



## “Healthify Knee” Exercise Application for People with OA Knee: An Expert Driven Validation Study

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### Abstract

Osteoarthritis (OA) is the most common degenerative joint condition, often leading to chronic pain, impaired mobility, and diminished quality of life, particularly among older adults and women. With rising global prevalence and the substantial economic burden it imposes, there is an urgent need for effective, accessible, and scalable interventions to support self-management of the condition. This study presents the development and validation of "Healthify Knee," a mobile health (mHealth) application designed specifically to assist individuals with knee OA in managing their symptoms through guided exercise and self-monitoring.

The app was developed in collaboration with the Computer Science Department at Charotar University of Science and Technology (CHARUSAT), following a structured methodology involving initial consultation, requirement analysis, prototype development, pilot testing, refinement, and expert validation. Female participants with diagnosed knee OA were selected for pilot testing, and their feedback was used to enhance usability and functionality. Subsequently, content validation was conducted with 10–12 domain experts using a structured face validity form.

Quantitative analysis of expert responses demonstrated high levels of agreement on the app's content relevance, with an Item-level Content Validity Index (I-CVI) ranging from 0.88 to 1.00, and a Scale-level Content Validity Index (S-CVI/Ave) of 0.95. These results indicate excellent content validity and support the application's potential for community use.

"Healthify Knee" provides an innovative, user-friendly, and evidence-informed approach for OA management. Future work will include broader usability testing, long-term user satisfaction studies, and integration with healthcare systems to expand its reach and effectiveness in chronic disease management.

**Keywords:** Healthify Knee; Osteoarthritis

### Introduction

- Osteoarthritis (OA) is a degenerative joint disease that causes pain and decreases physical function and quality of life. It is the most common musculoskeletal disorder, and globally, it is a heavy economic burden with annual costs of US \$89.1 billion in the US alone [1].
- Fortunately, mobile health (mHealth) technology, defined as “medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices,” including apps holds great promise for advancing the treatment and management of chronic diseases, such as knee osteoarthritis [2].

- The steps being taken to develop mobile applications may differ depending on the project or established technologies. Mobile apps are the result of several activities that are carried out, such as, assigning roles to the work group, defining objectives and activities, implementing a set of good practices for teamwork and collaboration, establishing the schedule of activities, risk management, among others. In the end, guidelines must be adapted according to available resources and customer requirements [3].
- In 2014, an exercise app (Therapeutic exercise [Ther-ex]) (Ther-Ex APS, Denmark) targeting people with OA was

brought to market in both iOS and Android versions. The developers were an orthopedic surgeon and a physiotherapist. Their concept for the app was to compile general OA recommendations of exercise and its monitoring into a solution, which was readily available for people with OA. The app contains approximately 100 individual videos of land-based functional exercises, which can be combined into individualized exercise programs (Textbox 1). Furthermore, the app contains an exercise and pain rating log, and these data can be displayed in various ways [1].

**Textbox 1.** Exercise app—therapeutic exercise.

Idea: to compile general osteoarthritis (OA) recommendations of exercise and its monitoring into an easy accessible tool

Contains: approximately 100 videos of land-based functional exercises and combines these into the following:

- Exercise programs
- Visual pain rating scale
- Exercise and weight diary
- Module for visualization of the above

Developed by a physiotherapist and an orthopedic surgeon with both clinical and research knowledge of OA

**Textbox 1**

### Related work

In this section, we present the works that have addressed the challenges related to the study of current mobile application development processes.

Flora, *et al.* [4] investigate the challenges faced during mobile application development processes through a survey of the mobile research and development community. Some business restrict their focus to a single platform which reduces the reach of their applications, few participants expressed concern about the lack of informed and experienced resources to develop mobile apps, assessing the effort required at the beginning of the cycle and note developer team spend a lot of time understanding and analyzing customer’s requirements increasing their workload with developing, integrating and testing the apps [4].

Mostly, I design methodology that allows the analysis of specific mobile applications which can be useful for community people with OA knee.

### Methodology

Initially, we sought assistance from the Computer Science Department at Charusat University, Changa, to develop an exercise application for individuals with OA knee, employing a design methodology focused on creating mobile applications tailored for community use.

### Procedure

#### Initial Consultation phase

- **Approval and Assignment:** With approval from higher authorities, the computer science department at changa provided one computer science student and a faculty member.

- **Initial Meeting:** Conducted a meeting with the assigned student and faculty member to discuss the app concept and prototype requirements.

**Development phase**

- **Information Gathering:** The faculty member and student gathered detailed information from our discussions, focusing on the specific needs and functionalities required for the exercise app, and utilizing this input, they developed its initial version—acknowledging that mobile app development processes can vary significantly depending on the project’s goals, available resources, and overall scope.

**Data collection and feedback**

**Pilot testing**

- **Participants:** Women with OA knee were selected for the initial testing phase.
- **Procedure:** Participants were instructed to use the app and provide ratings based on their user experience.
- **Feedback Collection:** Based on the participants’ reviews, feedback was collected to identify areas for improvement.

**Redevelopment**

App Refinement: Using the feedback obtained, necessary changes and improvements were made to redevelop the app.

**Final validation [5]**  
**Expert validation**

- **Objective:** To ensure the app met the required standards and effectively served its purpose for the target population.
- The final version of the app was validated with the assistance of experts in the field.

**Stage 1**

To validate the app, a face validity form was prepared. While developing Validity Google form, response sheet should include rate criteria, its rating scale, remarks, rater’s name, rater’s qualification, rater’s years of experience, rater’s profession and date of response.

**Stage 2**

Expert with experience in topic/subject/work will be selected to evaluate it. More experts will be selected to get more opinions; however, the feasibility of handling logistics should be considered. Based on experience, author suggests 10-12 experts can give enough and good recommendations.

**Stage 3**

Response of validation form will be taken by non face-to face mode (Google Form).

**Stage 4**

After having all completed forms, responses will be compiled in result table.

**Stage 5**

% calculation: response is to calculate the % of response through the given formula.

**The definition and formula of I-CVI, S-CVI/Ave and S-CVI/UA**

The CVI indices	Definition	Formula
<b>I-CVI</b> (item-level content validity index)	The proportion of content experts giving item a relevance rating of 3 or 4	$I-CVI = \frac{\text{agreed item}}{\text{number of expert}}$
<b>S-CVI/Ave</b> (scale-level content validity index based on the average method)	The average of the I-CVI scores for all items on the scale or the average of proportion relevance judged by all experts. The proportion relevant is the average of relevance rating by individual expert.	$S-CVI/Ave = \frac{\text{sum of I-CVI scores}}{\text{number of item}}$ $S-CVI/Ave = \frac{\text{sum of proportion relevance rating}}{\text{number of expert}}$
<b>S-CVI/UA</b> (scale-level content validity index based on the universal agreement method)	The proportion of items on the scale that achieve a relevance scale of 3 or 4 by all experts. Universal agreement (UA) score is given as 1 when the item achieved 100% experts in agreement, otherwise the UA score is given as 0.	$S-CVI/UA = \frac{\text{sum of UA scores}}{\text{number of item}}$

Note: The definition and formula were based on the recommendations by Lynn (8), Davis (5), Polit & Beck (6) and Polit et al. (7)

**Figure 1**

Result

Application Validation Form Response									
Sr. No	Qualification	Experience	Q-1	Q-2	Q-3	Q-4	Q-5	Q-6	
1	MPT in Ortho	8	1	1	1	1	1	1	1
2	MPT in Ortho	8	1	0	1	1	1	1	0.8
3	MPT in Community	3	1	1	1	1	1	1	1
4	Orthopedic Surgeon	10	1	1	1	1	1	1	1
5	Orthopedic Surgeon	15	1	1	1	0	1	1	0.8
6	Orthopedic Surgeon	7	1	1	1	1	1	1	1
7	MPT in Geriatrics	15	1	1	1	1	1	1	1
8	Computer Science App Expert	3	1	1	1	1	1	1	1
9	Bilingual Expert	5	1	1	1	1	1	1	1
		9	8	9	8	9	9	9	
% of overall agreement			0.09	0.08	0.09	0.08	0.09	0.09	S-CVI/Ave= 0.95
Y/N = Yes or No   Action Taken for remark = Correction done or not for received remark(s).									
			9	8	9	8	9	9	52

Table 1: The relevance ratings on the item scale by experts.

As we can see in Table 1, we have calculated expert agreement, I-CVI, S-CVI/Ave and S=CVI/UA score.

- **Experts in agreement:** For example, the experts in agreement for Q2 (1 + 0 + 1 + 1 + 1 + 1 + 1 + 1) = 8
- **I-CVI:** The expert in agreement divided by the number of experts, for example I-CVI of Q2 is 8 divided by 9 experts that is equal to 0.88.
- **S-CVI/Ave (based on I-CVI):** The average of I-CVI scores across all items, for example the S-CVI/Ave [9+8+9+8+9+9/6] is equal to 0.86.
- **S-CVI/Ave (based on proportion relevance):** The average of proportion relevance scores across all experts, for example the S-CVI/Ave [(1 + 0.8 + 1+ 1+ 0.8+ 1+ 1 + 1 + 1)/9] is equal to 0.95.

Based on the above calculation, we can conclude that I-CVI and S-CVI/Ave. meet satisfactory level, and thus the Mobile Application has achieved satisfactory level of content validity.

Conclusion

The Mobile Application “Healthify Knee” developed for community people with OA knee has demonstrated excellent validity,

with a validity score of 0.95. This high score indicated that the app is a reliable and accurate tool for its intended purpose.

Future research should focus on broader usability testing and long-term user engagement.

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