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Finding the root cause: Embedding vegetable education into pre-health professional programs using an iterative mixed-methods approach

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Abstract

Reduced consumption of fruits and vegetables is linked to an increased risk of noncommunicable diseases and chronic health issues. With health professionals at the frontline of patient care, there has been an identified need to enhance vegetable education throughout training programs. In undertaking this curriculum change, Design-Based Research (DBR) presents a modern framework highly suitable for health professional programs due to its focus on co-development with a variety of stakeholders. This study aimed to utilise a DBR approach to develop insights and recommendations into what would constitute an effective and evidence-based vegetable curriculum that can be embedded within a pre-health professional course. This study underwent a five-phase iterative process of DBR with a mixed-methods research approach used to collect both quantitative and qualitative data to explore stakeholders' perceptions. The results provide three evidence-based recommendations for educators and curriculum developers to assist in the creation and embedding of vegetable education into a pre-health professional curriculum. Firstly, this study highlights that any resource or curriculum change should be simple, focussing on reiterating the regional government's recommended intake of vegetables and fruits. Moreover, any resource should involve hands-on activities such as laboratories or workshops and be embedded directly into the curriculum rather than self-study options. With the five phases, DBR provides an ideal framework for educational research due to its iterative design and the engagement of stakeholders.

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Practitioner Notes

1. Most people do not consume enough vegetables in their daily diets, presenting an increased risk of preventable diseases and chronic health issues.
2. Health professionals are at the frontline of patient care and are well-placed to provide education on vegetable consumption and its benefits to the broader community.
3. By incorporating relevant content, hands-on activities, and curriculum embedding, vegetable education can be successfully incorporated throughout a health professional program.
4. This study provides evidence-based recommendations for educators and curriculum developers to create and embed vegetable education into a pre-health professional curriculum.

Keywords

Nutrition, education, medical education, curriculum integration, sustainable development goals.

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Introduction

A balanced diet is a central component of a healthy lifestyle. Fruit and vegetable consumption provides essential and non-essential nutrients to the body, decreasing the risk of developing chronic diseases (Liu, 2013). According to the World Health Organisation, the recommended consumption of fruits and vegetables is at least 400g/day (World Health Organization, 2004; World Health Organization, 2024). Each country has its own adaptation to this recommendation; however, a 2020 systematic review identified that 88% of countries' vegetable intake was below the recommendations, with a mean vegetable intake of 186g/day (Kalmpourtzidou et al., 2020).

Over the past 50 years, diets deficient in essential nutrients found in fruit and vegetables, combined with excessive consumption of salt, sugars, and fats, have contributed to inadequate nutrition and a growing burden on healthcare (Crowley et al., 2019). In 2017, poor dietary habits were linked to 11 million deaths worldwide, making it the leading risk factor for mortality across the globe (Afshin et al., 2019). One step towards addressing this issue is increased education of the public, to enhance awareness of the national guidelines, and stimulate healthy dietary intake. Nonetheless, despite ongoing public educational campaigns, doctors and allied health professionals have remained the primary point of contact for patients seeking health advice for many years (Brunton, 1984; Caldow et al., 2022).

One key strategy to support healthy eating in populations globally is to advocate for healthy eating through health care services. A number of studies have highlighted the need to educate health professionals about diets and their effects on disease, as well as their importance in clinical practice (Lepre et al., 2024; Moro et al., 2023; Yannakoulia & Scarmeas, 2024). In many countries, doctors are recommended to apply their knowledge of nutrition to help patients manage lifestyle-related chronic diseases and other diet-related conditions where poor nutrition is a key risk factor (Caldow et al., 2022; Crowley et al., 2019). Fundamental nutrition education is crucial for facilitating those conversations between doctors and patients and for recognising when a referral to other healthcare professionals is necessary (Albin et al., 2024). Without sufficient nutrition education, doctors may be unable to deliver the highest quality care to patients (Mogre et al., 2018). There also remains general public misconceptions and inaccurate understandings of vegetables. Anchored by the educational theory of conceptual change (Posner et al., 1982; Vosniadou, 2013), there is an identified need to transform understanding into improved conceptual and coherent knowledge for health professionals. As such, a new way of approaching the evidence-practice gap in medical nutrition education is required to prevent further escalation of the prevalence of poor dietary intake (Beck et al., 2023; Khiri & Howells, 2025). This paper works with a variety of stakeholders to identify design principles and recommendations for an effective and welcomed integration of vegetable education within a pre-health and medical physiology course. This study is underpinned by the following research question:

> **Research question:** How can a pre-health and medical physiology course be designed to effectively integrate vegetable education to improve healthcare professional practice, and what content could be incorporated for its assessment?

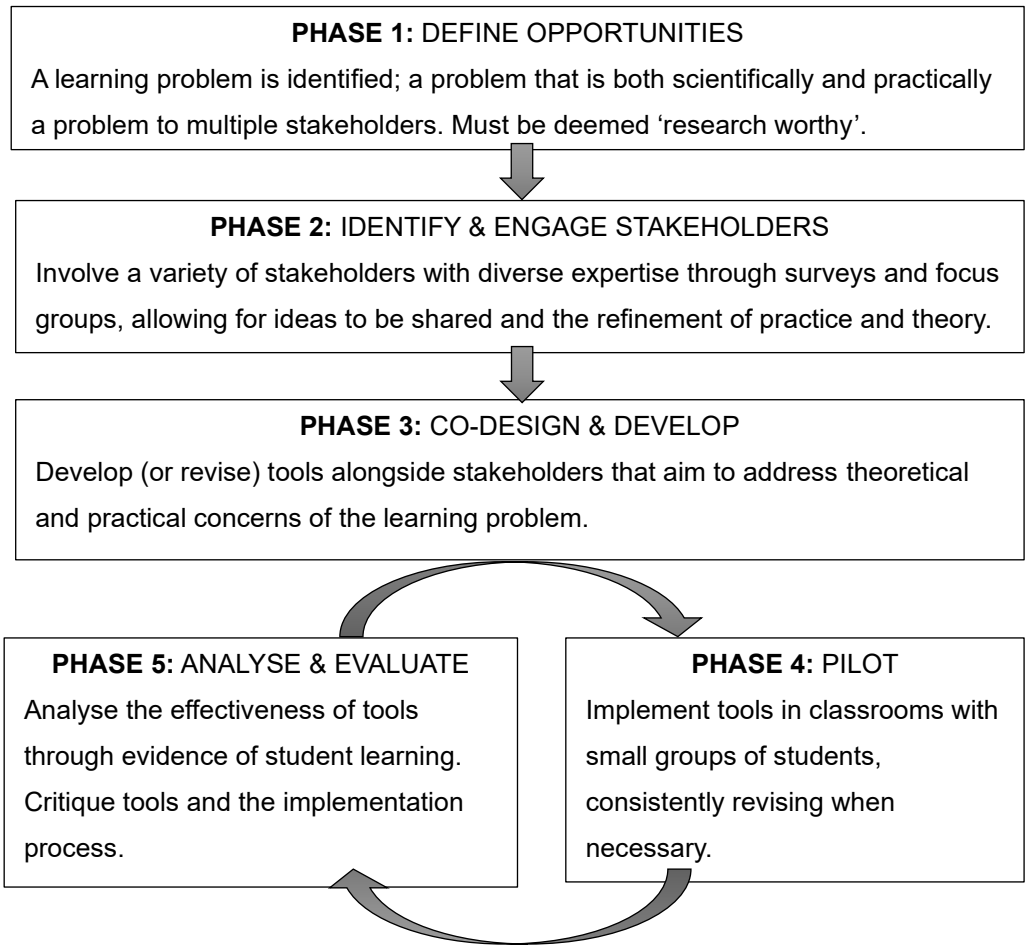
Method

Applying a DBR approach to vegetable education

This project used a design-based research (DBR) protocol, which is an approach aimed at improving educational practices. The iterative approach utilised is outlined in Figure 1, based on Novak and Hallowell (2022) Scott et al. (2020) and incorporating concepts from McKenney and Reeves (2013) and McKenney and Reeves (2021). Phase 1 defined opportunities, Phase 2 identified and engaged stakeholders, Phase 3 co-designed and developed the potential interventions, Phase 4 piloted the interventions with Phase 5 analysing and evaluating. Although portraying five discrete steps to DBR, the steps overlapped as the research progressed to facilitate an iterative design approach and evaluation processes. The outcome will be to demonstrate the completion of the early phases of a DBR study, and develop a set of design principles that summarise the results obtained through the engagement of stakeholders, co-design processes, piloting and evaluation (Bakker, 2019).

Figure 1

The five phases of design-based research that was applied in this study.



As many universities aim to integrate new course curricula effectively, this paper collaborates with stakeholders to develop design principles for incorporating vegetable education into an introductory physiology course, run for Bachelor's degree students in the first year of a Biomedical Science, Health Science, and Sports and Exercise Science program. This 12-week introductory subject serves as a required and core subject for students wishing to pathway into postgraduate healthcare professional degrees. Students enrolled in the subject undertake the pre-health professional major in either a biomedical science, health science or exercise science degree. The subject included a two-hour forum, followed by a one-hour tutorial and a one-hour group learning session each week. Three-hour laboratory practicals run at the end of most weeks. The remainder of the week, students are involved in researching for assignments, attending staff open hours or working through activities on the learning management system. The subject syllabus covers the organisation of the human body from cells to tissues and organs, with a primary focus on the physiology of nerve, muscle, and bone, and on the principles of homeostasis and body system regulation. While students could elect for certain dietetics subject towards the end of their degrees, there was no information regarding vegetables, or healthy eating at all in the core required (non-elective) curriculum. The subject or overall course (foundational non-elective subjects) did not have any assessments incorporated that related to vegetables or healthy eating.

Participants

Participants in this study included health profession students, tutors, medical doctors, dietitians, content experts, curriculum developers, and an external panel of the Australian public. Phase 1 involved a survey of 1110 Australian participants who were registered as research panellists with TGM Research (TGM Research, Singapore). Participants were distributed across all states and territories: ACT (*n* = 23), NSW (*n* = 293), NT (*n* = 6), QLD (*n* = 304), SA (*n* = 84), TAS (*n* = 28), VIC (*n* = 250), WA (*n* = 122). Participants were distributed across all ages, 18-29 years old (*n* = 213), 30-44 years old (*n* = 360), 45-59 years old (*n* = 225) and 60-75 years old (*n* = 205). The survey asked participants to define a vegetable within a sentence or two. The correct definition for a vegetable was "a vegetable is a plant, or part of the plant, which is consumed or used as food, grouped according to the edible part of each plant: leaves, stalks, roots, bulbs, and flowers", as adapted from Britannica (2025). Exact definitions were not expected, but answers were graded based on the general similarity or suitability of the response to this definition. Knowing the definition of a vegetable is important, as it is required in order to understanding the associated Government recommendations and guidelines. For example, where vegetable intake per day is identified and measured separately to other dietary interventions.

Phase 2-5 participants included students, tutors, and health professionals. All students participating in this study (*n* = 60) were either undertaking or had recently completed a 12-week pre-medical Physiology subject within a health science and medicine faculty at a single Australian University. Recruitment was performed through a noticeboard on campus, and a slide presented during lectures and workshops. Faculty tutors (*n* = 5) were physiologists who held at least a postgraduate degree and had previously tutored the subject. Their primary responsibility was guiding a weekly one-hour tutorial for the subject, which usually followed a day or two after the two-hour lecture at the start of the week. Various healthcare professionals were also involved in this study, including one dietician, two nurses, four doctors and one clinical psychologist.

Development of survey instruments

During the development of the surveys, several steps were undertaken to ensure validity and reliability. The research team designed the various survey tools. For this process, a panel of three faculty experts in physiology education reviewed the survey to ensure face validity and to identify any ambiguities. Grammar, clarity and overall relevance to the physiology content of the subject were also assessed. No training was required for stakeholders to complete the various surveys during the semester. The items were designed to allow participants to complete them without additional instruction after the initial information. No participants posed any queries to the research assistant who oversaw the survey administration.

Data collection

This study utilised a mixed-methods research approach to collect both quantitative and qualitative data in order to provide a detailed picture of the perceptions of stakeholders throughout the Design-Based Research process (Wang & Hannafin, 2005). A convergent parallel mixed methods design was conducted, whereby the qualitative and quantitative data were collected, analysed and interpreted independently. The study used two measures to collect data from stakeholders: a Likert scale to evaluate perceptions for quantitative data collection and open-ended questions for qualitative data.

For Phase 1 of Design-Based Research, an open-ended question, “In a sentence or two, write the “definition of a vegetable” (to the best of your knowledge, please don’t look it up)”, was asked to 1110 participants across Australia and responses were scored on a scale between 1-4 by the research team. Throughout Phases 2 to 5, quantitative data on stakeholders’ perceptions were rated using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree), where a high score indicates a positive perception of the statement. This was either administered paper-based or using the online-based surveying system, Qualtrics (Seattle, Washington, USA).

Written responses were also collected from students during Phase 5 of Design-Based Research after the piloting of the activity using the same Qualtrics survey link. Students were provided with an open-ended question to provide written responses to how the piloted activity could be improved. This survey was optional for students. The open-ended question was presented as follows: “How could the carotene reader station be more useful for your learning within the subject?” Additionally, tutors present for the piloting of the activity were asked to provide feedback on their perception of the activity.

Data analysis

Data collected from this study was exported into Microsoft Excel (Microsoft Inc, Redmond, USA) and analysed using the statistical analysis program Prism Version 10.2.1 (GraphPad Software, Boston, MA, USA). For Phase 1, researchers analysed the data, rating definitions on a scale from 1 to 4. The correct definition for a vegetable was: “A vegetable is a plant, or part of the plant, which is consumed or used as food, grouped according to the edible part of each plant: leaves, stalks, roots, bulbs, and flowers”. Scores of 1-2 were considered incorrect, and scores of 3-4 were considered correct. Examples of each rating are provided in Table 3. A Mann-Whitney U test was used to compare the percentage of correct answers between demographical groups.

Table 1

Examples of responses and their corresponding rating

Example	Rating
A plant that is edible	4
A vegetable is an edible food item grown in soil etc that compliments other foods	3
A vegetable is something that is grown in the ground and is healthy food you	2
A means to satisfy hunger	1

During Phase 3, the stakeholders' perception of teaching options for vegetables within a physiology subject was analysed using a Kruskal-Wallis test, and multiple comparisons were evaluated with Dunn's multiple comparisons test. The research team evaluated and interpreted written responses from student and tutor feedback. A conceptual approach to content analysis was employed to identify the presence and frequency of specific concepts in participant responses (Krippendorff, 2018). Data was coded based on certain concepts, allowing for the identification of key themes according to emerging patterns. Measures were taken to ensure reliability in coding, including consultation with a qualitative expert, thereby supporting the robustness of the analysis. Ethical approval for this study was obtained from the University's Human Research Ethics Committee. All participants were provided with an explanatory statement, and informed consent was obtained before commencing. All data was anonymous.

Results

Phase 1: Define opportunities

Applying a 5-phase DBR framework illustrated in Figure 1, each of the 5 phases of the study and the accompanying results are outlined. To identify an opportunity, knowledge surrounding the definition of a vegetable was obtained to gain an understanding of the problem. A total of 1110 participants Australian-wide were asked to define a vegetable within a sentence or two. Of 1110 responses, 23.69% (n = 263) provided a definition that was correct or correct with minor errors. Only 10.72% (n = 119) provided a completely correct definition that scored the full 4 marks. 76.31% (n = 847) of participants could not correctly define a vegetable (scoring 1 or 2). There were no differences in any correctness or scores from the various states of Australia where participants resided.

To assess if age had any influence on the ability to provide definitions, participants were divided into two age brackets (determined by the research panel): 18 - 44 years (n = 680) and 45 – 75 years (n = 430). There was a significant difference in scores between the two age groups ($P < 0.01$, Mann-Whitney U test). The younger participants performed much poorly, with only 18.53% providing a definition that was awarded a score of 3 or 4, compared to 31.86% of the older group. There were no significant differences in the correlation between the age or the ability of the participant to provide a correct definition of a vegetable (r = 0.076, P = NSD, Table of Critical Values for a Pearson Correlation). For all other data presented, both age brackets were combined. Most participants provided their gender, which was distributed equally between males (n = 499) and females (n = 504). There were no differences in the ability to correctly define a vegetable between males (26.25% correct) and females (24.21% correct).

The knowledge of vegetables demonstrated by a portion of the Australian public showcases an opportunity for additional education. Doctors and allied health professionals are placed at the forefront of health information to the broader community. As such, embedding up-to-date information about vegetables in pre-health professional programs may be an important way to educate the population.

Phase 2: Identify & Engage Stakeholders

Identified stakeholders included (i) pre-health profession students, (ii) Faculty content experts and curriculum developers, (iii) dieticians and (iv) doctors. Stakeholders from each group were engaged by an email invitation or by responding to a printed advertisement posted at a local university.

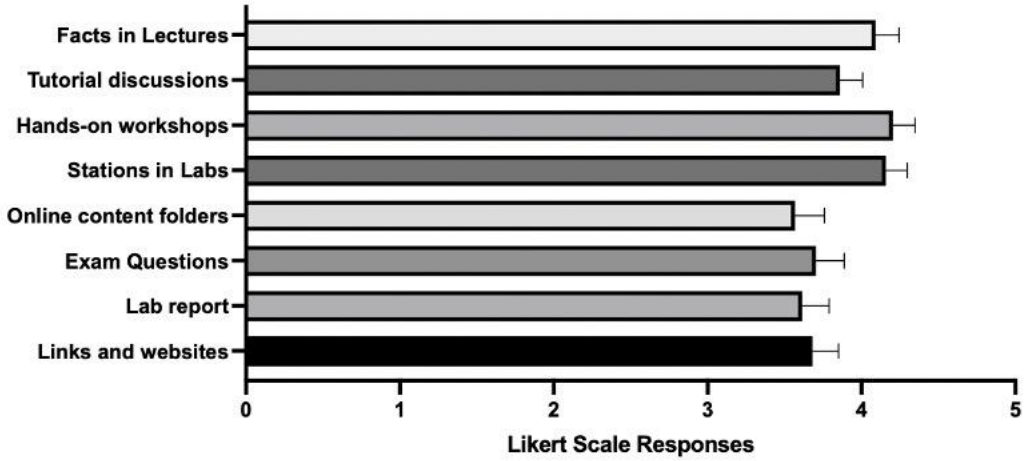
Phase 3: Co-Design & Develop

It can be challenging to teach students something new unless they genuinely want to learn, so understanding their perspective is essential to obtaining engagement (Deslauriers et al., 2019). Therefore, before teaching options were presented, an online survey (Poll Everywhere, San Francisco, California, USA) was distributed to 41 pre-health professional students from biomedical sciences, health science and exercise science courses. All students were enrolled and had completed half of their first semester. Students were asked how interested they would be in the inclusion of vegetable facts, information and content in physiology classes. Scores were rated on a five-point Likert scale, with 80% of students either being *very interested* (5) or *interested* (4) in learning about vegetable education, showing positive attitudes towards it.

Identified stakeholders were surveyed on different teaching options and delivery methods for vegetable education within a pre-health physiology subject. Responses were rated on a Likert scale. Options included *tutorial discussion, facts and information embedded throughout forums, hands-on workshop activities, stations embedded within laboratory sessions, content added to online learning site, exam questions, lab report assessment with a vegetable focus, links and website*s. Stakeholder feedback (students n = 25, faculty tutors n = 5, doctors n = 4, nurses n = 2, clinical psychologist n = 1, graduates of pre-health undergraduate programs n = 5 and dietician n = 1) identified that vegetable education is recommended to be embedded through stations in laboratories, hands-on workshop activities and facts in lectures rather than questions within the end of semester examinations (Figure 2). No statistically significant differences were found between teaching options. Stakeholders preferred interactive learning methods rather than assessment pieces or self-study options.

Figure 2

Mean Likert scale responses of participant perceptions of vegetable education content.



Phase 4: Pilot

From the feedback obtained, the stakeholders rated hands-on workshops and lab stations highly. Therefore, researchers created an activity to pilot within a small group of students. The activity involved students collecting their carotene values from the Veggie Meter®, a non-invasive instrument that detects and quantifies carotenoids in the skin using spectrophotometry (Radtke et al., 2021). Carotene, or carotenoids, are phytochemicals commonly found in fruits and vegetables. They cannot be synthesised de novo by humans; therefore, they are obtained primarily by diet and often used as a biomarker for fruit and vegetable intake (Radtke et al., 2021).

Information surrounding average values of carotene for males and females was provided in the 'carotene station' activity worksheet, and students were asked to compare their results to these averages. Additionally, information regarding the recommended servings of vegetables was given, and students were asked whether they met these recommendations and to estimate the average number of servings of vegetables they consumed per week.

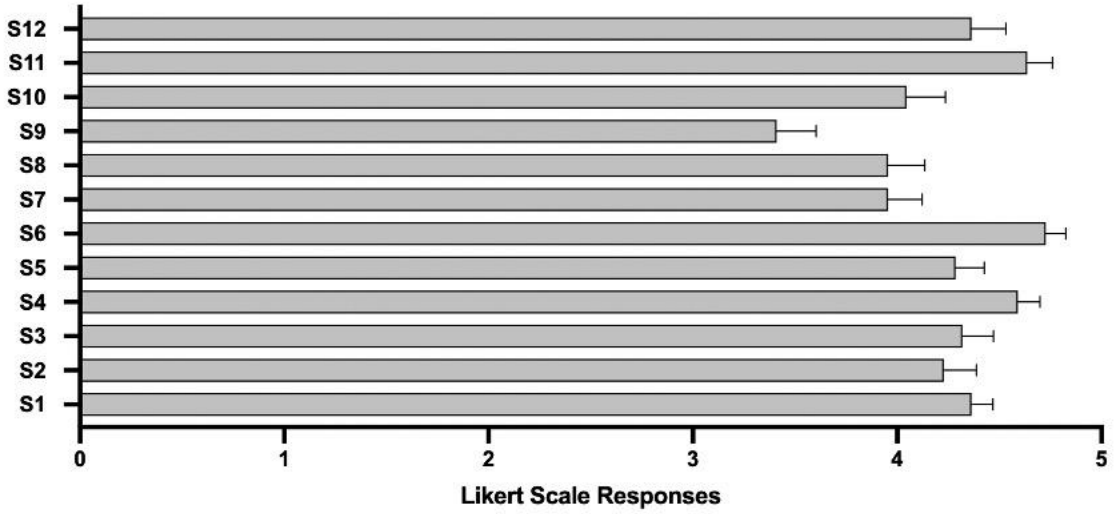
Prior to piloting the activity to students, stakeholders (students n = 7, faculty staff n = 2, health care professionals n = 8, graduates of pre-health undergraduate programs n = 4 and dietician n = 1) were asked their perceptions of the activity to gain insight on whether this would be an effective way to integrate vegetable education into a physiology course. Stakeholders (n = 22) were asked to rate the following statements on a five-point Likert scale and reported the average score for each (Figure 3).

The criteria asked for each participant were: (S1) Students would enjoy using a carotene reader; (S2) The carotene reader can provide useful information; (S3) The carotene reader is a good learning tool; (S4) The instructions are clear; (S5) The process of the carotene reader is adequate in length; (S6) Students will be able to understand carotene better when they can visualise it; (S7): Students will be able to better explain the importance of vegetable intake to other people after using the carotene reader; (S8) This station helps prepare students for learning about

vegetable intake in future classes; (S9) It would help non-student friends or family to better understand vegetable intake if they had access to the carotene reader station; (S10) Learning about carotene is related to the discipline of physiology; (S11) Learning about vegetables is important for graduates from a health professional program; (S12) Learning about vegetables is directly related to the United Nations Sustainable Development Goals (Figure 3).

Figure 3

Mean Likert scale responses of stakeholders' perceptions on the carotene station



Phase 5: Evaluate

The carotene station activity was piloted in a small group of students (*n* = 28). Students were asked to provide feedback on the activity, which was admitted via an online survey software, Qualtrics. Perceptions on the activity were given with responses rated on a five-point Likert scale.

Table 2

Summary of Likert scale response provided by students

Likert scale statement	Mean	Total agreement (4 or 5)
I enjoyed using the carotene reader	4.2	79%
The carotene reader provided useful information	4.0	75%
It was easier to understand when I can visualise it	4.0	81%
The carotene reader was a good learning tool	4.1	75%
The instructions to use it were clear	3.7	64%
The length of the carotene reader was appropriate	3.4	56%
The carotene reading was easy to understand	3.8	68%
I became more confident in my knowledge about vegetable intake after using	3.6	61%
I am better able to explain the importance of vegetable intake to other people	3.4	46%
I feel better prepared to learn about vegetable intake in the future	3.8	64%
It would help non-student friends/family understand about vegetable intake	3.9	71%
Learning about carotene is related to content within the subject	3.9	71%
I am aware of the ways that learning about vegetables is important for health graduates	3.7	64%
I can see how learning about vegetables is related to the UN's SDGs	3.8	64%

Overall, the carotene reader was positively received, with the highest ratings in enjoyment, usefulness of visual aids, and it being a good learning tool. The feedback suggests that the tool was helpful to students but could improve in terms of clarity of instructions and process length. This may contribute to higher confidence in students' knowledge about vegetables as well as a broader applicability in explaining the content.

At the end of the survey, an open-ended question was asked, which was completed by 13 students (46% out of a total of 28 surveyed). The question asked was, "*How could the carotene reader station be more useful for your learning within the subject?".* Content analysis of these open-ended responses identified several emerging themes. A clear theme from student feedback was the need for a clearer connection between the activity and the course content. 46% of responses (n = 6) requested more background information about carotene to be included, its relevance to vegetables, and the purpose of the carotene reader. Suggestions included providing more detailed explanations about the activity's purpose and how it correlates to class material and content. Example student feedback included: "How carotene relates to vegetables" (S2); "Give a bit more content detail (like why we are using the carotene reader)" (S4); and "More education around the readings, what it means and how you can improve your carotene score" (S6).

Another theme was requesting more skill and practical development. Students requested more hands-on practice with the lab equipment and the desire for activities that highlight practical application. Some students wanted to know how to operate the carotene reader and understand the impact of certain variables on the readings. Selected responses include “Learning how to operate it and knowing exactly what increases it by what amount” (S8); “Have a piece of assessment possibly worth 5% which demonstrates us analysing the data” (S10); and “More information on it” (S11).

Twenty-three per cent (23%) of responses (*n* = 3) requested the incorporation of assessment or feedback on performance. Students suggested tracking class averages or comparing results over time, which could enhance student motivation and engagement with the activity. For example: “Potentially collect the students' values so we can find an average within the class” (S9); “Have a piece of assessment possibly worth 5%” (S10); “Do one at the beginning of the semester and another at the end to see the difference and change over the semester” (S12).

During the piloting of this activity, four faculty tutors were presented and asked to provide feedback. The four responses are provided in Table 6. All tutors agreed that students were excited and engaged with the activity. Additionally, two tutors agreed that the hands-on nature of the station made it more interactive and fun for students, contributing to their interest. Comments included: “Being very hands-on and receiving instant measurements about their carotene reading meant there was a lot of excitement and discussion in the room” (T1); and “As it was hands-on, the activity seemed to interest students, and they seemed excited to learn and ask questions” (T4).

Moreover, tutors agreed that the station began conversations and opened a door for learning about vegetables and diet’s effect on health. For example: “It certainly generated a discussion about the benefits of eating vegetables but highlighted a nutrition deficiency in those who acknowledged to the class they were not good at eating vegetables” (T1) and “It created conversations about everyday diets and vegetable intake” (T4). However, a clear theme from the feedback was that more information was needed. One tutor stated that students did not really seem to understand the results or what they meant. Another stated that by the comment from students it was clear they wanted more information regarding the carotene readings too, such as “More context was needed for their results from the carotene reader” (T2).

Discussion

Increasing vegetable intake in the general population is an essential health strategy to address public health issues. Not only does increasing vegetable intake often replace the consumption of high-fat, high-sodium, and sugar-rich foods, but it also greatly improves the overall nutritional profile of individuals. The growing prevalence of nutrient deficiencies, particularly fibre deficiency, highlights the urgent need to integrate vegetables into daily diets (Chapman et al., 2016; Moro et al., 2023). With a clear interest from students, faculty, staff and other institutions for the integration of basic nutrition and vegetable knowledge within medical and pre-health professional programs, it is imperative that curriculum designers consider ways to incorporate this into pre-existing education. Following the use of DBR, this study offers three key design principles based on the findings for educators and curriculum developers wishing to incorporate vegetable education in an existing subject without overloading students or academics:

Design principle 1: Avoid complexity and maintaining accessible information

For most health professional programs, the need for vegetable information does not need to be complex, with the focus on outlining the knowledge required to comprehend the regional government's recommended intake of vegetables and fruits. If more complex dietary information is required for patients, a referral to a dietitian may be appropriate. Rather than focusing on specific dietary recommendations, nutrient intakes, or the individual vitamins and compounds found in vegetables, stakeholders expressed satisfaction with a broader approach that primarily focused on more holistic and important concepts. The results identified that stakeholders valued educational options that encouraged a holistic understanding of vegetables, emphasising their role as whole foods with no recommendations to dissect them into isolated nutritional components. This suggests that more accessible, straightforward information on vegetable education should be provided to health professional students. It also promotes the role of dieticians in providing more specific nutritional advice to referred patients. Keeping the content straightforward ensures that students grasp key public health messages without overwhelming them with detailed nutrition science. Stakeholders agreed that this approach allows health professional education to emphasise practical dietary recommendations, aligning with students' future roles while respecting the specialised expertise of dieticians.

Design principle 2: Incorporate hands-on activities

Vegetable education should be linked with hands-on activities such as laboratories or workshops, rather than didactic classes, to enhance the student learning process. Previous literature has supported that hands-on activities and experiences help students learn, particularly in scientific environments (Moro et al., 2024; Phelps & Moro, 2022). Experiential learning engages students actively, allowing them to apply theory in practical settings, and thus improves comprehension and retention. Stakeholders noted that hands-on sessions make learning more engaging and relevant, fostering a deeper understanding and encouraging critical thinking and collaboration, which are key skills in health professional education.

Design principle 3: Embed content directly within the curricula

Embedding resources directly into the curriculum allows for greater contextual integration and alignment with learning objectives and fosters collaborative learning and discussions. Stakeholders emphasised that structured, curriculum-based approaches ensure that all students engage with the material rather than relying on self-directed study, which can lead to uneven uptake and variable understanding. Participants also agreed that incorporating vegetable education within their course did present a direct link to the Sustainable Development Goals, which is an important concept in a modern health curriculum (McLean et al., 2023; Moro et al., 2025). In particular, SDG 3 (Good Health and Well-Being), Target 3.4 regarding reducing premature mortality from noncommunicable diseases, SDG 4 (Education), Target 4.7 regarding promotion of knowledge and skills, and SDG 12 (Sustainable Consumption and Production), Target 12.3 regarding reducing consumer-level food waste (McLean et al., 2022).

Limitations and improvements

A limitation of this study was the use of a convenience sample from a single institution. A more representative cohort from different universities might enhance the outcome's relevance to a

wider cohort. Future directions could consider these limitations and develop alternative methodologies that can address and provide additional insights into the development and implementation of vegetable education in a health sciences and medical course. Future studies could also complete additional DBR phases, such as outlining analyses after testing a curriculum change and collating and analysing iterative DBR cycle feedback to evaluate if the alteration has helped students or if more improvements are needed (potentially over two cycles).

Conclusion

The identified need to enhance vegetable education in pre-health professional programs is critical to equipping future health professionals with the knowledge and skills necessary to promote healthier dietary behaviours in their communities. This study provides evidence-based design principles and recommendations for educators and curriculum developers to create and embed vegetable education into a pre-health professional curriculum. This can help fulfil the expectations of students, faculty, employers, and accreditors in preparing graduates for success in the health professions workforce. Globally, with most countries reporting daily vegetable consumption averages that are below recommendations, it is important to ensure that health professionals are well-versed in this field. As a result, education and guidance can be provided to patients and the community by their primary and allied health clinicians. The design principles presented would be relevant to a broad range of courses, such as medicine, physiotherapy, nursing, occupational therapy, pharmacy, psychology, exercise and health science.

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