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Designing a Fully Online Work-Integrated Learning Module for Craniofacial Orthodontics

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ABSTRACT

Introduction: Research has found that orthodontists often lack the knowledge and confidence to engage in craniofacial orthodontics, such as treating cleft-lip and palate patients. This gap highlights the need for an educational strategy that enhances skills transfer in this sub-speciality. This study explores the design considerations for developing a fully online, work-integrated learning module tailored to this need.

Materials and Methods: The research adopts a case study approach, guided by design thinking as the overarching conceptual model combined with a range of data collection strategies. Following the first three stages of design thinking, a thematic analysis was conducted, similar to the novel six-step process for conceptual model development in qualitative research, to identify the needs of educators and students engaged in orthodontic qualifications or certified examinations.

Results: Five key themes emerged through this process, forming the basis for a problem statement and module definition. Building on these insights, five theoretical constructs were developed, providing a conceptual framework for designing a fully online, work-integrated learning module.

Discussion: Using this framework, we addressed the identified needs while ensuring alignment with best practices. The next phase of this research will involve prototyping and testing the module with a cohort of students.

Conclusion: The success of this model has the potential to extend beyond craniofacial orthodontics, offering valuable applications to other medical and dental specialities.

1 | Introduction

Craniofacial orthodontics is a sub-speciality in orthodontics that contributes to managing patients with physical disabilities and facial anomalies acquired through iatrogenic factor(s) or genetic disposition [1]. Owing to the complexity of the field, craniofacial orthodontics requires additional training in dealing with cases that generally fall outside the scope of an orthodontic residency [2, 3].

A needs assessment published in 2021 [4] indicated that orthodontists generally lack the knowledge and confidence to immerse themselves in craniofacial orthodontics, such as treating cleft lip and palate patients. A need, therefore, exists to develop an educational strategy and systems to increase the transfer of skills in the sub-speciality [3, 5, 6].

The face-to-face craniofacial orthodontic fellowships are usually limited to specific high-volume centres such as universities

and hospitals, owing to the centralised location of expertise [7] which has several limitations. Teaching the clinical aspects of craniofacial orthodontics hands-on to a group of orthodontists on a centralised platform is difficult because it requires regular patient follow-ups over extended periods to enable sufficient clinical exposure, similar to that of the conventional orthodontic residency [8].

According to Kumar, [9] online education has the potential to enhance training opportunities in the field of orthodontics. Ongoing technological advancement in online education provides potential solutions to overcome face-to-face education limitations [10] and has the potential to deliver content effectively on a larger scale [11]. Since an increased volume of formal postgraduate training in craniofacial orthodontics is desperately needed because many practitioners continue to refer craniofacial patients to universities or hospital centres owing to the lack of training opportunities in craniofacial orthodontics, [1, 12] online education could provide for this need.

There have been attempts in the past to increase the volume of this field of study. In 2010, an online lecturer series was established where experts presented lectures on various topics in craniofacial orthodontics [13]. These ranged from treatment concepts and multifaceted cleft-palate problems to craniofacial surgery. These lecture series lacked updates when new information became available. Although students do not have to travel or leave their practices, this lecture series lacks a formal structure, is at a professional development level and does not lead to further standardised qualifications.

In the meantime, a much-needed transformation in craniofacial orthodontic education, [1, 12] has been initiated and structured by the American Board of Orthodontics (ABO) in the use of online scenario cases as an assessment tool [14, 15]. Online education platforms have proven to be suited to teach clinical reasoning through problem-based or case-based learning [14, 16]. Orthodontics is specifically suited to this problem-based or case-based learning because the orthodontist's role is mainly to diagnose, develop treatment plans and monitor treatment progress, with other tasks often executed by other members of the oral health team [17]. Not only does contemporary online education have the ability to facilitate clinical reasoning through structured case studies, but it can also assist in coordinating decentralised work-integrated learning for postgraduate qualifications and ensure work readiness [18].

Given the need for online qualifications [11] in this domain, a fully online postgraduate diploma in craniofacial orthodontics is being considered. This study aims specifically to explore the design considerations for developing a fully online work-integrated learning module. This leads us to the question: What are the design considerations when developing a fully online work-integrated learning module?

2 | Materials and Methods

The development of a fully online work-integrated learning module for a postgraduate diploma in craniofacial orthodontics is presented as a case study using design thinking [19] as the overarching conceptual model combined with various data collection strategies [20, 21].

2.1 | Case Study

The initial focus was on real-life practices and experiences of the learning designer and program coordinator to inform the development of an online WIL module [21].

Literature published by credible organisations such as ABO [14, 22, 23] and the General Assembly of the Association for Dental Education in Europe [24] and research undertaken on specific needs in orthodontics education [4, 25] coupled with informal conversations with other module developers and professionals at academic conferences [26] were integrated, synthesised and analysed thematically [27] through an iterative process of exchange. When generating the list of needs, no identities or names were used, nor were all the conferences attended mentioned. Therefore, no additional ethical approval or consent beyond what we already had for the study was needed.

2.2 | Design Thinking

This constant process of going back and forth was driven by our understanding of design thinking [28, 29].

Design thinking is a user-centric approach to problem-solving. Originating from 'design' as a discipline. Design thinking has the potential to be applied to education projects [19]. One of the main variants of design thinking (Figure 1) comprises five iterative stages, namely, empathise, define, ideate, prototype and test [28, 29].

Vallis and Redmond [19] described design thinking as using creative skills to understand and solve complex problems, such as designing a fully online WIL module, by placing people and their needs at the centre. Brenner, Uebernickel and Abrell [31] and Dam [30] explain design thinking as a way of thinking, a process and a toolkit. Brown and Katz [32, p. 277] describe the mission of design thinking as 'to translate observations into insights, and insights into the products and services that will improve lives'. In other words, a designer's sense and methods match people's needs with ones that are technologically feasible [33]. Brown's [33] idea is similar to this study's theoretical application of design thinking by using stakeholders' published research and communications to determine educational needs to design a fully online work-integrated module that will address the needs of the practising craniofacial orthodontist.

What made design thinking attractive was that it accommodated the back-and-forth iteration until we reached the point where the design considerations were clear. The 'messy area', as seen by Cook [34, p. 277] is the context where new ideas are shaped and transformation takes place.

Similar to other researchers who used the design thinking stages in the development of educational content [35–37], this study also focused on the design thinking stages. However, in this study, the focus is only on the first three stages (Table 1) to

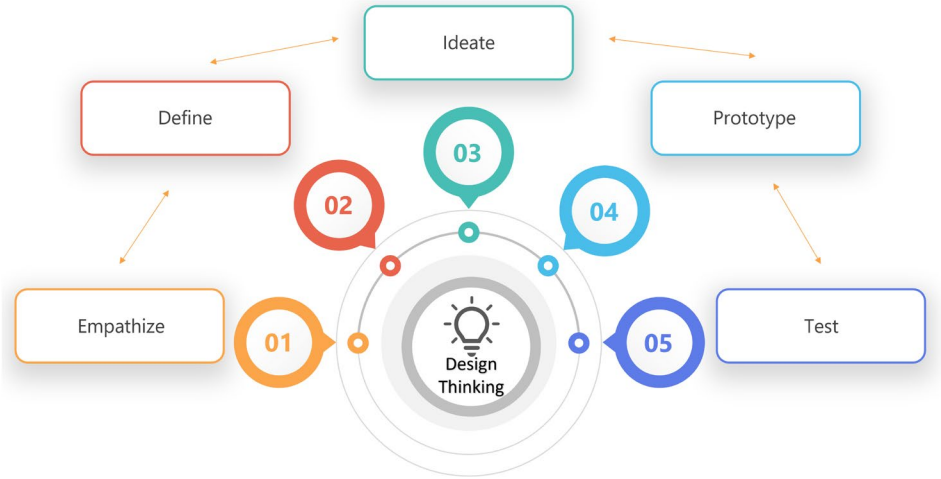

FIGURE 1 | Design thinking (adapted from [30]).

TABLE 1 | A summary of the design thinking stages in the context of this study.

Design thinking stage	Application in the study	Sources of information
Empathise	The focus on empathy compels the designer to put people and their needs first in the design process [32] The process starts with the user observing and gathering information about the problem to be solved Information includes published research [33], personal understandings and experiences involving the problem, and immersing themselves in the user's physical environment [28, 30]	Relevant literature [4], [5], [14], [22]; [23], [24], [25] was identified through multiple searches in the context of craniofacial orthodontics Informal discussions with craniofacial orthodontics researchers and practitioners (orthodontists, plastic surgeons, speech therapists, nutritionists) at conferences (e.g., European Cleft Palate and Craniofacial Anomalies Congress, International Cleft Congress) and meetings and collaborative sessions with other module developers
Define	The insights generated from the empathy stage formulate the problem statement [29] and define potential solutions	The information collected during the empathy stage was scrutinised and grouped, and themes were identified to define what the module needs to address (learning outcomes)
Ideate	During the ideation stage, the design team is ready to examine the problem statement from various perspectives and to generate possible innovative solutions [29]	The researchers reflected on what type of online activities could address and support students' needs, considering the previous stages of the development process. Research in the field of educational technologies was also explored. The list of activities was narrowed down to only those that can be applied in our asynchronous, online, low-cost environment

inform the design considerations of the design and development of a fully online WIL module and not like Linton and Klintons [35] who use all five stages. Stages 4 and 5 involve the creation and testing of a prototype and will be included in follow-up research after this study.

2.3 | Data Analysis

Based on the first three stages of design thinking (Figure 1), a thematic analysis was performed, similar to the novel six-step process for conceptual model development in qualitative research (Figure 2) [38], to determine the universal needs of educators/lecturers and students in typical orthodontic qualifications or certified examinations. After the informal conversations were documented in an MS Word document, the literature sources and conversations were scrutinised to identify common themes related to needs and challenges in orthodontics education. Particular attention was paid to identifying the potential needs of craniofacial orthodontics students, especially regarding their understanding of orthodontic treatment for, or the absence thereof in, patients with cleft lip and/or palate (CLP). An initial list of needs was compiled and then categorised to identify overlaps and recurring patterns. These

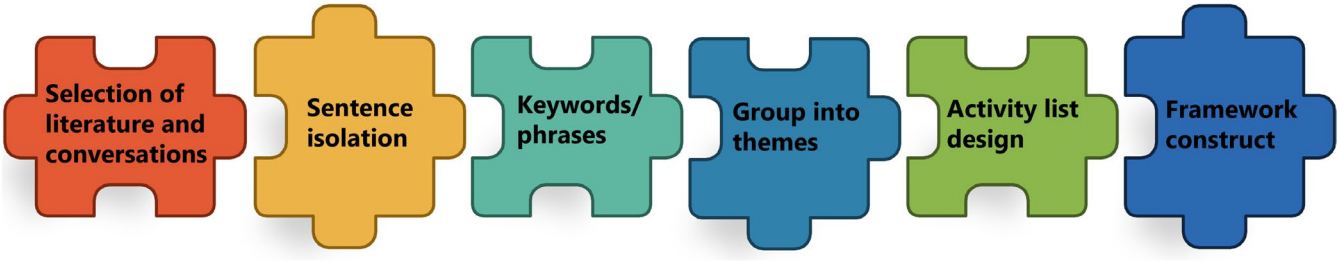

FIGURE 2 | Adapted novel six-step process for conceptual model development in qualitative research (adapted from [38]).

categories were subsequently synthesised into high-level themes. The themes from the literature were supplemented with notes from informal conversations, as mentioned earlier. The themes were derived and categorised to respond to the stages of design thinking, and keywords were isolated for the design considerations of the online work-integrated learning module.

To get a full picture of what is needed in craniofacial orthodontics training, different types of information were used. These included professional accreditation board documents, clinical studies, a PhD project and informal conversations with people involved in the field.

True to the nature of design thinking, during these stages of empathising, defining and ideating, the focus was on the experiences of the role players in orthodontics education and not on quantifiable data. The role players included the programme coordinator, module coordinators, orthodontics educators, researchers in the field of orthodontics education and a learning designer. These role players formed the design thinking team and included the researchers.

3 | Results

During the empathise stage of the design thinking process, the researchers identified specific needs and challenges faced by orthodontists to inform the development of an effective postgraduate programme. From the literature and conversations, the identified needs encompassed the development of capabilities to work within interdisciplinary teams [4, 25, 39], an ongoing demand for professional development [25], and a holistic approach to patient care that prioritises empathy, well-being and societal integration. In addition, the training must cultivate perseverance and patience, especially when compensation is modest. Critical challenges highlighted by practitioners included insufficient coursework and a general need for passion in treating candidates with craniofacial anomalies [4, 25, 39]. In the studies by Ghabrial and Bütow [4], Gibson and Grayson [25] and in informal conversations, students expressed concerns about their limited experience with diverse cases and their fears of working directly with patients, compounded by a noticeable deficiency in teamwork in interdisciplinary settings. They were drawing from the insights of Ghabrial [5] on the need for the content of the training program to address specific domains, such as data gathering, diagnosis, detailed treatment planning, implementation and management of treatments and critical analysis of outcome assessments [5, 15].

The insights gathered during the empathy stage resulted in five themes: the importance of clinical reasoning, practical exposure to multiple cases, working in an interdisciplinary team, a holistic approach to patient care and developing interpersonal skills. These five themes were combined into the following point of view (POV) statement (define):

A WIL module in craniofacial orthodontics needs to be designed and developed to integrate interdisciplinary teamwork, continuous professional development and a holistic approach to patient care and cultivating perseverance and patience. Consequently, the curriculum must incorporate the development of students' essential skills in interdisciplinary communication, data gathering, diagnosis, detailed treatment planning, management and critical analysis of treatment outcomes to prepare graduates better for the demands of the profession.

During the ideate stage, the program coordinator, module coordinators and learning designer put together ideas for activities that could be used in the WIL module. From the definition, it is clear that these activities need to foster certain competencies. The group of facilitators considered a wide variety of options. Ultimately, the researchers (module coordinator and learning designer) listed what was commonly used in the online environment, what they wished to use and what was mentioned in the literature. The following activities were seen as possibilities in the online environment: quizzes, discussions, visuals (infographics, mind maps, posters), videos, podcasts, written assignments, scenario cases, OSCEs, interactive videos, educational games, simulations, virtual reality, virtual patients, role-playing, webinars, seminars, article reviews, peer collaboration, rotation stations, video lectures, readings, reflective exercises, live discussions, guest lectures, e-courses (designed by third parties), practice patient consultations, attending interdisciplinary meetings, discussing cases in groups, digital portfolios, case analyses, interdisciplinary projects, mobile apps and reflections on holistic care and interpersonal skills [11, 14, 17, 18, 40–44].

Activities, such as reading, watching, discussing, quizzes, written assignments (submit videos, visuals, podcasts) and reflective exercises, are common in the online asynchronous environment and could be used in the WIL module. Based on the literature, scenario cases, educational games and OSCEs are valid and reliable tools [15, 43], which should also be used. Some activities/tools could be eliminated owing to their synchronous nature and cost. Since the fully online postgraduate qualification is primarily asynchronous, synchronous activities will be minimal. Finally, because cost is a factor, expensive subscription

TABLE 2 | Themes identified in the define stage mapped with example activities.

Themes	Type of activities to support the themes
Interdisciplinary team	Scenario cases, virtual reality (case discussions and rotation stations), simulations and group discussions
A holistic approach to patient care	Scenario cases, virtual reality (case discussions), simulations, webinars and reflections on holistic care
Interpersonal skills	Virtual reality (role play), peer collaboration, simulations and reflections on interpersonal skills
Professional development	E-courses, webinars and seminars
Clinical reasoning	Scenario cases, peer collaboration (case discussion), OSCEs and interactive videos

applications were removed, and only the more affordable ones were included, as seen in Table 2.

Activities, such as quizzes, interactive videos, discussion forums and various visual formats (including infographics, mind maps, posters, video lectures, readings, podcasts, written assignments and article reviews), can be used alongside the activities listed in Table 2 across all five themes. In some instances, live discussions and guest lectures may also be incorporated synchronously.

It is highly conceivable that learner engagement, technological constraints and difficulties in evaluating clinical competencies may influence our choice of activities. These issues will therefore be considered during the prototype development phase. For example, various forms of engagement (social, cognitive, behavioural, collaborative and emotional) can be supported through activities such as discussion forums, scenario-based cases, quizzes, assignments, group work and reflection journals [45], depending on the observations during the prototyping phase.

Lecturers involved in the design and development of the WIL module are recruited and selected based on their expertise in craniofacial orthodontics, formally introduced to programme expectations, and provided with structured, ongoing mentoring (learning designer) to ensure pedagogical coherence, digital fluency and alignment with curriculum outcomes.

When integrating technology into these activities, learning designers will take into account students' varying levels of digital literacy, and support will be provided through instructional 'how-to' videos. Assessment may also pose challenges; however, the application of programmatic assessment [46] and an emphasis on real-world tasks and scenario-based evaluations, as recommended by the American Board of Orthodontics (ABO) [14], may help mitigate these concerns.

The activities outlined in Table 2 can potentially address the five themes identified during the empathise stage. Implementing these activities could lead to developing a work-integrated module designed to prepare orthodontic specialists through the practicing of clinical reasoning skills through real-life examples, all within a primarily asynchronous learning environment.

4 | Discussion

To develop a conceptual framework for the Work-Integrated Learning module, design thinking, particularly its first three stages, facilitated this process in a focused and structured manner [30]. Similar to the work of Padzil et al. [36] a needs analysis is a critical step in the development of educational products. During this phase, information is gathered directly or indirectly from stakeholders such as orthodontists. Accordingly, the needs analysis in this study involves a thorough investigation of users' needs and challenges. For example, in the empathy stage of design thinking, a thorough investigation must occur of users' needs and challenges [28, 30]. Input was from stakeholders involved in orthodontic education, as these individuals work directly with the students and can identify educational needs. Therefore, literature reviews, feedback from accreditation boards, general articles on the state of orthodontic education and insights from mentors and subject matter experts were all integral to this initial information-gathering stage [33]. This leads us to the first construct of the conceptual framework for the online Work-Integrated Learning module, namely, research. Before developing a module such as the work-integrated learning module, a comprehensive literature review, discussions with field experts and potential students (direct or from literature sources) and extensive information gathering are essential to understand the needs and challenges of users [36].

After collecting all the information, analysing the data to identify needs, challenges and required competencies is crucial because it provides perspectives of the users, such as the educators in the field of craniofacial orthodontics [36]. This analysis leads to the second construct, needs analysis, which includes the knowledge, skills and competencies students must have acquired upon completing a WIL module.

From the identified needs, challenges and competencies, aspects are grouped according to themes. Considering the needs analysis, these themes are rewritten and defined to address the module requirements. Similar to the define stage of design thinking [29], this constitutes our module definition, directly linking to the students' needs. Therefore, the third construct is module definition.

During the design of the WIL module, the module definitions are translated into learning activities. Only after a deep understanding of the problem at hand can you start creating possibilities to solve problems [35]. This idea creation, as mentioned in the research of Schiele et al. [37], prompted a list of various innovative activities. Generating as many activity ideas as possible to align with the outcomes parallels the ideate stage of the design thinking process [29]. These activities can be drawn from example courses, literature and guiding documents, forming the activity ideas construct. This list of activity ideas serves as a wish

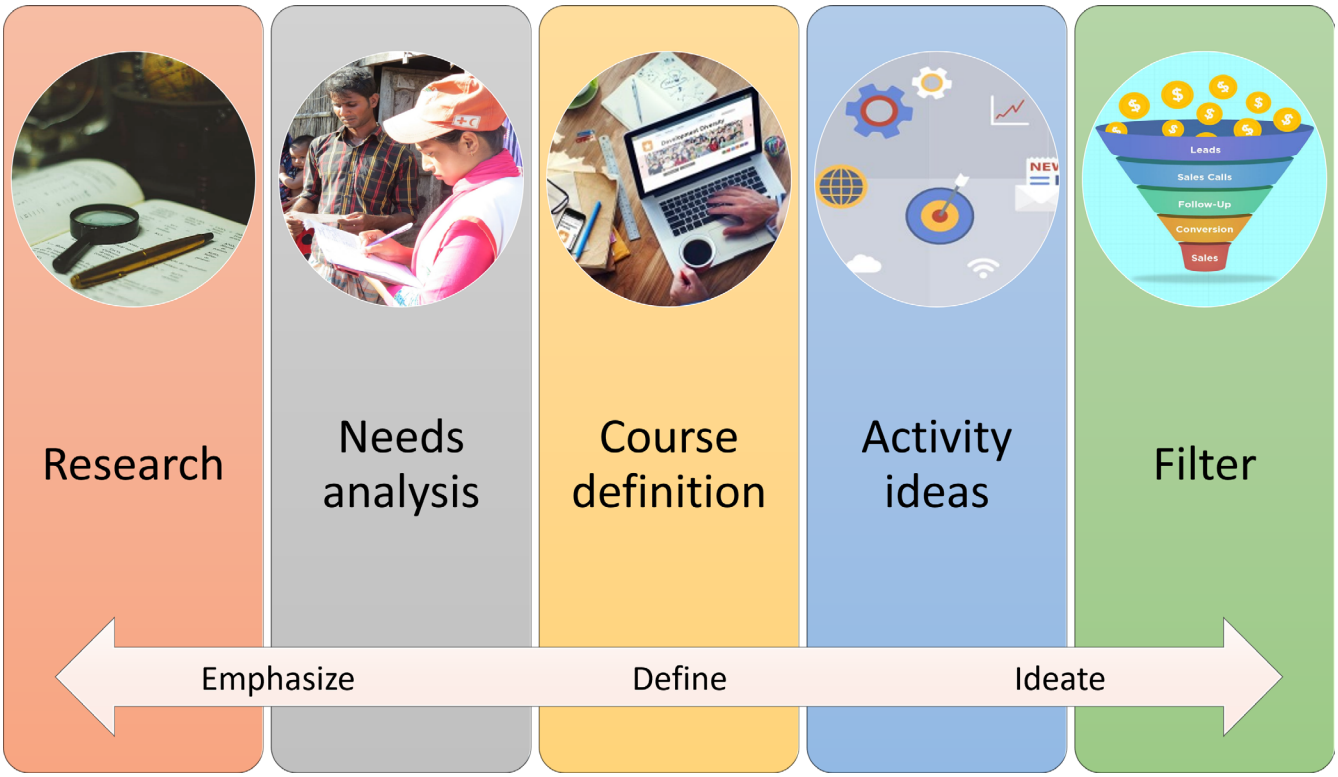

FIGURE 3 | Conceptual framework to design a WIL module (Images sourced through Microsoft PowerPoint. Photo 1 by Krista Kennedy is licensed under CC B-NC-SA 2.0, photo 2 by Unknown Author is licensed under CC BY-NC-ND, photo 3 by Unknown Author is licensed under CC BY-NC-ND, photos 4 and 5 by Unknown Author are licensed under CC BY-SA-NC).

list, where some activities may not be feasible in your teaching mode or address your learning outcomes.

Based on the uniqueness of the subject field and the module definition, the list of activities is filtered to retain only those suitable for your context. This online WIL module focuses strongly on exposing students to structured scenario cases [15] and activities are designed accordingly. To ensure accessibility, high-fidelity technology and subscription applications are excluded, and synchronous activities are minimised. This final construct, filter, will then conclude the design considerations. The link between design thinking and the conceptual framework is indicated in Figure 3.

This study has several limitations. It is pertinent to note that the inferences drawn in the design thinking process were dependent on the knowledge and interpretation of the researchers. The local context may also have played a role in the synthesis of the framework. Other observations and conclusions may have been reached by other similarly experienced researchers, dependent on their context. The researchers acknowledge that the functionalisation of the online module may still highlight possible challenges such as learner engagement or technology constraints. Possible challenges with regard to evaluation and the assessment of clinical competencies are also envisaged. These aspects will consciously be addressed in the prototype stage but may only be dealt with during the implementation phase. Other limitations, including but not limited to logistical, linguistic and financial constraints, should be continuously assessed through an iterative process of curriculum development.

However, our application of design thinking has provided a robust framework for developing the work-integrated learning module. Achieving the alignment of activities with competencies required several critical steps and will serve as a solid foundation for the implementation of the work-integrated learning module.

5 | Conclusion

Although the value of work-integrated learning is recognised, the traditional method of work-placed learning is impossible because of the gamut of possible cases to which students must be exposed. Therefore, a problem-based learning approach was followed, coupled with scenario cases.

To address the research question, the researchers use the first three stages of the design thinking approach [28, 29] to design this module to address the needs of prospective craniofacial orthodontics education. Five themes were identified from the needs analysis. A problem statement or module definition was developed, considering the five themes. Brainstorming activities were conducted to find online activities that can be used to create an engaging learning environment where students' clinical reasoning skills are developed within the themes identified. Five theoretical constructs were derived to create a conceptual framework for designing a fully online work-integrated learning module.

In the next step of this research, the researchers plan to create a prototype and final product and to test it with a group of students [35]. The prototype will be a paper-based version of all the

content, activities and scenario cases that the students will have to do to achieve the module outcomes. This prototype will be evaluated by a peer facilitator against a checklist that evaluates the pedagogical soundness of the module, and the feedback will be used to improve the module. The final product will be created on the learning management system and opened for students to participate. At the end of the module, feedback will be collected, and the approach will be refined based on student outcomes, ensuring continuous improvement. The success of this approach has the potential to be extended to other specialities.

Acknowledgements

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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