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Research Article

Acceptability and Feasibility in Using Gamified Mobile Application for Working Memory Training in Older Adults

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Background: The increasing adoption of mobile technologies among older adults presents new opportunities for cognitive health interventions. This study explores the acceptability and feasibility of a Cantonese-language gamified mobile application, *Challenges in Town*, designed to support cognitive training through real-life simulations. Grounded in the Technology Acceptance Model (TAM), the research investigates how gender, age, education and socioeconomic status influence older adults' engagement with the app.

Method: A qualitative methodology was employed, involving 18 semistructured interviews and two focus groups with 20 participants aged 66–85 years in Hong Kong. Thematic analysis was conducted using TAM constructs: perceived usefulness (PU), perceived ease of use (PEU), attitude towards use (ATU) and behavioural intention to use (BIU). Stratified analysis provided insights into demographic-specific experiences.

Results: Findings revealed high acceptability, with participants reporting cognitive benefits, emotional satisfaction and motivation to continue use. Younger and more tech-savvy users adapted quickly, while older participants required initial support but expressed satisfaction postadaptation. Gendered differences emerged, with men valuing cognitive challenge and women emphasising practical memory support. Educational and socioeconomic backgrounds influenced expectations and perceived utility.

Discussion and Conclusion: The study highlights the importance of user-centred design, including intuitive navigation, customizable features and family-assisted onboarding. While TAM provided a useful framework, emergent themes such as family support and intergenerational support, and emotional engagement and social dimensions suggest the need for broader models. These findings inform the development of inclusive digital tools that promote cognitive well-being in ageing populations.

1. Introduction

Engagement of the ageing population with mobile applications is an important area of study because of the potential benefits these platforms offer in health management, social interaction and overall well-being [1]. Mobile applications designed for seniors can enhance quality of life by providing easy access to health resources, promoting social connections and fostering independence in health management [2, 3]. Integrating gamification elements into these applications can motivate seniors to engage more actively, making cognitive training both enjoyable and effective [3].

Research shows that gamified experiences can improve cognitive outcomes, especially working memory, which is essential for daily functioning and independence in older adults [4, 5]. The application of reminders and personalised notifications can greatly assist older adults in adhering to their medication schedules and attending appointments,

consequently reducing the probability of health-related issues [6]. Investigations reveal that the inclusion of features such as daily practice routines, challenge modes and options for social sharing can significantly enhance motivation and adherence among users [3, 5]. By promoting communal engagement through functionalities that encourage interaction among peers, these applications have the potential to alleviate feelings of loneliness and isolation, which are notably prevalent in geriatric populations [7]. This integrative technique improves cognitive functions while also cultivating emotional stability, thus promoting a more satisfying life experience for ageing adults [8]. The incorporation of gamification elements into mobile applications can further amplify engagement by rendering cognitive training more enjoyable and less intimidating for older adults [9]. Furthermore, by integrating game-like features such as rewards, levels and friendly competition, these applications can stimulate motivation while cultivating a sense of community among users. Empirical evidence indicates that social influences significantly affect technology adoption; hence, promoting collaborative challenges or peer support networks within mobile applications could result in enhanced adherence rates [10].

Practically, addressing usability issues such as legibility and intuitive navigation is crucial, as these factors directly affect how well older adults can interact with technology [11]. By cultivating an environment where older individuals feel empowered and competent in utilising these tools, developers can bridge the gap between technological innovations and the specific requirements of this demographic, ultimately facilitating improved cognitive health outcomes [12]. Moreover, continuous support and educational resources can further bolster user confidence, ensuring that older adults not only embrace these technologies but also incorporate them into their daily routines for enduring advantages [13]. Consequently, the acceptability and feasibility from the users' viewpoint should invariably be regarded as the critical determinant of success [14–16]. This not only enhances user engagement but also cultivates trust, as users perceive their perspectives as acknowledged and valued throughout the development process.

This project aimed to investigate the acceptability and feasibility of a gamified mobile application among older adults, with a focus on how these outcomes may be influenced by gender, age, education level and socioeconomic status. Acceptability refers to participants' views on the application, their enthusiasm for incorporating it into their daily routines and their assessment of its overall value. In contrast, feasibility evaluated how successfully the application could be implemented and used by older adults, considering individual circumstances, socioeconomic factors and age-related considerations. Our study applies the Technology Acceptance Model (TAM) [1] to a real-world, community-based mobile application in Cantonese—*"Challenges in Town"* (https://apps.apple.com/hk/app%25E5%25B0%258F%25E5%259F%258E%25E5%25A4%25A7%25E4%25BA%258B%25E8%2585%25A6%25E5%258A%259B%25E6%258C%2591%25E6%2588%25B0/id1562013643), which uniquely integrates cognitive training with daily living tasks such as home safety, grocery shopping and community navigation. This multifaceted design distinguishes it from more generic cognitive apps and provides a novel context for examining technology acceptance among older adults.

TAM provided a structured yet flexible construct for exploring older adults' experiences with the mobile application. It enabled us to capture both cognitive and affective dimensions of technology acceptance in a way that was accessible and meaningful to participants. The project would explore users' feedback on their perceived usefulness (PU), perceived ease of use (PEU), attitude towards using (ATU) and behavioural intention to use (BIU) to this gamified mobile application. The research questions targeted at shedding light on the factors that affect technology acceptance in the older population [17]. The interview guide was developed based on a review of prior TAM-based studies in digital health and ageing. It was reviewed by two experts in gerontology and digital interventions and four members of the Patient and Public Involvement and Engagement of the community to ensure conceptual alignment and clarity for older adult participants. The guide was explicitly structured around the four core TAM constructs. Each section of the guide was designed to elicit participant responses aligned with these constructs. Examples of representative questions to illustrate how each construct was operationalised. For example, in PU, "In what ways did the app help you with memory or daily tasks?"; in PEU, "How easy or difficult was it to learn how to use the app?"; in ATU, "How did you feel about using the app regularly?" and in BIU, "Would you consider continuing to use this app in the future".

1.1. About the Mobile Application. Challenges in Town is a mobile application thoughtfully designed to support cognitive development through real-world simulations, delivered in Cantonese. The app features three core modules: (1) Community Living Challenges, which simulates real-world navigation and travelling in a virtual town subway transportation; (2) Home Safety, which presents interactive scenarios for identifying and resolving household hazards and (3) Grocery Store Tasks, which involves item selection and budgeting tasks. These modules are designed to stimulate working memory and executive function through culturally relevant, realistic and goal-oriented activities. Each is crafted to mimic everyday scenarios that require users to plan, remember and make decisions. These experiences are enhanced by a gamified structure that includes level progression, time-based challenges, performance feedback and virtual rewards, all aimed at maintaining motivation and reinforcing learning outcomes.

Challenges in Town is grounded in cognitive science and its adaptive, user-centred design. The app's activities are intentionally repetitive and sequenced to strengthen memory retention, while decision-making and problem-solving tasks challenge users' higher-order thinking skills. An adaptive difficulty system ensures that each user is met with the right level of challenge, promoting sustained engagement and neuroplasticity. The app features

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a thoughtfully designed set of interactive elements to enhance user engagement and support cognitive development. It includes a level-based progression system that gradually increases task complexity, allowing users to build skills over time. Reward mechanisms, the three-tier virtual trophy, are integrated to reinforce success and maintain motivation. Users receive real-time feedback through visual and auditory cues, helping them understand their performance and encouraging learning through immediate reinforcement. The user flow diagram, as depicted in Figure 1, and a feature-to-cognition summary table, as shown in Table 1, shared a clear view of how each component contributes to cognitive training. Altogether, *Challenges in Town* offers a compelling, evidence-informed approach to digital cognitive rehabilitation and skill-building.

The development of *Challenges in Town* was deeply informed by the cultural and linguistic context of older Cantonese-speaking adults living in urban Hong Kong. The app's scenarios, language and visual design reflect familiar environments and daily routines—such as navigating the Mass Transit Railway (MTR), shopping at local markets and managing household safety in apartments. These culturally grounded elements were incorporated to enhance user relatability, engagement and ecological validity. The use of Cantonese, including colloquial expressions and culturally specific references, ensures that the app resonates with users' lived experiences and communication styles. While this cultural specificity enhances the app's effectiveness for its target population, it may limit its direct applicability to other linguistic or cultural settings without adaptation.

2. Methods

This study is framed as a design-oriented contribution that translates TAM findings into practical development strategies. This research employed a qualitative methodology to explore the needs and expectations of older adults regarding the *Challenges in Town*. We conducted extensive semi-structured interviews and focus group discussion to gather insights about participants' feelings on usability, features and overall satisfaction with the mobile application. Participants were encouraged to take part in both data collection formats, allowing them to express their individual perspectives while also engaging flexibly with others in a group setting. This methodological framework sought to encapsulate a diverse array of insights on their engagement with technology and its ramifications on their quotidian existence, employing a purposive sampling technique specifically designed to recruit participants from the elderly demographic.

2.1. Data Analysis. Two researchers independently coded all transcripts. Both coders reviewed the full dataset to ensure comprehensive familiarity with the content and to support a robust thematic analysis. The data analytical process incorporated both first and second cycle coding methodologies. First cycle coding employed a combination of descriptive and coding to capture participants' language and key ideas. Second cycle coding used pattern coding to group initial codes into broader categories aligned with the TAM framework. NVivo 14 was used to organise and manage the coding process, visualise thematic relationships and track code frequency across transcripts. This supported transparency, traceability and systematic analysis of the qualitative data. To ensure consistency, the coders met regularly to compare interpretations, resolve discrepancies and refine the coding framework. A shared codebook was developed iteratively and used throughout the analysis to maintain coherence in theme identification. Detailed stratified analysis across age, gender, education and socioeconomic status was conducted. This level of granularity revealed differentiated user needs and motivations, offering a richer understanding of how diverse older adult subgroups interact with gamified technology and tailored design implications—an area that remains underexplored in the literature. The exploratory demographic comparisons were intended to provide contextual depth to the qualitative findings rather than to support statistically or thematically saturated subgroup analysis.

2.2. Participants. Participants were identified and approached through collaborations with local community centres and elderly service organisations, which helped identify eligible individuals and facilitated initial contact. These partners assisted in disseminating study information and referring individuals who met the eligibility criteria. Inclusion criteria required participants to be aged between 60 and 85 years, possess basic familiarity with mobile devices and have no diagnosed cognitive impairments. These criteria ensured that participants could meaningfully engage with the mobile application. Interested individuals underwent a brief screening interview to confirm eligibility. Informed consent was obtained in writing, with verbal explanations provided as needed to ensure comprehension. A purposive sampling method was employed to ensure diversity in age, gender, educational background and socioeconomic status. This approach aligned with the study's aim to explore a broad range of user experiences and perspectives.

2.3. Qualitative Data Collection Procedures. Semistructured interviews were chosen to elicit in-depth, personal reflections, while focus groups were used to explore shared experiences and social influences on technology use. Semistructured interviews are guided conversations with a set of predetermined questions [18]. This study pursued enquiries designed to comprehend individuals' attitudes towards the mobile application, their desire to embed it in their daily schedules and their reflections on its adaptability. Focus groups are discussion and sharing among a small group of participants [19], as in this study, the researchers moderated the focus groups to explore and share individuals' experiences on the use of the mobile application. This dual approach enriched the data and supported the triangulation of findings. Demographic variables were included to enrich interpretation and provide context for the

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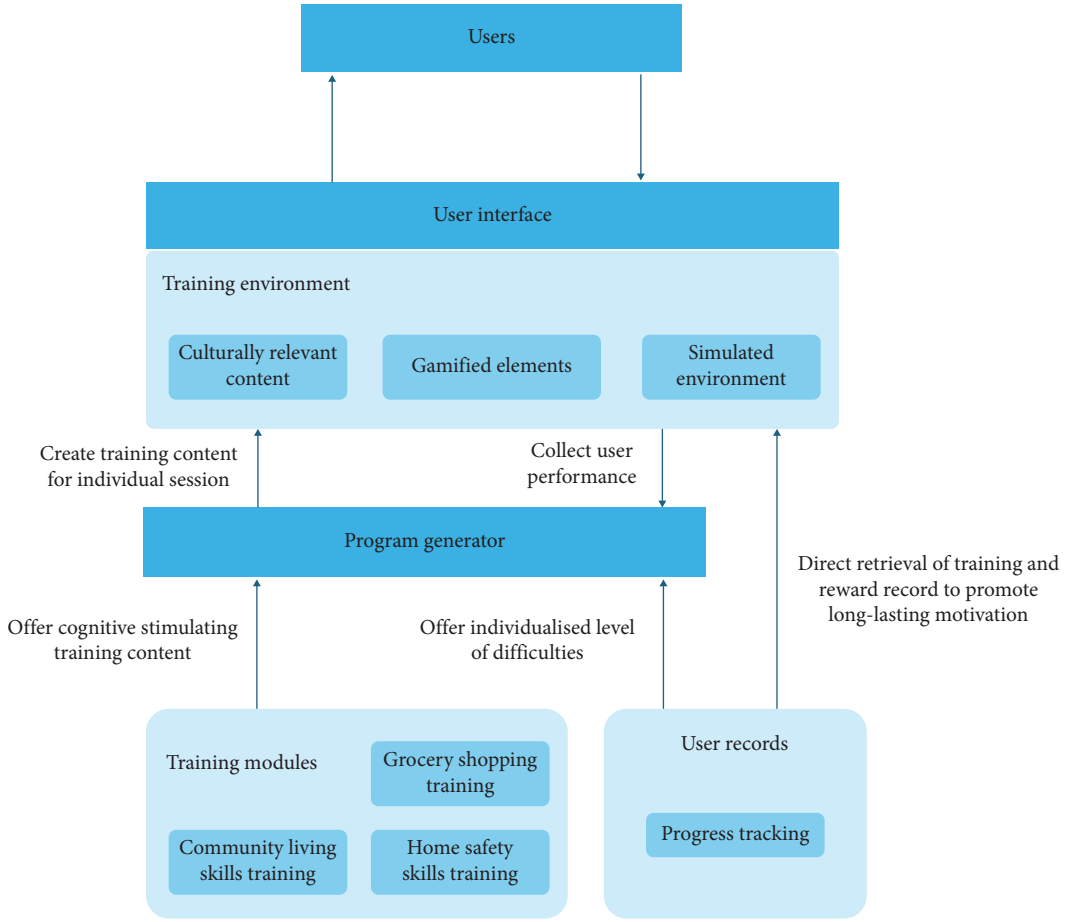

Figure 1: User flow diagram.

Table 1: Feature-to-cognition summary table of *Challenges in Town*.

Feature	Description	Cognitive function targeted
Community living	Simulates real-life subway transportation tasks in a virtual town to enhance community living skills	Working memory, executive function
Home safety	Provides scenarios to identify hazards and improve home safety awareness	Working memory, executive function
Grocery store	Offers item selection and budgeting tasks	Working memory, executive function
Levels	Progressively increases the difficulty to challenge cognitive abilities	Working memory, executive function
Rewards	Three-tier virtual trophy for task completion	Motivation, engagement
Feedback	Visual and auditory cues to reinforce learning	Reinforcement, learning
Progress tracking	Tracks user performance and cognitive improvements	Monitoring, self-assessment

qualitative themes. For example, differences in PEU between younger and older participants helped illustrate the influence of digital familiarity, even if not generalisable. Additionally, engagement metrics data such as participants' self-reported frequency of use, perceived enjoyment and consistency of interaction with the mobile application were explored through targeted questions in the interview questions such as "How often did you use the app?", "What motivated you to return to it?" and "Were there any features that kept you engaged?" These questions were designed to elicit rich, reflective responses on user interaction and motivation.

Each session lasted approximately 45–60 min and was conducted in a quiet, private room within local community centres. A structured interview guide was used to ensure consistency across sessions, covering topics such as usability, engagement and perceived cognitive benefits. All interviews and focus groups were facilitated by trained researchers with experience in qualitative methods.

3. Results

The study recruited 20 elderly participants, including nine males and 11 females. Participants' ages ranged from 66 to

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85 years, with the mean age = 76.23 (SD = 8.67). Among the participants, six possessed a high school diploma or lower educational qualifications, five had pursued some collegiate education, and nine attained a bachelor's degree or higher. Participants represented a diverse socioeconomic background, with varying income levels and access to technology, which significantly influenced their experiences and perceptions. A total of 18 semistructured interviews and 2 focus groups (each comprising 6 participants) were conducted. This combination allowed us to capture both individual experiences and group-level dynamics. A consistent moderator was assigned to each data collection format to ensure procedural uniformity and rapport with participants. All sessions were audio-recorded and transcribed verbatim (see Table 2).

Qualitative data gathered from interviews revealed distinct themes related to daily challenges, social interactions and the impact of technology on participants' lives (see Table 3).

3.1. Gender. The study included a balanced representation of both male and female participants, highlighting diverse perspectives on the application's advantages and usability. Each demographic contributed distinct perspectives regarding their perceptions of the application's advantages and usability, thereby illustrating diverse preferences and requirements. Male participants often emphasised cognitive stimulation and structure. For instance, a 76-year-old retired professor remarked, "I recognise the advantages—it resembles academic exercises but possesses a greater level of engagement," while a 79-year-old retired business owner described the app as "a constructive utilisation of my time" that enhanced his cognitive acuity. In contrast, female participants frequently highlighted emotional satisfaction and practical benefits. A 74-year-old homemaker shared, "The application has significantly enhanced my ability to recall names, for which I express my gratitude," and an 82-year-old homemaker noted, "It has significantly enhanced my confidence in retaining information." These insights reflect how gendered experiences shaped the perceived value of the application—males often focused on cognitive challenge, while females emphasised emotional and practical gains. Additionally, several female participants also expressed a preference for auditory guidance during onboarding, noting that written instructions were sometimes difficult to follow. This feedback supports the recommendation for a voice-assisted onboarding feature to enhance accessibility.

3.2. Age. The younger cohort, aged in their 60s to early 70s, generally adapted quickly and found the interface intuitive. A 66-year-old retired accountant remarked, "The interface is quite intuitive; however, an increase in customisation options would be advantageous," and a 68-year-old former bank clerk added, "The application is remarkably user-friendly, despite my infrequent engagement with mobile applications." In contrast, the older cohort, aged mid-70s–80s+, often required initial assistance but ultimately found the app manageable. An 82-year-old homemaker shared, "My daughter assisted me in the initial setup, and I am now capable of managing it independently," while an 85-year-old former librarian noted, "The process is straightforward; however, it could be augmented by the inclusion of additional instructional materials." Older participants in the focus group strongly requested clearer instructions and slower-paced interactions, reinforcing the need for voice-assisted onboarding and simplified navigation options. Despite early challenges, older users expressed satisfaction and a strong intention to continue using the application.

Table 2: Participants' characteristics.

Gender	Male ($n = 9$)	Female ($n = 11$)
Age range	65–85	65–82
Mean age (SD)	78.67 (4.71)	71.27 (5.05)
Education level		
High school	3 (33.3%)	3 (27.3%)
Collegiate	2 (22.2%)	3 (27.3%)
Bachelor's degree or higher	4 (44.4%)	5 (45.5%)

Note: Percentages are based on gender-specific totals ($n = 9$ males, $n = 11$ females).
Abbreviation: SD = standard deviation.

3.3. Education Level. Educational background influenced how participants perceived and interacted with the application. Those with a high school education or lower often emphasised practical benefits. A 74-year-old retired mechanic stated, *"It assists in enhancing my cognitive retention, which has become increasingly significant as I advance in age,"* and a 71-year-old homemaker added, *"I now possess the confidence to utilise it independently."* Participants with some college education appreciated the app's simplicity and benefits. A retired electrician, aged 80, commented, *"The application functions as a cognitive exercise, which I am convinced contributes to my mental acuity."* Meanwhile, individuals with a bachelor's degree or higher sought more advanced features and intellectual engagement. A 69-year-old former social worker said, *"It is gratifying to observe the progression in my performance metrics,"* and a 70-year-old retired manager noted, *"I derive pleasure from its use and appreciate the sense of achievement it engenders."*

Participants with higher education levels frequently requested adjustable difficulty levels to maintain engagement, while those with less formal education preferred simpler tasks. This supports the recommendation for customizable difficulty settings to accommodate diverse cognitive needs.

3.4. Socioeconomic Background. Socioeconomic background also shaped user experiences. Participants from lower-income backgrounds focused on practical memory support. A 73-year-old homemaker shared, "It has significantly enhanced my cognitive retention, particularly in recalling tasks that require my attention," and a 71-year-old added, "Engaging with it is enjoyable and conveys a sense of personal improvement." Middle-income users valued the app's

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Table 3: Users' feedback on this gamified mobile application.

Participant characteristics	Perceived usefulness (PU)	Perceived ease of use (PEU)	Attitude towards using (ATU)	Behavioural intention to use (BIU)
Male, 68, high school diploma, retired construction worker	"I truly believe this app is great for keeping my mind sharp! I've noticed I can remember things better, like where I put my keys!"	"It's simple; even though I'm not the most tech-people, I found it really easy to pick up."	"I really enjoy using it! completing each level gives me such a wonderful feeling of achievement."	"I'm definitely going to keep using it—it fits perfectly into my morning routine!"
Female, 75, bachelor's degree, retired nurse	"I think it's beneficial, as I feel more alert during the day. It reminds me of exercises we used to do with patients for cognitive health."	"Some games are challenging, but overall, it's very manageable."	"I enjoy it and find it very rewarding."	"I'd like to keep using it to keep my mind active."
Male, 80, college, retired electrician	"The application functions as a cognitive exercise, which I am convinced contributes to my mental acuity."	"After familiarising myself with it, the operation became instinctive."	"I am astonished by the extent of my enjoyment derived from its use. It appears to be a constructive endeavour."	"Indeed, I plan to utilise it consistently as it is facilitating my cognitive development."
Female, 70, bachelor's degree, former teacher, middle income	"It effectively facilitates my ability to maintain concentration and recall specific information, such as the names of individuals."	"The interface is highly intuitive; however, I would appreciate the inclusion of additional instructional guidance initially."	"I possess a strong affinity for it and eagerly anticipate engaging with it daily."	"I am unequivocally committed to its continuous usage and am actively recommending it to my peers."
Male, 74, high school education, retired mechanic	"It assists in enhancing my cognitive retention, which has become increasingly significant as I advance in age."	"The application is not cumbersome to operate, despite my limited familiarity with technological applications."	"I find the experience enjoyable—it presents challenges that are ultimately gratifying."	"I intend to continue utilising it, provided I consistently observe enhancements in my performance."
Female, 82, high school diploma, homemaker, lower income	"It has significantly enhanced my confidence in retaining information."	"My daughter assisted me in the initial setup, and I am now capable of managing it independently."	"I derive pleasure from utilising it, and it provides a sense of satisfaction in exercising my cognitive abilities."	"I intend to continue utilising it due to its practical benefits."
Male, 76, master's degree, retired professor, upper income	"I recognise the advantages—it resembles academic exercises but possesses a greater level of engagement."	"The interface is user-friendly; however, I believe it could be improved by incorporating additional options for personalisation."	"I perceive it as intellectually stimulating and cognitively engaging."	"I intend to continue utilising it as an integral component of my daily routine."
Female, 68, high school education, former bank clerk, middle income	"I perceive that it contributes positively to my cognitive acuity. I have observed a reduction in instances of memory lapses."	"The application is remarkably user-friendly, despite my infrequent engagement with mobile applications."	"I derive pleasure from its utilisation and anticipate engaging with it in the future."	"I intend to continue utilising it to promote mental activity."
Male, 79, bachelor's degree, retired business owner, high income	"Engaging in this activity represents a constructive utilisation of my time. I experience an enhancement in my cognitive acuity."	"The interface is straightforward and user-friendly, facilitating ease of navigation."	"The experience is pleasurable, and I perceive it as a beneficial contribution to my personal development."	"I intend to integrate this practice into my daily morning regimen consistently."
Female, 71, high school diploma, homemaker, lower income	"I assert that it significantly enhances my capacity for memory retention."	"My daughter demonstrated the fundamental operations, and I now possess the confidence to utilise it independently."	"Engaging with it is enjoyable and conveys a sense of personal improvement."	"I intend to continue utilising it as it contributes positively to my endeavours."

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Table 3: Continued.

Participant characteristics	Perceived usefulness (PU)	Perceived ease of use (PEU)	Attitude towards using (ATU)	Behavioural intention to use (BIU)
Male, 83, bachelor's degree, retired engineer, middle income	"Engaging in this activity serves as a cognitive exercise, leading to a notable enhancement in my mental acuity over the past several weeks."	"At first, there was a requisite period of adjustment; however, it has now become remarkably intuitive."	"I perceive this experience as enjoyable and unexpectedly captivating."	"Indeed, I intend to continue utilising it, as I regard it as beneficial for cognitive upkeep."
Female, 69, master's degree, former social worker, upper-middle income	"The application aids in enhancing my cognitive acuity. It is gratifying to observe the progression in my performance metrics."	"The interface is intuitively designed with explicit guidance, which I find commendable."	"I derive pleasure from utilising it, and it appears to confer substantial advantages."	"Indubitably—I am resolutely dedicated to engaging with it on a daily basis."
Male, 72, high school education, retired factory worker, lower-middle income	"I perceive that it enhances my cognitive retention, which constitutes a significant advantage."	"My daughter provided initial assistance, and I am now capable of utilising it independently."	"I derive satisfaction from its use; it is beneficial to have such a resource accessible."	"Indeed, I intend to persist in its usage as it is manageable for daily engagement."
Female, 78, high school education, retired school secretary, middle income	"I observe an increased level of alertness throughout the day subsequent to its regular utilisation."	"It is exceedingly user-friendly, even for individuals possessing limited technological proficiency."	"I find the experience enjoyable—it resembles a game; however, I am cognizant of its beneficial effects on my well-being."	"I intend to continue its usage and will advocate for it among my acquaintances."
Male, 66, bachelor's degree, retired accountant, middle income	"The efficacy of the system is notable, as I find myself able to recall intricate details with significantly enhanced ease."	"The interface is quite intuitive; however, an increase in customisation options would be advantageous."	"The experience is pleasurable, and I value the cognitive challenge it provides."	"Indeed, I intend to integrate it into my daily routine moving forward."
Female, 73, vocational training, homemaker, lower income	"It has significantly enhanced my cognitive retention, particularly in recalling tasks that require my attention."	"My granddaughter provided me with instructions on its utilisation, and I now navigate its functionalities with ease."	"Engaging with it is enjoyable, and I experience a sense of satisfaction knowing it contributes positively to my well-being."	"I intend to persist in utilising it—its utility is remarkably beneficial."
Male, 79, high school diploma, retired firefighter, middle income	"It engages my cognitive faculties, which is essential for my requirements."	"It is straightforward to navigate, notwithstanding my lack of technological proficiency."	"I find pleasure in utilising it, which was unexpected for me."	"I intend to continue utilising it, as it is both effortless and gratifying."
Female, 85, former librarian, upper-middle income	"I have observed enhancements in my concentration and cognitive retention, particularly subsequent to engaging in reading activities."	"Engaging with it is enjoyable and conveys a sense of personal improvement; however, it could be augmented by the inclusion of additional instructional materials."	"I derive pleasure from it; it presents a modest challenge on a daily basis."	"Indeed, I will persist in utilising it as long as I perceive advantageous outcomes."
Male, 70, bachelor's degree, retired manager, upper-middle income	"I consider it advantageous in enhancing my cognitive retention capabilities."	"It is sufficiently user-friendly, although an increase in text size would be beneficial."	"I derive pleasure from its use and appreciate the sense of achievement it engenders."	"Indeed, I intend to continue utilising it on a regular basis."
Female, 74, high school, homemaker, lower income	"The application has significantly enhanced my ability to recall names, for which I express my gratitude."	"My daughter instructed me on the fundamental principles, and as a result, I now perceive it as user-friendly."	"I derive considerable satisfaction from utilising it and harbour a positive sentiment towards its use."	"I intend to persist in its utilisation, as I perceive it to be advantageous to my personal development."

Note: Some original speech from the older adults included hesitations, informal phrasing or grammatical inconsistencies that could obscure meaning. Quotes from older adult participants have been lightly edited for grammar and clarity to ensure readability while preserving the original meaning and intent.

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integration into daily routines. A 70-year-old former teacher said, "I possess a strong affinity for it and eagerly anticipate engaging with it daily," and a 79-year-old retired firefighter described it as "both effortless and gratifying". Those from upper-middle to high-income brackets emphasised personalisation and cognitive challenge. A 76-year-old retired professor remarked, "It could be improved by incorporating additional options for personalisation", while a 79-year-old business owner described it as "a beneficial contribution to my personal development."

Several participants from lower-income backgrounds, in the focus groups, expressed concern about potential costs associated with continuous app use. This highlights the importance of cost-sensitive features, such as free access tiers or community sponsorships, to ensure equitable access.

3.5. PU. Most participants reported subjective impressions of cognitive improvements, including improved recollection of their daily living tasks and recall specific information. A 68-year-old male noted, *"I've noticed I can remember things better, like where I put my keys!"* A 70-year-old female commented, *"It effectively facilitates my ability to maintain concentration and recall specific information, such as the names of individuals,"* and a 66-year-old accountant shared, *"I find myself able to recall intricate details with significantly enhanced ease."* These responses illustrate that PU ranged from practical memory support to enhanced cognitive sharpness, depending on users' backgrounds and expectations. Many viewed the app as a valuable "workout" for their cognitive abilities. Participants from academic or managerial backgrounds often associated the app's usefulness with heightened mental acuity and productivity, aligning with their preference for structured, intellectually stimulating activities. In contrast, users from economically disadvantaged backgrounds or with limited formal education expressed usefulness in more practical terms, appreciating how the app supported memory in daily life.

Several participants from lower-income groups expressed concern about potential costs associated with long-term use, suggesting that affordability would be a key factor in sustained engagement. This supports the recommendation for cost-sensitive features, such as free devices or community-based sponsorships.

3.6. PEU. Most participants found the app easy to use after an initial setup period. Both interview and focus group data indicated that older adults could successfully adopt mobile applications with minimal support. A 79-year-old male said, *"It is straightforward to navigate, notwithstanding my lack of technological proficiency,"* and a 72-year-old factory worker shared, *"My daughter provided initial assistance, and I am now capable of utilising it independently."* A 69-year-old social worker praised the design, stating, *"The interface is intuitively designed with explicit guidance, which I find commendable."* While older users appreciated support from family, younger and more tech-savvy users adapted quickly and suggested enhancements for personalisation. A minority of users, particularly those exhibiting lower technological proficiency, acknowledged the requirement for fundamental guidance but subsequently regarded the mobile application as manageable. Participants frequently recommended the use of audio instructions or voice-guided tutorials to support those with limited reading ability or visual impairments. This feedback reinforces the need for voice-assisted onboarding to improve accessibility.

Participants in their 60s and early 70s, or those with greater digital literacy, found the interface more intuitive. In contrast, older adults (80+) or those with limited tech experience reported initial challenges, particularly with font size and interaction speed. In focus groups, several participants also requested the ability to adjust the pace and complexity of tasks, indicating a desire for customizable difficulty levels. This would allow users to tailor the experience to their cognitive comfort zone and learning pace.

3.7. ATU. The majority of participants expressed a positive ATU the app, often describing the experience as enjoyable and rewarding. Users positively indicated that the mobile application provided them with a sense of accomplishment, particularly upon completing levels or recognising cognitive improvements. A 75-year-old nurse said, *"I enjoy it and find it very rewarding,"* and a 78-year-old school secretary shared, *"It resembles a game; however, I am cognizant of its beneficial effects on my well-being."* A 70-year-old manager added, *"I derive pleasure from its use and appreciate the sense of achievement it engenders."* Although motivations varied—some enjoyed the intellectual challenge, others the practical benefits—overall sentiment was highly favourable. The app's gamified features, such as level progression and rewards, resonated across socioeconomic and educational backgrounds.

Participants from higher education backgrounds expressed a desire for more advanced challenges, while others preferred simpler tasks. This divergence further supports the need for adjustable difficulty settings to accommodate a wide range of cognitive abilities and preferences.

3.8. BIU. Many participants expressed a strong intention to continue using the app, citing its cognitive benefits and ease of integration into daily routines. A 79-year-old male said, *"I intend to integrate this practice into my daily morning regimen consistently,"* and a 69-year-old female stated, *"Indubitably—I am resolutely dedicated to engaging with it on a daily basis."* A 74-year-old mechanic added, *"I intend to continue utilising it, provided I consistently observe enhancements in my performance."* Participants viewed the app as a meaningful part of their daily lives, with many expressing willingness to recommend it to others. These endorsements were often accompanied by personal stories of improved organisation and mental clarity, reinforcing the app's perceived value.

However, a few participants noted that if the app were to become subscription-based or include in-app purchases, they might discontinue use. This highlights the importance of maintaining cost-sensitive access models to support long-

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term adoption. The qualitative data presented in Table 3 reveal rich and diverse experiences among older adults using the gamified mobile application. While the TAM provided a useful structure for organising user feedback, several emergent themes—particularly the role of family support and intergenerational learning, emotional engagement and social dimensions—extend beyond the traditional TAM constructs and warrant deeper discussion.

3.9. Family Support and Intergenerational Learning. A recurring theme across several responses was the importance of family assistance in facilitating initial engagement with the application. For example, a 71-year-old homemaker shared, *"My daughter demonstrated the fundamental operations, and I now possess the confidence to utilise it independently."* Similarly, a 73-year-old participant noted, *"My granddaughter provided me with instructions on its utilisation, and I now navigate its functionalities with ease."* These narratives highlight the critical role of intergenerational support in overcoming technological barriers, particularly for users with limited digital literacy. Participants frequently suggested that onboarding would be more effective if it included audio instructions or voice-guided walkthroughs, especially for those unfamiliar with smartphones. This reinforces the recommendation for voice-assisted onboarding as a means of enhancing accessibility and reducing reliance on family members. These findings suggest that future interventions could benefit from incorporating family-based onboarding strategies or peer-mentoring systems.

3.10. Emotional Engagement and Social Dimensions. While TAM focuses on PU and PEU, many participants described emotional and social benefits that fall outside these categories. A 78-year-old retired school secretary remarked, *"It resembles a game; however, I am cognizant of its beneficial effects on my well-being,"* indicating that the app provided not only cognitive stimulation but also a sense of enjoyment and purpose. Similarly, a 68-year-old former bank clerk expressed, *"I derive pleasure from its utilisation and anticipate engaging with it in the future,"* suggesting that emotional satisfaction was a key motivator for continuous use. These emotional responses were particularly strong among participants who felt socially isolated or cognitively understimulated in daily life. The app's gamified structure and sense of progression contributed to feelings of accomplishment and connection, suggesting that emotional engagement is a critical factor in long-term adoption. These insights highlight the importance of affective engagement—an element not explicitly captured within the TAM framework but essential for sustained use among older adults.

3.11. Cognitive Empowerment and Identity. Participants frequently linked the app's benefits to a sense of cognitive empowerment and personal identity. A 76-year-old retired professor stated, *"I perceive it as intellectually stimulating and cognitively engaging,"* while a 66-year-old retired accountant noted, *"I value the cognitive challenge it provides."* These reflections suggest that for some users, the app served as a means of maintaining intellectual identity and self-efficacy in later life.

Participants with higher educational attainment often expressed a desire for more complex tasks or adaptive challenges, reinforcing the need for customizable difficulty levels. This would allow users to feel appropriately challenged and maintain a sense of cognitive growth. These findings align with broader gerontological theories that emphasise the role of meaningful activity in promoting psychological well-being and preserving a sense of purpose among older adults.

4. Discussion

Unlike many lab-based studies, our research was conducted in community service settings, enhancing ecological validity. This real-world context provides valuable insights into the practical challenges and facilitators of deploying digital interventions at scale, particularly in public health and social care environments.

Beyond theoretical validation, our findings yield actionable recommendations for inclusive app design. These include the need for voice-assisted onboarding, customizable difficulty levels and cost-sensitive features. Such practical implications extend the utility of TAM by informing the development of more accessible and engaging digital tools for ageing populations. Incorporating user feedback and engagement metrics allowed us to gain a comprehensive understanding of the mobile application's efficacy and usability.

4.1. User Perceptions of Specific Application Features. User feedback on *Challenges in Town* revealed a nuanced understanding of how specific features influenced engagement and usability. Participants consistently praised the app's gamified elements, such as level progression and virtual trophies, which were seen as motivating and enjoyable. The visual design and ease of navigation were also well-received, with users noting that the interface felt intuitive and accessible. Particularly valued was the real-life relevance of tasks, such as the grocery shopping simulation, which users found both familiar and cognitively stimulating. As one participant shared, *"I liked the grocery game—it felt like something I actually do, and it helped me remember my list better."* However, some features posed challenges. Several users reported that the font size was too small, especially for older adults, and others found navigation between screens confusing due to limited visual cues or instructions. One participant noted, *"The font was too small at first. I had to ask my grandson to help me."* These insights align with the TAM positive feedback on real-life relevance, and rewards reflect high PU, while navigation and accessibility issues impacted PEU. This is consistent with the findings from Silva et al. [20], who emphasised the importance of tailoring cognitive training apps to older adults' needs, including usability and

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task relevance [20]. Similarly, researchers found that older adults' acceptance of mobile apps is strongly influenced by PU and PEU, reinforcing the value of user-centred design in digital health interventions [21].

4.2. Acceptability of the Mobile Application. Our research findings corroborated the results of prior studies, wherein participants from heterogeneous backgrounds consistently recognised the application's utilitarian cognitive benefits [22]. Participants reported improvements in memory retention, cognitive vigilance and task organisation, enhancing the application's perceived utility, thereby solidifying their positive attitudes towards ongoing engagement with the mobile application [23]. Consistent with the existing literature [24, 25], this perspective was especially prevalent among older adults with a high school education or lower, who identified the mobile application as beneficial for the management of quotidian tasks such as recalling appointments and daily routines. Conversely, individuals with elevated educational qualifications emphasised the demand for cognitive challenges and performance assessments, suggesting that these demographic cohorts value more sophisticated feedback mechanisms [26]. The integration of customizable features intended to track cognitive progress could potentially enhance engagement for these users, thereby further augmenting the application's perceived utility.

Another important factor influencing acceptability was the application's ability to meet age-specific preferences [27]. While younger seniors (aged 60–70) readily adopted the interface, older participants (aged 80 and above) initially faced challenges, frequently requiring familial support for configuration. The findings reiterated that older-old participants encountered difficulties with the mobile application's functionalities [28]. This suggests that age-related cognitive and technological literacy barriers may influence the intention to utilise mobile applications [29].

Nonetheless, consistent with previous research, the majority found the mobile application to be both enjoyable and functional once they adapted, indicating that initial support and user-friendly onboarding processes could elevate comfort levels, thereby facilitating the bridging of technological gaps across generations [30]. Regarding gender differences, men generally adopt modern technology more readily than women, often perceiving it as more advantageous. This perception significantly impacts their heightened intention to utilise the mobile application [28]. Furthermore, their responses indicated subtle distinctions: Males seemed to prioritise cognitive challenges, whereas females demonstrated a stronger emphasis on practical advantages, underscoring the potential efficacy of tailored content that highlights both intellectual stimulation and pragmatic memory support [2, 28].

4.3. Feasibility of the Mobile Application. Usability was a critical factor affecting the application's overall feasibility [7, 8], with a majority of participants indicating that, following their familiarisation with the application's design, its gamified elements significantly enhanced their user experience. The existing literature posits that the fundamental characteristics of usability that foster user friendliness encompass understandability, operability and aesthetic appeal. These characteristics ensure that the application is comprehensible, functional and visually engaging, which is vital for addressing the age-related perceptual capacities of older users [8]. This includes creating interfaces that are easy to navigate and understand, reducing cognitive load for older users.

In research of cognitive processes and the use of mobile application, the educational attainment of participants emerges as a significant variable. It can influence the extent to which participants can acclimate to new technologies and grasp the gaming or task-related elements involved [13]. In our study, older participants and those with lower educational backgrounds often needed an accessible introduction, wherein structured guidance or visual aids were deemed essential [29]. To augment feasibility for these demographic segments, as indicated in previous research [4], the mobile application could integrate an optional tutorial or voice-assisted instructions, thereby promoting a more fluid initial user experience. Participants exceeding the age of 80, as observed in this study, would significantly benefit from a streamlined interface, which may encompass enlarged text, intuitive navigation and customizable visual indicators that cater to varying levels of technological adeptness [9, 27].

Additionally, participants' socioeconomic status significantly affected their assessment of feasibility [31]. Participants hailing from lower-income backgrounds in this study expressed concerns regarding potential financial implications, such as the costs associated with network usage and possible application upgrade fees, suggesting that a more affordable or tiered pricing structure could facilitate broader adoption. In contrast, participants from higher-income demographics demonstrated more consistent engagement, thereby underscoring the effectiveness of premium features in maintaining sustained interest and behavioural engagement. While this particular study does not delve into socioeconomic status details, future research endeavours, particularly those of a larger scale, could benefit from incorporating such data to gain a more profound understanding of its influence on the adoption and efficacy of cognitive interventions.

The findings of this study underscore the importance of designing mobile applications with user-friendly interfaces tailored to the cognitive and technological needs of older adults. Specifically, developers should prioritise features such as simplified navigation, larger text options and customizable settings to enhance usability. Additionally, integrating gamification elements can motivate engagement and facilitate cognitive exercise, thereby improving users' daily functioning and quality of life. Training programmes that provide initial guidance and ongoing support could also be beneficial, particularly for older users who may struggle with technology.

Future research should explore the long-term effects of using the '*Challenges in Town*' application on cognitive health and daily functioning among older adults. Studies

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with larger and more diverse samples could provide deeper insights into how socioeconomic factors influence technology acceptance and use. Additionally, investigating the impact of different gamification strategies on engagement and learning outcomes could help refine application design. Research could also examine the effectiveness of tailored content that addresses the distinct preferences of various demographic groups, including those based on educational attainment and gender.

4.4. Comparative Analysis: Challenges in Town vs. Existing Applications. The recent literature on mobile health and cognitive training applications for older adults provides a valuable context for evaluating the *Challenges in Town* app. Yu et al. [32] conducted a scoping review of mobile gaming applications marketed for cognitive health in older adults. Out of 227 apps reviewed, only 14 met the inclusion criteria for cognitive training relevance. The study found that while many apps claimed cognitive benefits, few were grounded in empirical research or included features such as baseline assessments or adaptive difficulty [32]. Unlike many existing apps that claim cognitive benefits without empirical grounding, through the three core modules, the *Challenges in Town* app is explicitly designed around cognitive science principles, targeting working memory and executive function through real-life simulations and adaptive difficulty. With this novelty in the Cantonese-speaking community, this positions *Challenges in Town* as a more robust and theoretically informed intervention. In terms of usability, Wang et al. [8] emphasise the importance of accessibility features such as intuitive navigation and visual clarity [8]—areas where *Challenges in Town* performs well, though user feedback also highlighted common issues such as small font size and screen transitions. The app's gamification strategy with achievement, including levels, badges and feedback, aligns with systematic literature review findings by Koivisto and Malik [33], who noted that such elements can enhance motivation among older adults when thoughtfully implemented. What sets *Challenges in Town* apart is its strong emphasis on ecological validity; by simulating everyday tasks such as grocery shopping and home safety, it offers a more relatable and transferable experience than many apps that rely on abstract games or puzzles. This real-life relevance not only enhances engagement but also supports PU, an essential factor in technology adoption among older adults. Overall, *Challenges in Town* compares favourably with the existing applications, offering a more comprehensive, user-centred and cognitively grounded approach to digital health for ageing populations.

4.5. Limitation. This study acknowledges several limitations that should be considered when interpreting the findings. First, while participant quotes are a valuable form of qualitative evidence, they must be presented in a way that is both authentic and accessible. As Lingard and Watling [34] emphasise, quotes in qualitative research serve as evidence rather than argument and should be illustrative, succinct and representative of broader patterns in the data [34]. In this study, some quotes from older adult participants included hesitations, informal phrasing or grammatical inconsistencies that could obscure meaning. To enhance readability and ensure clarity for a wider audience, these quotes were lightly edited for grammar and structure while preserving the original intent and voice. This practice is widely accepted in qualitative research, particularly in health and education contexts, where the goal is to honour participants' perspectives while making their insights understandable to diverse stakeholders [35, 36].

Second, the relatively small sample size of 20 participants limits the generalisability of the findings across all demographic subgroups. The primary aim of this study was exploratory—to identify emerging patterns and user perceptions that could inform future research and app development, rather than to produce statistically representative conclusions. Moreover, the targeted recruitment strategy and voluntary nature of participation may have introduced self-selection bias. Individuals with a pre-existing interest in mobile applications or cognitive training may have been more inclined to participate, potentially limiting the representativeness of the sample in relation to the broader older adult population.

Third, while the TAM provided a useful framework for interpreting user feedback, its focus on PU and PEU may have constrained the depth and novelty of insights. TAM does not fully account for the influence of family support, social environment or emotional and motivational factors, all of which are particularly relevant when studying older adults' engagement with technology. For example, several participants relied on family members for assistance, which likely shaped their experience with the app in ways not captured by TAM. Future research may benefit from integrating complementary frameworks, such as the Unified Theory of Acceptance and Use of Technology (UTAUT) [37, 38] or socioecological models [39] to better capture the complex interplay of individual, social and contextual factors.

Since this study focus on individuals' subjective experience, we acknowledge that the study did not incorporate objective usage data (e.g., session logs or feature interaction metrics) due to ethical constraints. Thematic analysis was conducted until code saturation was achieved across the full sample, meaning that no new codes emerged from the final interviews. This approach aligns with qualitative research standards, which distinguish between code saturation (the point at which no additional codes are identified) and meaning saturation (a deeper understanding of themes) [40]. Given the exploratory nature of this study, the focus was on achieving code saturation at the overall sample level rather than within specific demographic subgroups. While subgroup-specific saturation was not feasible due to the modest sample size, demographic variables were included to provide contextual depth and inform future hypothesis generation. The study achieved code saturation at the overall sample level, which is appropriate for exploratory qualitative research, while acknowledging that subgroup-specific saturation was not the goal.

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Finally, while this study focused on qualitative feedback, we recognise the value of integrating behavioural data to enrich interpretation. Future research would benefit from triangulating self-reported experiences with app usage analytics, such as task completion rates, time-on-task and interaction patterns. This mixed-methods approach could offer a more comprehensive understanding of user engagement and cognitive outcomes.

5. Conclusion

This study provides valuable insights into the acceptability and feasibility of a gamified mobile application, *Challenges in Town*, designed to support cognitive health among older adults. By applying the TAM, the research illuminated how PU, PEU, attitudes and behavioural intentions shape older adults' engagement with digital cognitive tools. The findings underscore that while older adults are open to adopting mobile technologies, their experiences are deeply influenced by age, gender, education and socioeconomic status.

Participants widely acknowledged the app's cognitive and emotional benefits, with many reporting improved memory, increased confidence and a sense of accomplishment. The gamified structure, real-life relevance of tasks and adaptive difficulty were particularly effective in sustaining engagement. However, initial usability challenges—especially among the oldest participants and those with limited digital literacy—highlight the need for accessible onboarding processes and customizable features such as font size and navigation aids. Beyond the TAM framework, the study revealed the critical role of family support and intergenerational learning, emotional engagement and social dimensions in technology adoption. Intergenerational assistance not only facilitated initial use but also fostered confidence and independence. These findings suggest that future digital interventions should consider broader socio-emotional and contextual factors alongside traditional usability metrics.

In conclusion, *Challenges in Town* demonstrates strong potential as a cognitively enriching and socially meaningful tool for older adults. To maximise its impact, developers should prioritise inclusive design, affordability and support mechanisms that address the diverse needs of ageing populations. Future research should explore long-term cognitive outcomes, integrate behavioural usage data and examine the effectiveness of tailored gamification strategies. By centring older adults' lived experiences, digital health innovations can become more equitable, empowering and impactful in promoting healthy ageing.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics Statement

Ethics approvals had been granted under the project title 'VR & AI-based Mobile Apps in Enhancing Independence of Daily Living in Older Adults and People with Early Dementia' with the reference number HSEARS20191220001.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Frank Ho-Yin Lai: conceptualisation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, supervision, writing–original draft and writing–review and editing. Ben Chi-Bun Yip: conceptualisation, funding acquisition, methodology, project administration, supervision, writing–original draft and writing–review and editing. Eddie Yip-Kuen Hai: conceptualisation, funding acquisition, methodology, resources, visualisation and writing–review and editing. Cath Darling: conceptualisation, methodology, project administration and writing–review and editing. David Wai-Kwong Man: conceptualisation, methodology, project administration, resources, validation and writing–review and editing.

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