducing harm from drug-use among higher education students
- Indicates harm reduction implementation practices in higher education settings

Background

Illicit drug-use is a pertinent public health issue among young adults, with the United Nations (1) referring to the use of illicit drugs as a “youth phenomenon”. The prevalence of drug-use reaches its peak among 18–25 years (2–4) which coincides with the time when many individuals enter higher education. Cannabis is the most commonly used illicit drug, with 30% of higher education students in the US reporting past-year use (5). The non-prescribed use of prescription medications, including drugs such as Amphetamines, is also becoming more prevalent among students in higher education (4). Drug use corresponds with a period of transition for young adults who are gaining independence and many may be living away from family for the first time (6). In this transitional phase, experimentation with or regular use of drugs may be perceived as a normative behaviour by students, to either achieve some form of personal enhancements (7), develop new social support structures (2), or enhance a new experience (8,9). Any problematic pattern of behaviour which is established at this time can continue far into adulthood with drug-use becoming a core health-compromising behaviour (10,11).

The potential risks and adverse consequences of drug-use to student populations maps across several life domains, including lower grade point averages, poor class attendance (12), heavy drinking (13), polydrug-use (14), and other high-risk behaviours, such as driving under the influence, unprotected sex, physical fights (15), or exacerbation of mental health problems (16). These potential consequences may be experienced concurrently, potentially reshaping trajectories of wellbeing across the life course (12,17,18). Given the broad harms illicit drugs can cause, preventive and intervention programmes at higher education institutions levels are needed to respond effectively to drug-use by students.

Interventions to target illicit drug-use in this population have previously used personalized feedback provision with norm corrections (19–21). Although these interventions are often delivered digitally, due to their relative low-cost, ease of implementation, and acceptability among young adults (22,23), they achieve only modest success in harm reduction (24,25). The reasons for this may be the lack of a unified theory-driven behaviour change framework that informs the design and development of the behaviour change intervention. Also, the interventions lack theory-based contextual-driven approaches as vehicles to implement harm-reduction practices (24,25). In order to effectively employ behaviour change practices, we must describe the target behaviour (26) and understand the contextually bound influences on this behaviour (27,28). We must also make use of process-based behavioural change practices (29–31) which can predict and influence behaviours (e.g., ongoing decisions and actions) with scope, precision, and sensitivity of the context where these behaviours occur (32).

For drug-use, there have been calls for research that goes beyond understanding the antecedents and consequences of use (e.g. motivation for use, intention to change) and towards the explicit use of theories to understand what is at the core of the drug-use behaviours (33) within a person's context (34). The psychological theories in motivation for change and transtheoretical models of change (35) have produced a plethora of perspectives that explain the phenomenon of drug-use. However, a synthesis of this knowledge to systematically map drug-use behaviours in the users' context and to inform current

interventions development and implementation practices, has yet to be developed. A framework that could provide a systematic way to use behavioural theories in practice is the Behaviour Change Wheel (BCW) (26).

At the core of the BCW approach is the COM-B model (26,36) which suggests that individuals need the capability (C), opportunity (O), and motivation (M) to change behaviours. In addition, there are nine intervention functions (e.g., modelling) via which an intervention exerts its effect and seven policy categories (e.g., regulation) that will support the implementation of the intervention (26). Also, the COM-B approach includes the behaviour change taxonomy (BCCTv1) (37) which allows the identification of the “active ingredients” of the intervention through a list of 93 possible theory-driven behaviour change techniques (BCTs). Coupled with COM-B model is the Theoretical Domain Framework (TDF) (28). This framework consists of 14 theoretical determinants (e.g., knowledge, skills, beliefs about consequences, etc.) which can enhance understanding of the cognitive, emotional, social, and environmental influences on target behaviours (28). In turn, this knowledge can be translated into agile and effective behaviour change components (33,38) that can reduce the harm of drug-use at a population-level (39). In drug-use, the BCW method and the TDF framework have guided the development and implementation of interventions that target drug-use related harm (40). Yet, these frameworks have never been applied in the context of higher education populations.

To address this gap, we established the X (masked for reviewing purposes; MRP) project that aims to develop a theoretically based, digitally delivered behaviour change intervention to reduce harms from drug-use, focusing on higher education students. The X project adopted the BCW (26) approach that allows intervention researchers to understand the target behaviours via a behavioural analysis of the problem and then design an intervention on the basis of this analysis.

In this article, for the first time in the relevant literature, we use the BCW method and the TDF framework, as guides to identify the BCTs that informed the X content. Specific aims of this study were to synthesize the evidence from primary (survey) and secondary (three systematic reviews) data sources, gathered as part of the X project (MRP) in order to (a) identify clusters of drug-use target behaviours among higher education students; (b) select specific intervention functions through which the intervention will exert its effect, and (c) choose specific BCTs to be operationalized within the X digital intervention.

Methods

In January 2020, we established a multidisciplinary advisory team with experts in Behavioural Science (MRP), Information Systems (MRP), Public Health (MRP), and Student Health Services (MRP), to assist the completion of the BCW method. The advisory team completed four open-sort grouping exercises, a Delphi-type exercise with two rounds, and a discourse pattern-based analysis, over eight-months. Prior to the beginning of the analyses, all members attended a training session on the BCW method and consented to participate in a series of consensus-type meetings. For all the research activities, ethical approval was granted from the Social Research Ethics Committee at x (SREC reference number no; MRP). Written informed consent was obtained from all participants in this study. TIDieR checklist was used for developing this manuscript.

Phase I- Identifying the problem in behavioural terms

As presented in the BCW method (36), phase I consists of four steps. In steps one to three, we analysed drug-use behaviours among higher education students in behavioural terms. In step four, we sought to identify what specific aspects need to change to achieved changes in the targeted behaviour.

Step 1- Define the Problem in Behavioural Terms

The research group conducted three systematic reviews to understand what is at the core of drug-use behaviours in higher education students (24,25). To define the problem in behavioural terms, the advisory group participated in the first open sort grouping exercise. The advisory group worked in pairs and filled out a template, including two questions: (a) what is the target group involved in the behaviour? and (b) where does the behaviour occur?.

Step 2- Select the Target Behaviour

The first author (MRP) synthesized the findings from three systematic reviews (one in preparation) (24,25). Next, a long list with items deemed relevant to the targeted behaviour was generated from the synthesis of the reviews. The group then participated in a Delphi-type exercise with two rounds. In each round, the members rated each behaviour using the APEASE criteria (Affordability, Practicability, Effectiveness, Acceptability, Side effects, Equity; see Table 1 for definitions of the APEASE criteria) (42). The members of the expert advisory group rated the long-list of the targeted behaviours and these ratings were used to collate a shorter-list for the second round of ratings. Inter-rater agreements were calculated, using a 70% threshold (i.e., participants fall within two agreement categories on a Likert-type scale (43) as an agreement point for the first round (long-list rating), and a threshold of 3.25 median score in the second round (short-list) to resolve differences (convergence biases of opinion) (42). The final selection of the target behaviour was agreed upon by the expert group members in a consensus meeting.

Table 1: Behavioural specification of the target behaviours

Target behaviour	Who	What	When	Where
Increase students' behavioural awareness regarding their decision to take drugs	Higher education students (aged 18-25 yrs)	1. Pause automatic/habitual decision making in relation to drug-use	1. In night outs/ social media/ festive periods	Social contexts involving a decision to take drugs (e.g., at campus, in social media, streets around the university, etc.)
Reflect on alternatives to drug-use activities which fulfil personal enhancements	Full-time/ part time students, Erasmus/visiting students (bachelor to graduate studies)	2. Increase behavioural awareness in relation to drug-use decision making	2. During induction weeks	
		3. Committing in specified goals which can fulfil personal enhancements	3. Before, during & after the exam's periods	
			4. Randomly repeated during the semester	
Selected items derided from the Delphi-type exercise using the APEASE criteria				
[A1]	Users to compare their own use with the norm (descriptive norm correction; e.g., % of students with higher use than their own)			
[A2]	Users to reflect on their close friends' perception about their own use or abstinence (injunctive norm correction)			
[A5]	Users to find out personally relevant primary motives for use, listing the personal enhancements drug use fulfil to them (underlying needs that drive the decision to take drugs)			
[A10]	Users to reflect on the possible negative consequences of using drugs on academic, athletic and social performance			

Note1: Given that the four selected items (see supplementary table 2) are all clustered within the behavioural domain A, specifications are applied for both targeting behaviours.

Note 2: The advisory group consulted the APEASE criteria to guide their decisions making. The APEASE criteria specify as to: (a) the impact of the selected behaviour on the intervention's desired outcomes; (b) the likelihood of behavioural change (c) the spillover effect of behaviour on related behaviours; (d) the accessibility of the targeted behaviour; and (e) the efficacy of the behaviour in bringing about the desired outcomes (36).

Step 3- Specify the Target Behaviour

Following the synthesis of the reviews (6–8), in Step 3 the expert advisory group participated in a third open sort grouping exercise to specify: the target behaviours, the population, and the context (when and where the behaviours will be performed).

Step 4- Identify What Needs to Change

In step 4, we triangulated data to better understand the behaviours to target (36). First, we systematically reviewed the context and motivations underpinning student illicit drug-use (41) and examined previous digital interventions in reducing harm from illicit drug-use in a higher education population (24). Then, in response to the dearth of existing relevant research (e.g., only three papers identified in our scoping review; in preparation), we conducted a quantitative survey to further understand the motivations, experiences, and patterns of drug-use behaviours in an Irish university student population.

We developed a survey to measure individual and contextual factors relevant to drug-use behaviours. A Public and Patient Involvement (PPI) group that consisted of higher education students reviewed the survey for cultural context appropriateness. The clarity, acceptability, and relevance to students' context were piloted by a small group of students ($n=6$) that made several modifications to items and phrasing. The final survey comprised of six sections (demographics, student life, patterns of drug-use, decision-making process, motivations for using, and behaviour change). The survey was then distributed electronically to a randomly selected representative sample of X (MRP) students ($n=3770$) via emails. The survey achieved a 30% response rate and a 60% completion rate. Following descriptive analysis (SPSS, V22), a mapping exercise was used to synthesize qualitatively, aspects of the targeted behaviour to change.

The mapping exercise was completed in four steps by two members of the expert advisory group (MRP) to map the identified items on the COM-B and the TDF domains. First, the first author interrogated the data and extracted patterns of the selected data (i.e., descriptors explaining various features of the targeting behaviours) (44). The second author examined the patterns for transparency issues (45) and reached agreement on the mapped items. Third, the survey's findings were synthesized per the TDF domains. Fourth, we conducted a pattern-based discourse analysis (46,47) on the data to map on the TDF domains and COM-B components. This mapping exercise was targeted to examine: (a) what function each TDF domain and COM-B components serve in the target behaviours and (b) what needs to change for the target behaviour to occur. The final goal of this step was for the group to develop a roadmap with clusters of target-behaviours.

Phase II: Identifying Intervention Options

Phase II consisted of two steps to guide our decision on intervention functions and policy categories.

Step 5 & 6- Identify Intervention Function and Policy Categories

Using the APEASE criteria, three co-authors (MRP) examined, first individually, and then as a group, the nine intervention functions. The goal was to examine whether the functions would serve each of the identified clusters of target behaviours. Further, they also identified policies that support intervention functions.

In each selection of functions Fleiss' kappa statistics (48) were calculated, to quantify the reliability of agreement between the raters.

Phase III: Identify Content and Implementation Options

Step 7- Identify Behaviour Change Techniques

To identify specific BCTs the first author employed the taxonomy matrix of 93 BCTs (BCTTv1) (37) to generate an extended list of BCTs that could be mapped on the eight identified clusters of techniques relevant to drug-use behaviours. Using the APEASE criteria, a shorter list was generated and a final selection of the targeted BCTs was agreed.

Step 8- Identify Modes of Delivery

The mode was predetermined as digital, so this step was not executed.

Results

The results reported below represent the application of the BCW method. A summary of the BCW method employed is illustrated in Figure 1.

Step 1- Define the Problem in Behavioural Terms

Following a consensus meeting, the problem was defined as (a) the low level of awareness regarding drug-use decision making, (b) the poor insight as to the consequences of drug-use behaviours, and (c) the lack of opportunities to consider alternatives to fulfil personal enhancement. Therefore, the group decided that the intervention should focus on (a) increasing mindful decision-making in relation to illicit drug-use behaviours, and (b) enhancing individuals' insight for alternatives to drug-use behaviours as means to fulfil the students' personal enhancement. In relation to the context where the intervention should target, the group decided that the social events which involve alcohol consumption and students' grouping who either declare occasional drug-use or non-use as targeted contextual features.

Some of the identified influences on drug-use are related to the physical and social opportunities that may be afforded by the university context. Other factors are related to students' reflective motivation (e.g., how their peers would view them, feelings of shame) and automatic motivation (e.g., a desired outcome from the use). Finally, capabilities are not identified in the context of students' drug-use behaviours. The scoping review (MRP) identified two contextual variables as potentially risky factors: the university context and the transition period from the second level (i.e., high school) to higher education. These factors require harm-reduction strategies at a systemic/policy-level (e.g., new public health responses to illicit drugs and alcohol use) (49). However, our analyses of behavioural diagnostics indicated the value of individual-level focus.

Step 2- Select the Target Behaviour

A long list of 67 potential behaviours (items) was derived from the synthesis of all the relevant literature review. Figure 2 illustrates five potential targets relevant to drug-use behaviours that can increase students' awareness in relation to their decision to take drugs and can increase understanding of alternatives as means to fulfil the students' personally relevant enhancements (the entire list is shown in Supplementary Table S1). In refining the long list of potential targets, one can see that current university service provisions address some of the targeting behaviours. For example, psychoeducation about the consequences of illicit drug-use (domain C) is service universities often provide as part of their health care policies (49). The advisory group participated in a Delphi-type exercise with two ranks.

In round one from the 67 items identified, only 24 items reached the agreement point of 70% (see Supplementary Table S1). Seventeen items were from the targeted behaviour A (increase awareness of current illicit drug-use behaviours), four from B (maximize self-regulatory capacity and skill), one from C (resilient-related skills), and two from E (address personalized-contextual factors). None of the items from domain D (provide psychoeducation relevant to drug-use) reached the agreement point and this behavioural target was excluded from round two.

In round two, from the 24 items selected, 15 items reached the agreement point of the median score, using the APEASE criteria (values > 3.25), as potential drug-use behaviours to target (10 from A; 4 for B; and one from E; see Supplementary Table S2). Finally, of these 15 items, only 4 reached the agreement of the mean score of the APEASE criteria (ranked > 70%) and these were selected as potential behaviours to target. All four items (targets relevant to drug-use behaviours) were from the behavioural target A (see Table 1 for the four identified behaviours). These items indicate that the targeted behaviours should increase awareness in relation to contextual factors (e.g., peers) that influence drug-use decision making and enhance insight as to the internal motivations of the students to use drugs (e.g., expectations).

Step 3- Specify the Target Behaviour

Table 1 presents the specifications of the targeted behaviours and the four selected items derived from the Delphi-type exercise.

Step 4- Identify What Needs to Change

Below, we first present an overview of the findings from the on-line survey. We then present the findings from mapping the 25 identified patterns of drug-use behaviours into the COM-B components. We finally present the findings from the discourse-based analysis that shows what needs to change for the targeted behaviours to occur, using the TDF domains. Table 2 shows the patterns of drug-use related behaviours that were mapped on the COM-B components and the TDF domains. Table 3 summarizes the findings of the whole analyses arising from the step 4.

Table 2: Mapping patterns of drug-use related behaviours within COM-B components and the TDF domains

	Motivation								Of
	Reflective				Automatic				Social
25 Patterns of influences on drug-use related behaviours (identified)	Identity	Belief about capabilities	Optimism	Intentions	Goals	Belief about Consequences	Reinforcement	Emotions	Social Influences
Frequencies (number of times each domain coded in									
	10	7	9	11	10	18	13	8	8
Perceived reasons for using drugs									
Perceived consequences from drug-use in users' daily functioning (immediate)									
Perceived consequences from drug-use in users' daily functioning (distal)									
Perceived reasons for never use									
Norm correction									
Perceived concerns from the absence of use									
Perceived differences from use between the general and student population									
Questioning future use									
Planning to use drugs									
Time proximity of drug-use									
Perceived drug-use when alternative, non-use behaviours, are present									
Intention to use drugs									
Reasons for reducing drug-use									
Noticeable effects of drugs in students' daily functioning resulting in increasing students' motivation for change									
Perceived attitudes of students as risky population when compared with the general population									
Recognition of valued activities as									

an antidote to drug-use									
Perceived ability to implement harm-reduction practices when needed									
Perceived capability to reduce or stop taking drugs									
Perceived knowledge about the risk of drug-use									
Methods used to reduce or stop using drugs									
Perceived ability to influence others on drug-use decision making									
Contextual forces-A: Recognition of peers influence in reducing drug-use									
Contextual forces-B: Recognition of students' users as contributors to drug-use									
Contextual forces-C: Recognition of the physical environment as an influencing factor for drug-use									
Contextual forces-D: Recognition of sources (suppliers) as an influencing factor for drug-use									

Note 1: we identified the following TDF domains, expanded on the COM-B components; *motivation* [86]: social/professional role and identity (10), beliefs about capabilities (7), optimism (9), intentions (11), goals (10), beliefs about consequences (18), reinforcement (13) and emotion (8); *opportunity* [18]: social influences (8), environment (10); *capability* [19]: physical skills (0), knowledge (3), cognitive and interpersonal skills (4), memory attention and decision processes (4), behavioural regulation (5).

Note 2: Id.: Social/Professional Role and Identity, Bel cap.: beliefs about capabilities, Opt.: optimism, Int.: Intentions, Bel cons.: Beliefs about consequences, Reinf.: reinforcements, Em.: Emotions, Env.: Environmental context & resources, know.: knowledge, cog.: cognitive and interpersonal skills, mem.: memory, attention and decision processes, Beh. Reg.: behavioural regulation. The shaded squares highlight evidence or consensus that these identifiers map on a specific TDF domain.

Table 3: Intervention components targeting the eight identified patterns of drug-use related behaviours

Pattern of drug-use related target behaviours	COM-B mapped elements targeted	Intervention Function served	Coded identified (from BCTTv1)	BCTs selected	Translation of BCTs within X intervention
Cluster 1: Increase awareness about the real vs. anticipated effects drug-use can have on students' personally desired behaviours	Reflective motivation	Education	5.1.	Information about health consequences	Provide a personalized animated feedback explaining the possible health-related risks and harms per drug-use type and frequency.
			5.3.	Information about social and environmental consequences	Present a gamified quiz showing the possible consequences of drugs in students' academic and emotional area of living (e.g., legal problems, etc.).
			5.6.	Information about emotional consequences	
			6.3.	Information about others' approval	Provide a subjunctive norm correction, in a gamified quiz way.
			13.4.	Valued self-identity	Include a story-telling exercise requesting from students to produce self-statements of their life they want while in college.
Cluster 2: Promote identification of personally relevant activities (which are they?) which lead to positive expected outcomes in students' desired behaviours (fun & enjoyment)		Education	1.3.	Goal setting (outcome)	Present an interactive value's identification and committed action exercise.
			7.2.	Cue signalling reward	Present a reflective- non-judgmental rhetorical question, prompting students to consider how their values match with drug-use behaviours.
			13.2.	Framing/reframing	Suggest the adoption of alternative to drug-use activities as means to enhance fun and enjoyment.
		Modeling	5.6.	Information about emotional consequences	Present a mindful-based exercise ("how fully present am I?"), prompting students to visualize (mental representation) how they would feel after achieving college-related goals.
			15.1	Verbal persuasion about capability	Use motivational cards to show how students can pursue value committed actions.
			16.3.	Vicarious learning	Present a scenario-based story showing a student pursuing his/her goals while enjoying college's years.
		Training	1.4.	Action planning	Prompt students to use their e-calendar to plan implementing SMART defined goals.
Cluster 3: Increase perceived competence & optimism that an implementation plan of alternatives to drug-use activities can induce positive expected experiences (fun & enjoyment)		Education	1.3	Goal setting (outcome)	Use an animation to educate how commitment to SMART goals can work as alternative to drug-use behaviours and reinforce the deliberate adoption of several, non-drug-use behaviours, asserting that these behaviours can elicit as fun as drugs can, without putting students into risks or harms.
			1.9.	Commitment	
			6.3.	Information about others' approval	
			8.2.	Behaviour substitutions	
			8.6.	Generalization of a target behaviour	
			13.2	Framing/reframing	
			15.1.	Verbal persuasion about capability	
Cluster 4: Increase awareness of the university context as a risk factor that increase the chances for drug-use behaviours and how this can restrict students from having positive college's experiences		Education	2.3.	Self-monitoring of behaviour	Explain the role of cues (triggers of use) within an ABC analysis (behavioural analysis), prompting students to identify (self-monitoring) their own antecedent triggers in relation to the context of use.
			4.2.	Information about antecedents	
		Modeling	7.1.	Prompt/cues	Show how self-talk can be used to help students recognize cues that can influence decision making in relation to drug-use.
			15.4	Self-talk	
Cluster 5: Cultivate mindful awareness of the perceived reasons for using (why I use?) and increase insight as to whether the use leads to desired		Education	1.6.	Discrepancy between current behaviours and goals	Present a personalized feedback showing students' level of behavioural awareness and goal attainment (i.e. whether their decision to take drugs is influenced
			2.4.	Self-monitoring of	

outcomes in goal-directed behaviours at a long-run				the outcomes of behaviours	by others).Then, prompt students to monitor whether there is a discrepancy between goals and present behaviours.
			4.1.	Instructions on how to perform a behaviour	Introduce via an animation the mindful decision making skill (learn to pause step-back, notice and decide) and prompt students to think how this skill resonates with their role identity.
			8.1.	Behavioural practice/rehearsal	
			13.4	Valued self-identity	
			4.2.	Information about antecedents	Prompt students to apply the new skills to identify cues.
		Modelling	4.1.	Instructions on how to perform a behaviour	Present via a story-narrative (a party house) how a student applying mindful decision making skill (pausing- noticing- deciding) in a situation requiring drug-use decision making.
			6.1.	Demonstration of the behaviour (modelling)	
			8.1.	Behavioural practice/rehearsal	Reinforce students' capacity to apply the new skill in different situations
			8.6.	Generalization of a target behaviour	
			15.1.	Verbal persuasion about capability	
		Training	6.1.	Demonstration of the behaviour	Present a series of mindful cards demonstrating what mindful decision making skill does and advice for a gradual implementation of this skill building activity.
			8.7.	Graded tasks	
Cluster 6: Resolve students' misleading expectations about the expected outcomes of drug-use in students' desired behaviours in the long-run	Automatic motivation	Education	5.2.	Salience of consequences	Provide a general performance score in a drug-use quiz activity. Wrong-answered responses will provide feedback that will target at correcting students' expectations about the effect of drugs in the long-run. They will also aim at increasing awareness about the potential regrets students may experience from the use of drugs
			13.2.	Framing/reframing	
		Persuasion	5.5.	Anticipated regret	
Cluster 7: Increase procedural knowledge and practice skills on how harm-reduction practices are implemented within the university context	Capability Physical	Education	1.8.	Behavioural contract	Present a series of harm-reduction practices and invite students to select the ones that best fit with their experiences (personalized plan).
			4.1.	Instructions on how to perform a behaviour	Show instructions in detail on how to perform selected harm-reduction practices via a series of illustrative cards.
			8.6.	Generalization of the target behaviour	Prompts students to generalize the new harm-reduction practices, including awareness of exposure to cues, to multiple different situation.
			12.3.	Avoidance/ reducing exposure to cues for the behaviour	
		Modelling	1.9.	Commitment	Show an animation illustrating a student to perform one harm reduction practice, highlighting his/her commitment.
			4.1.	Instruction on how to perform a behaviour	
		Training	4.1.	Instruction on how to perform a behaviour	
			6.1.	Demonstration of the behaviour	
Cluster 8: Promote behavioural awareness and behavioural regulation regarding drug-use decision making under the influence of peers	Social Opportunity	Education	1.6.	Discrepancy between current behaviour and goal	Prompt students to reflect on their personalized feedback scores in questionnaires assessing levels of decision making influenced by others.
			4.1.	Instruction on how to perform a behaviour	Present instructions on how to promote behavioural awareness in relation to decision making.
			4.2.	Information about antecedents	Prompt students to think peers' influences as antecedent (cues) for them to use drugs.
			5.2.	Salience of consequences	

			8.2.	Behavioural substitution	Promote a mindful decision-making, highlighting that influences from peers should be aware.
			8.7.	Graded tasks	Provide suggestions on building the new behavioural regulation skill (behavioural awareness).
			13.2.	Framing/reframing	Prompt students to consider their feedback on subjunctive norm correction (how behaviours are approved by others) in relation to their valued identity.
			15.2.	Mental rehearsal of successful performance	Advise students to imagine themselves taking a mindful decision, despite the presence of peers' influence.
		Modelling	4.1.	Instruction on how to perform a behaviour	Illustrate an animation (a narrative story) with a student denying using drugs, while recognizing the potential influence of peers.
			6.1.	Demonstration of the behaviour	

Note1: Physical opportunity was not targeted.

Note 2: Translation of BCTs into digitally delivered components represent only concepts which are designed into ideations prototypes to be tested with students, rather than actual implementation practices for the X digital intervention.

Findings from the On-line Survey

Over half of the responders reported using an illicit drug in their lifetime ($n=394$), with a third reporting use in the last year ($n=236$). Cannabis was the most commonly reported drug ($n=230$; 31.25%), followed by ecstasy ($n=139$; 19%), cocaine ($n=120$; 16.30%), ketamine ($n=73$; 10%), mushrooms ($n=53$; 7.20%), and others ($n= 121$; 16.55%). The age of first use was 19-21 years for most drugs, except for cannabis which was 16-18 years old.

The majority (>77%) of respondents indicated experiencing negative effects from the use of any drug. They reported motivations to abstain from concerns raised regarding the impact of drugs in their psychological well-being, cognitive function, academic performance, and the lack of further pleasuring effects. The majority of responders (82%) also believed that students are much more likely to use drugs, compared to the general population, mostly due to opportunities for use, provided by the university context (e.g., acceptability, lack of control, and peer influences). Students reported social factors related to use, including peer pressures (54%) and at least one occasion (reported by 81%) where they were around people who were using drugs. The majority of students (72%) reported that they would be positively influenced to abstain if their friends reduced their usage. The primary reason for use was given as "fun and enjoyment" (86%), followed by "coping with daily academic stressors" (7.3%).

Students felt they possessed adequate knowledge of the risks associated with drug-use (89%), mentioning perceived deterioration in finances (9.5%), personal physical safety (42%), academic progress, physical activity (40% in both conditions), athletic performance (35%), and psychological wellbeing (32%) as the main areas that are affected by drug-use behaviours. Notably, students reported experiencing positive changes in several areas of functioning while taking drugs, including increases in confidence (95%), social interaction (92%), relaxation (86%), energy levels (62%), and decreases in irritability (70%), and distress (68%), with these effects reverting when the effects of the drugs wear off. For those declaring previous use, the five main motivations for change were: noticeable psychological impacts, financial burden, physical effects, impairments in executive functions, and concerns about how other people perceive their drug-use. Students also reported willingness to change their use if they were to socialize with other groups (18.7%), had alternatives to drug-use activities (24%) or had better ways to manage unwanted emotions (10.5%). The majority of students lack knowledge and present with low confidence in how to apply harm reduction practices.

Findings from the COM-B Mapping exercise

From the survey, we identified, coded, and mapped onto the COM-B and TDF a total of 25 patterns of drug-use behaviours (see Table 2). 23 items were coded into motivation (17 reflective and 6 automatic), 5 in capability (3 in physical and 2 in psychological), and 7 in opportunity (5 in social and 2 in physical).

Findings from the Grounded Discourse Theory Pattern-based Analysis

Using a grounded discourse theory pattern-based analysis, we identified eight clusters of drug-use behaviours. As presented in Table 3, five clusters target reflective motivation, one

Reflective Motivation

automatic motivation, one physical capability, and one social opportunity.

Beliefs about consequences: students have strong expectations as for the role of drug-use will play in enhancing personally relevant areas of interest. Given the immediate and potent effects of drugs (e.g., increased energy level, social interactions, confidence, reduction in anxiety, irritability, etc.), students' beliefs about the positive consequences of drugs in fulfilling personal enhancement are strengthened, and thus maintained, at every drug-use experience. Using and non-using students voice concerns about the overall value of drug-use, tending to associate the use with negative effects in their life (i.e., more than 80% positively responded to the question). However, the presence of strongly held beliefs and other contextual variables (peers, the perceived expectation for use in

higher education, positive immediate effects, absence of risks or control, etc.) serve to minimize students' reflective motivation as to the potential negative longer-term effects of drugs. Increasing students' awareness of the perceived long term consequences versus the perceived short term benefits may lead to an increase in students' harm reduction practices and possibly reduce levels of drug-use.

Intention: the current users' intention to abstain from drug-use, in contrast to the non-users, was found to be low. Students report confidence to use harm-reduction practices and use practices that are considered to be the most effective ones (e.g., avoid certain environments or people who frequently use). However, this expressed intention to use harm-reduction practices is buffered because contextual influences prevail. Low behavioural awareness, lack of planned alternatives, and long-term habitually established patterns of drug-use behaviours are thought to influence students' motivation to engage with preventative or protective health behaviours. Harm reduction interventions should therefore aim to help students build personalized plans for alternatives to drug-use activities and reinforce their awareness of the long-term negative effects drugs can have on valued-based activities of importance in their lives.

Social/professional role and identity: although students present with sufficient awareness of the negative effects of drug-use in their social identity (e.g., academic disruptions, risks in physical safety, reductions in popularity levels, etc.), contextual forces (e.g., acceptability of drug-use, peer pressure, fear of not fitting in, etc.) minimize the effect of this awareness on their willingness to change behaviour (e.g., abstain or reduce the use). Increasing awareness of the negative effects of drugs on students' identities (e.g., valued self-identity) can support harm-reduction interventions in higher education.

Goals: The goal of students who take drug is usually to fulfil some personal desires (e.g., such as induced fun and excitement while in college). This goal can become habitual, resulting in students to either planning specific actions to get drugs or prioritising activities around the drug-use. Findings showed that 50% of students plan to use drugs in the hours shortly before using, and 38% have a conscious plan (goal) several days in advance. Students report a willingness to abstain or reduce their drug-use if alternative activities will help them to achieve certain value-based outcomes (e.g., academic progress, secure physical safety, etc.). Therefore, altering the means via which students reach desired effects in personally relevant areas of interest (e.g., fun) can support harm-reduction interventions.

Automatic Motivation

Reinforcement: Students' drug-use is associated with some positive effects in certain college's areas (e.g., athletic performance, concentration enhancement, academic achievements). This "drug-use and positive effect" association strengthens every time students make use of drugs, increasing the likelihood of ongoing actual drug-use behaviour. Changing the association of seeing drug-use as an activity that can have a positive effect in certain college's areas into the one that is seen as risky, could support harm reduction interventions.

Opportunity

Environmental context and resources (Physical): Contextual factors (e.g., perceived normalization/acceptability of drug-use within university settings) have a "synergetic" effect that influence students' decision making. A harm reduction intervention should enhance students' awareness about the "synergetic" effects of environmental antecedents (personal and interpersonal cues) and their role in increasing social opportunities for drug-use.

Step 5- Identify Intervention Functions

Five intervention functions were identified from the eight clusters of target behaviours, using the APEASE criteria. The overall reliability of agreement between the raters was satisfactory $k = .47$ (.95% CI, 33 to .60), $p < .001$. As seen in Table 4, we selected education, modelling, and persuasion as the predominant intervention functions. To address the possible low engagement with the new behavioural repertoires (skills), we included incentivisation, considering that the expectation of rewards in personally relevant behaviours, may have reinforcing effects on the target behaviours. Finally, in response to students' lack of knowledge about implementing harm reduction practices, training was recognized as an important intervention function, mostly because it promotes procedural knowledge and practical skills (e.g., how to implement harm reduction practices).

Table 4: Links between the COM-B components and intervention functions

COM-B Components	Intervention Functions							
	Coercion	Education	Enablement	Environmental Restructuring	Incentivisation	Modelling	Persuasion	Restriction
Reflective motivation								
Automatic motivation								
Physical Capability								
Psychological Capability								
Physical Opportunity								
Social Opportunity								

Note: The shaded squares highlight evidence or consensus agreement among the members of the advisory group and shows that the identified clusters of target behaviours (8) can be targeted with a particular intervention function or a combination of them.

Step 6- Identify Policy categories

We also decided that five policy categories could serve the five selected intervention functions: (a) communication/marketing, (b) guidelines, (c) regulation, (d) service provision, and (e) environmental/social planning. The first three policies were shared across at least four of the five intervention functions. Environmental/social planning was considered a supporting policy for the incentivisation as an intervention function. Both communication/marketing and service provision policies were selected to support post-design promotional and delivery activities of the X digital intervention, rather than to update its content.

Step 7- Identify Behaviour Change Techniques

We created a long list of potential BCTs (see Supplementary Table S3). Using the APEASE criteria, we identified 29 BCTs matched with the eight clusters of behaviour to change and COM-B components (see Table 3). In Figure 3, we illustrate the combination of the selected BCTs (BCCTv1) matched with the eight clusters of target behaviours.

Discussion

To the best of our knowledge, this is the first study to systematically apply the BCW and the TDF frameworks to understand the dynamic and complex determinants supporting harm reduction practices in the context of higher education students' illicit drug-use. The findings have guided the design of the X intervention through the identification of the contextual, cognitive, and emotional determinants that support students' decision making to use drugs. The findings also generated a novel comprehensive conceptual map of the influences on drug-use behaviours in higher education students. This conceptual map indicates foci for harm reduction implementation practices and new paradigms in addressing drug-use among higher education students.

Increasing reflective and automatic motivation, physical capability, and social opportunity are important determinants to consider in supporting harm-reduction practices for higher education students. Implementation practices that respond to these determinants can be translated into selected BCTs which based on the study's theoretically grounded hypothesis, may work synergistically to increase students' mindful decision-making to drug-use, and enhance their motivation to find alternatives to drug-use activities. The analysis showed that reflective motivation prevails, indicating that any behavioural change intervention should focus on increasing students' reflective motivation. Yet, several other determinants should be also considered. Correcting students' expectancies about the benefits of drug-use in the long-run, increasing insight of finding alternatives to drug-use activities as means for fulfilling students' desires (mostly to have fun and enjoy activities), and enhancing awareness of their personal (e.g., personality, sensation-seeking, emotional dysregulation) and contextual (e.g., peer influences, norm perceptions, etc.) factors that influence students' drug-use decision are all novel implementation practices that can tackle the harm drugs can cause in higher education students populations.

Findings from the discourse pattern-based analysis identified eight patterns of drug-use behaviours. The eight patterns make use of education, modelling, persuasion, incentivisation, and training as the predominant intervention functions. These functions are supported by communication/marketing, guidelines, regulation, service provision, and environmental/social planning policy categories. Any implementation activity that focuses on cultivating one of the eight clusters of behaviours relevant to drug use can be implemented using a combination of the 29 identified theory-driven BCTs. These BCTs are now theorized as being implementable in an affordable, practical, and acceptable way, and as being capable of making changes in targeted drug-use behaviours. Notably, BCTs can be used in different modes of delivery, populations, contexts, and relevant types of behaviours (50), and as expected from the TDF framework, can increase clarity as to the mechanisms of action through which behaviour changes occur.

Drawing on the findings from the BCW analysis, this study provides a clear theoretical map for researchers and implementation scientists, highlighting novel context-specific components that can be translated into effective modularized, personalized harm-reduction practices. To achieve this objective, any effort to mitigate the harms drugs can cause in students' lives, require a multicomponent intervention that takes account of the specific developmental context of higher education and the life stage of students (11,51). This study illustrates how this can be achieved through the use of the eight clusters of target behaviours. In combination, these behavioural changes may enhance opportunities for creating positive life trajectories via teaching mindful decision-making and value-based actions. They also focus on increasing motivations for change and enhancing sensitivity to contextual influences and opportunities, including drug availability, environmental triggers, and the most salient features of the educational context (52–55). To date, previous interventional efforts have received criticisms as being too narrow (e.g., misperceived norms, lack of knowledge about harm-reduction practices, low motivation for change, etc.) or adopting a one-size-fits-all approach (e.g. individuals presenting with different levels of use, non-using students, etc.) (24). Though these interventions are promising (56), they address context variation and personalization for students, poorly (54). What is missing are innovations in delivering tailored-made harm-reduction supports to students' in higher education.

There is a need for use of contextually driven approaches that can deliver greater behavioural regulation by harnessing social, psychological, and situational forces (57,58). Of equal importance is the need for multidisciplinary collaboration in developing and delivering such preventive and intervention programmes. While COM-B and TDF frameworks provide a more granular understanding of psychological capability and reflective motivational processes (37), this knowledge can also guide researchers and implementation scientists to other relevant theories and approaches (28,59). The findings from the BCW method identified the key role of students' mindful decision-making in relation to drug-use and the promotion of valued-based activities. Contemporary behavioural accounts of psychological health indicate Psychological Flexibility (PF) (32) as a potentially effective approach to support students' mindful decision-making.

Psychological Flexibility encourages the disinhibition of immediate habitual gratification (e.g., having fun) over individuals' long-term goals (58,60). It does this by teaching behavioural awareness or the ability to be present and take decisions, considering all the possible influencing factors (61). The PF model approach also reinforces the recognition of personally desired life directions in domains that are congruent with students' values, such as academic achievement and attenuation of personal career goals (58). Given that targeted behaviour change can be effective, if they adopt specific approaches (37), PF affords the capacity to enact and maintain positive trajectories in youths' lives (60) and research shows that it can also effectively support implementation practices tailored to higher education needs (29,62,63). This can be achieved by capitalizing on the clinical application of the PF model which indicates six therapeutic facets, three of them align to the X goals: to increase mindfulness, promote the identification of values, and cultivate committed actions (29,64,65). Employing specific evidence-based therapeutic facets, such as the ones the PF model proposes (64–66), can increase sensitivity in treatment outcomes and knowledge as for the mechanisms via which behavioural changes occur (32).

Findings should be interpreted in light of some limitations. Despite the systematic approach of the BCW method, the triangulation of the present study data analyses occurred without specifying the primary drug-use. Though most higher education students report using hallucinogens (e.g., marijuana) (5), a sensitivity analysis per drug-use type may have revealed influences on behaviours relevant to specific types of drug-use (e.g., different clusters of behaviours from students using stimulants). Likewise, the findings from the behavioural analysis focus mainly on understanding the drug-use of experimental/occasional-use students, with limited references to those students who do not use drugs or those who describe heavy use of drugs. Finally, given that no well-validated scales were employed to capture the key indicators of the COM-B components in the survey, the findings may include measurement biases and so replication may be worthwhile.

Future research should assess which identified clusters of behaviours may improve efficacious outcomes if a change is needed. This should be conducted prior to pilot feasibility or pragmatic implementation trials to avoid premature development of a full service which may later need significant modifications. In addition, future research should examine how selected clusters of behaviours could be effective when applied in different contexts (e.g., digital, public health policy practices, etc.). Furthermore, validation of the eight clusters of behaviours through an in-depth qualitative deductive inquiry of student users and stakeholders (university policymakers) could increase insights as to the barriers to implementation which otherwise may not have been captured within the existing data collection, possibly due to the sensitive nature of the topic of drug-use as a research area. Finally, reporting of any innovations (e.g., personalization algorithms, computational models) resulting from turning the identified BCTs concepts into digital and interactive modules can accelerate a more robust knowledge base for behavioural change and implementation practices.

Conclusions

In conclusion, this research provides an approach to applying the BCW method to intervention development that draws upon primary and secondary data sources. The findings from the synthesis analysis enabled the identification of targeted problematic behaviours related to drug use. Increasing students' mindful awareness in relation to drug-use decision making and promoting alternatives to drug-use activities indicate foci for the implementation of harm reduction strategies for higher education students' drug-use. These can be delivered through a combination of the eight identified sources of drug-use behaviours. Researchers and implementation scientists can use the presented conceptual map to develop and design interventions and public policy strategies that can be highly specific to mitigate the harms resulting from the use of drugs within the context of higher education.

List Of Abbreviations

masked for reviewing purposes

Declarations

Ethics approval and consent to participate

Ethical approval for this project was granted by the Social Research Ethics Committee at the X (MRP).

Consent for publication

Not applicable

Availability of data and materials

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors conceived the manuscript and participated in the research activities to complete the BCW method. X (MRP) and X (MRP) led the writing of the manuscript and revised the manuscript. X (MRP) conducted the literature search and assisted in the Delphi-type exercise and with the writing of the background and edited the manuscript. X (MRP) edited the manuscript and assisted in the ranking exercise of the policy categories. X (MRP) edited the manuscript and assisted in the intervention function and BCTs identification exercises. X (MRP) edited the manuscript. X (MRP) edited the manuscript and provided overall supervision of the project. Also, X (MRP) was guarantor of the study. All authors read and approved the final manuscript.

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References

1. Vereinte Nationen, Büro für Drogenkontrolle und Verbrechensbekämpfung. World drug report 2019. 2019.
2. Skidmore CR, Kaufman EA, Crowell SE. Substance Use Among College Students. *Child and Adolescent Psychiatric Clinics of North America*. 2016 Oct;25(4):735–53.
3. European Union, European Monitoring Centre for Drugs and Drug Addiction. European drug report: trends and developments 2019. Luxembourg: Publications Office of the European Union; 2019.
4. Silvestri MM, Knight H, Britt J, Correia CJ. Beyond risky alcohol use: Screening non-medical use of prescription drugs at National Alcohol Screening Day. *Addictive Behaviors*. 2015 Apr;43:25–7.
5. Arria AM, Caldeira KM, Allen HK, Bugbee BA, Vincent KB, O'Grady KE. Prevalence and incidence of drug use among college students: an 8-year longitudinal analysis. *The American Journal of Drug and Alcohol Abuse*. 2017 Nov 2;43(6):711–8.
6. Dalton ED, Hammen CL. Independent and relative effects of stress, depressive symptoms, and affect on college students' daily health behaviors. *J Behav Med*. 2018 Dec;41(6):863–74.
7. Acharya L, Jin L, Collins W. College life is stressful today – Emerging stressors and depressive symptoms in college students. *Journal of American College Health*. 2018 Oct 3;66(7):655–64.
8. Awang MM, Kutty FM, Ahmad AR. Perceived Social Support and Well Being: First-Year Student Experience in University. *IES*. 2014 Dec 22;7(13):p261.
9. Caldeira KM, Kasperski SJ, Sharma E, Vincent KB, O'Grady KE, Wish ED, et al. College students rarely seek help despite serious substance use problems. *Journal of Substance Abuse Treatment*. 2009 Dec;37(4):368–78.
10. White HR, Labouvie EW, Papadaratsakis V. Changes in Substance use during the Transition to Adulthood: A Comparison of College Students and Their Noncollege Age Peers. *Journal of Drug Issues*. 2005 Apr;35(2):281–306.
11. Schwartz SJ, Petrova M. Prevention Science in Emerging Adulthood: a Field Coming of Age. *Prev Sci*. 2019 Apr;20(3):305–9.
12. Arria AM, Caldeira KM, Bugbee BA, Vincent KB, O'Grady KE. The academic consequences of marijuana use during college. *Psychology of Addictive Behaviors*. 2015 Sep;29(3):564–75.
13. O'Grady KE, Arria AM, Fitzelle DMB, Wish ED. Heavy Drinking and Polydrug Use among College Students. *Journal of Drug Issues*. 2008 Apr;38(2):445–65.
14. Meshesha L, Dennhardt A, Murphy, G. J. Polysubstance Use Is Associated With Deficits in Substance-Free Reinforcement in College Students. *Journal of Studies on Alcohol and Drugs*. 2015;76(1):106–16.
15. McCabe SE, Teter CJ. Drug use related problems among nonmedical users of prescription stimulants: A web-based survey of college students from a Midwestern university. *Drug and Alcohol Dependence*. 2007 Nov;91(1):69–76.
16. Pedrelli P, Nyer M, Yeung A, Zulauf C, Wilens T. College Students: Mental Health Problems and Treatment Considerations. *Acad Psychiatry*. 2015 Oct;39(5):503–11.
17. Schuster C, O'Malley PM, Bachman JG, Johnston LD, Schulenberg J. ADOLESCENT MARIJUANA USE AND ADULT OCCUPATIONAL ATTAINMENT: A LONGITUDINAL STUDY FROM AGE 18 TO 28. *Substance Use & Misuse*. 2001 Jan;36(8):997–1014.
18. Taylor DR, Poulton R, Moffitt TE, Ramankutty P, Sears MR. The respiratory effects of cannabis dependence in young adults. *Addiction*. 2000 Nov;95(11):1669–77.
19. Lee CM, Neighbors C, Kilmer JR, Larimer ME. A brief, web-based personalized feedback selective intervention for college student marijuana use: A randomized clinical trial. *Psychology of Addictive Behaviors*. 2010;24(2):265–73.
20. Elliott JC, Carey KB, Venable PA. A preliminary evaluation of a web-based intervention for college marijuana use. *Psychology of Addictive Behaviors*. 2014;28(1):288–93.
21. Palfai TP, Saitz R, Winter M, Brown TA, Kypri K, Goodness TM, et al. Web-based screening and brief intervention for student marijuana use in a university health center: Pilot study to examine the implementation of eCHECKUP TO GO in different contexts. *Addictive Behaviors*. 2014 Sep;39(9):1346–52.

22. Boumparis N, Karyotaki E, Schaub MP, Cuijpers P, Riper H. Internet interventions for adult illicit substance users: a meta-analysis: Internet interventions for illicit substances. *Addiction*. 2017 Sep;112(9):1521–32.
23. Gulliver A, Farrer L, Chan JK, Tait RJ, Bennett K, Calear AL, et al. Technology-based interventions for tobacco and other drug use in university and college students: a systematic review and meta-analysis. *Addict Sci Clin Pract*. 2015 Dec;10(1):5.
24. Dick S, Whelan E, Davoren MP, Dockray S, Heavin C, Linehan C, et al. A systematic review of the effectiveness of digital interventions for illicit substance misuse harm reduction in third-level students. *BMC Public Health*. 2019 Dec;19(1):1244.
25. Organ DD, Dick S, Hurley C, Heavin C, Linehan C, Dockray S, et al. A Systematic Review of User-Centred Design Practices in Illicit Substance Use Interventions for Higher Education Students. 2018;18.
26. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*. 2011 Dec;6(1):42.
27. Ovreteit J. Understanding the conditions for improvement: research to discover which context influences affect improvement success. *BMJ Quality & Safety*. 2011 Apr 1;20(Suppl 1):i18–23.
28. Atkins L, Francis J, Islam R, O'Connor D, Patey A, Ivers N, et al. A guide to using the Theoretical Domains Framework of behaviour change to investigate implementation problems. *Implementation Sci*. 2017 Dec;12(1):77.
29. Levin ME, Krafft J, Twohig MP. Examining processes of change in an online acceptance and commitment therapy dismantling trial with distressed college students. *Journal of Contextual Behavioral Science*. 2020 Jul;17:10–6.
30. Hayes SC, Hofmann SG, Stanton CE, Carpenter JK, Sanford BT, Curtiss JE, et al. The role of the individual in the coming era of process-based therapy. *Behaviour Research and Therapy*. 2019 Jun;117:40–53.
31. Hofmann SG, Hayes SC. The Future of Intervention Science: Process-Based Therapy. *Clinical Psychological Science*. 2019 Jan;7(1):37–50.
32. Hayes SC, Levin ME, Plumb-Villardaga J, Villatte JL, Pistorello J. Acceptance and Commitment Therapy and Contextual Behavioral Science: Examining the Progress of a Distinctive Model of Behavioral and Cognitive Therapy. *Behavior Therapy*. 2013 Jun 1;44(2):180–98.
33. Michie S, Johnston M. Theories and techniques of behaviour change: Developing a cumulative science of behaviour change. *Health Psychology Review*. 2012 Mar;6(1):1–6.
34. Simons JS, Joseph Clarke C, Simons RM, Spelman PJ. Marijuana consequences in a motivational context: Goal congruence reduces likelihood of taking steps toward change. *Addictive Behaviors*. 2016 Jan;52:83–90.
35. Prochaska JO, Redding CA, Evers KA. The transtheoretical model and stages of change. In: *Health behavior: Theory, research, and practice* [Internet]. 4th ed. John Wiley & Sons, Inc.; p. 125–48. (2008). Available from: file:///C:/Users/v.vasilou/OneDrive%20-%20University%20College%20Cork/Desktop/Theory_of_reasoned_action_theory_of_planned_behavi.pdf
36. Michie S, Atkins L, West R. The behaviour change wheel: a guide to designing Interventions. Silverback; 2014. 329 p.
37. Michie S, Richardson M, Johnston M, Abraham C, Francis J, Hardeman W, et al. The Behavior Change Technique Taxonomy (v1) of 93 Hierarchically Clustered Techniques: Building an International Consensus for the Reporting of Behavior Change Interventions. *Annals of Behavioral Medicine*. 2013 Aug;46(1):81–95.
38. Grol R, Grimshaw J. From best evidence to best practice: effective implementation of change in patients' care. *The Lancet*. 2003 Oct;362(9391):1225–30.
39. Nilsen P. Making sense of implementation theories, models and frameworks. *Implementation Sci*. 2015 Dec;10(1):53.
40. Dugdale S, Ward J, Hernen J, Elison S, Davies G, Donkor D. Using the Behavior Change Technique Taxonomy v1 to conceptualize the clinical content of Breaking Free Online: a computer-assisted therapy program for substance use disorders. *Subst Abuse Treat Prev Policy*. 2016 Dec;11(1):26.
41. Whelan E. A systematic review to identify motivations for students to change substance use.
42. Hasson F, Keeney S, McKenna H. Research guidelines for the Delphi survey technique. *Journal of Advanced Nursing*. 2000;32(4):1008–15.
43. Sumsion T. The Delphi Technique: An Adaptive Research Tool. *British Journal of Occupational Therapy*. 1998 Apr 1;61(4):153–6.
44. Coyle A. Discourse Analysis. In: *Analysing Qualitative Data in Psychology* [Internet]. London: SAGE Publications, Ltd; 2007. p. 98–116. (SAGE Research methods). Available from: <https://methods.sagepub.com/base/download/BookChapter/analysing-qualitative-data-in-psychology/d14.xml>
45. Braun V, Clarke V. *Successful Qualitative Research: A Practical Guide for Beginners* [Internet]. illustrated, reprint ed. SAGE; 2014. 400 p. Available from: https://books.google.ie/books/about/Successful_Qualitative_Research.html?id=PVbGngEACAAJ&redir_esc=y
46. Charmaz K. *Constructing grounded theory*. London; Thousand Oaks, Calif: Sage Publications; 2006. 208 p.
47. Birks M, Mills J. *Grounded theory: a practical guide*. Los Angeles, Calif: Sage; 2011. 210 p.
48. Fleiss JL, Bruce L, Paik MC. *Statistical Methods for Rates and Proportions* [Internet]. 3rd ed. Wiley; 800 p. Available from: <https://www.wiley.com/en-ie/Statistical+Methods+for+Rates+and+Proportions%2C+3rd+Edition-p-9780471526292>
49. Davoren MP, Calnan S, Mulcahy J, Lynch E, Perry IJ, Byrne M. Responding to excessive alcohol consumption in third-level (REACT): a study protocol. *BMC Health Serv Res*. 2018 Dec;18(1):364.
50. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ*. 2008 Sep 29;a1655.
51. Arnett JJ. The Developmental Context of Substance use in Emerging Adulthood. *Journal of Drug Issues*. 2005 Apr;35(2):235–54.
52. Dick S, Vasilou VS, Davoren MP, Dockray S, Heavin C, Linehan C, et al. My Understanding of Drug Use Experiences (MiUSE): a protocol for the development of a digitally delivered harm reduction intervention for students in higher education. (Preprint) [Internet]. *JMIR Research Protocols*; 2020 Jan [cited 2020 Jul 14]. Available from: <http://preprints.jmir.org/preprint/17829>

53. Stockings E, Hall WD, Lynskey M, Morley KI, Reavley N, Strang J, et al. Prevention, early intervention, harm reduction, and treatment of substance use in young people. *The Lancet Psychiatry*. 2016 Mar;3(3):280–96.
54. Jenkins EK, Slemon A, Haines-Saah RJ. Developing harm reduction in the context of youth substance use: insights from a multi-site qualitative analysis of young people's harm minimization strategies. *Harm Reduct J*. 2017 Dec;14(1):53.
55. Dick S, Davoren MP, Byrne M, Heavin C, Dockray S, Vasiliou V, et al. The Design of a Digital Behaviour Change Intervention for Third-Level Student Illicit Substance Use: A Persona Building Approach. In: *Proceedings of the 53rd Hawaii International Conference on System Sciences* [Internet]. Hawaii; p. 9. Available from: <http://hdl.handle.net/10125/64157>
56. Dennhardt AA, Murphy JG. Prevention and treatment of college student drug use: A review of the literature. *Addictive Behaviors*. 2013 Oct;38(10):2607–18.
57. Hansen S, Kanning M, Lauer R, Steinacker JM, Schlicht W. MAP-IT: A Practical Tool for Planning Complex Behavior Modification Interventions. *Health Promotion Practice*. 2017 Sep;18(5):696–705.
58. Zhang C-Q, Leeming E, Smith P, Chung P-K, Hagger MS, Hayes SC. Acceptance and Commitment Therapy for Health Behavior Change: A Contextually-Driven Approach. *Front Psychol*. 2018 Jan 11;8:2350.
59. Connell Bohlen L, Michie S, de Bruin M, Rothman A, Kelly MP, Groarke H, et al. Do combinations of behaviour change techniques that occur frequently in interventions reflect underlying theory? [Internet]. *PsyArXiv*; 2019 Dec [cited 2020 Jul 24]. Available from: <https://osf.io/49djm>
60. Ciarrochi J, Atkins PWB, Hayes LL, Sahdra BK, Parker P. Contextual Positive Psychology: Policy Recommendations for Implementing Positive Psychology into Schools. *Front Psychol* [Internet]. 2016 Oct 10 [cited 2020 May 24];7. Available from: <http://journal.frontiersin.org/article/10.3389/fpsyg.2016.01561/full>
61. Hayes SC, Villatte M, Levin M, Hildebrandt M. Open, Aware, and Active: Contextual Approaches as an Emerging Trend in the Behavioral and Cognitive Therapies. *Annu Rev Clin Psychol*. 2011 Apr 27;7(1):141–68.
62. Levin ME, Hicks ET, Krafft J. Pilot evaluation of the stop, breathe & think mindfulness app for student clients on a college counseling center waitlist. *Journal of American College Health*. 2020 Mar 9;1–9.
63. Räsänen P, Lappalainen P, Muotka J, Tolvanen A, Lappalainen R. An online guided ACT intervention for enhancing the psychological wellbeing of university students: A randomized controlled clinical trial. *Behaviour Research and Therapy*. 2016 Mar;78:30–42.
64. Fledderus M, Bohlmeijer ET, Fox J-P, Schreurs KMG, Spinhoven P. The role of psychological flexibility in a self-help acceptance and commitment therapy intervention for psychological distress in a randomized controlled trial. *Behaviour Research and Therapy*. 2013 Mar;51(3):142–51.
65. Gloster AT, Meyer AH, Lieb R. Psychological flexibility as a malleable public health target: Evidence from a representative sample. *Journal of Contextual Behavioral Science*. 2017 Apr;6(2):166–71.
66. Levin ME, Hildebrandt MJ, Lillis J, Hayes SC. The Impact of Treatment Components Suggested by the Psychological Flexibility Model: A Meta-Analysis of Laboratory-Based Component Studies. *Behavior Therapy*. 2012 Dec;43(4):741–56.

Figures

Figure 1

Figure 2
Potential behavioural targets relevant to drug-use

Drug Use Assessment & Profile Building							
Behavioural Awareness Values and Committed Actions Personalised Harm-Reduction Plan							
Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7	Cluster 8
BCT 5.1	BCT 1.3	BCT 1.3	BCT 2.3	BCT 1.6	BCT 5.2	BCT 1.8	BCT 1.6
BCT 5.3	BCT 1.4	BCT 1.9	BCT 4.2	BCT 2.4	BCT 5.5	BCT 1.9	BCT 4.1
BCT 5.6	BCT 5.6	BCT 6.3	BCT 7.1	BCT 4.1	BCT 13.2	BCT 4.1	BCT 4.2
BCT 6.3	BCT 7.2	BCT 8.2	BCT 15.4	BCT 4.2		BCT 6.1	BCT 5.2
BCT 13.4	BCT 13.2	BCT 8.6		BCT 6.1		BCT 8.6	BCT 6.1
	BCT 15.1	BCT 13.2		BCT 8.1		BCT 12.3	BCT 8.2
	BCT 16.3	BCT 15.1		BCT 8.6			BCT 8.7
				BCT 8.7			BCT 13.2
				BCT 13.4			BCT 15.2
				BCT 15.1			

Note 1 : Clusters: (1) Increase awareness of the effects of drug-use on personally desired behaviours; (2) Promote identification of activities which can have a positive effect on students targeted behaviours; (3) Increase optimism that drug-use alternatives can induce long-term positive experiences; (4) Increase awareness of the university as a risky context for drug-use; (5) Cultivate awareness of the reasons for use and how these lead to students goal-directed outcomes; (6) Resolve expectations about the effects of drugs on students desired behaviours in the long run; (7) Increase procedural knowledge on how harm reduction practices are implemented at a university level; (8) Promote behavioural awareness of the decision to take drugs under the influence of peers.

Note 2: Actual names with definitions of the labels (BCTTv1) can be found at Michie S, Atkins L, West R. The behaviour change wheel: a guide to designing interventions. 2014. Great Britain: Silverback Publishing. 2015.

Figure 3

Supplementary Files

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- [TIDieRChecklistPDF.pdf](#)
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