

Mobile Apps for Professional Dermatology Education: An Objective Review

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PRACTICE POINTS

- Mobile applications (apps) are a convenient way to learn dermatology, but there is no objective method to assess their quality.
- To determine which apps are most useful for education, we performed a graded review of dermatology apps targeted to students and residents.
- By applying a rubric to 36 affordable apps, we identified 18 (50%) with adequate teaching value.

Mobile dermatology applications (apps) created for the purpose of educating students and trainees present convenient supplemental learning opportunities. Before these apps can be widely utilized, there must be a method to assess educational objectives, quality, comprehensiveness of content, evidence-based accuracy, user-friendly design, and potential for bias. Herein, an established rubric was used to conduct a graded review of apps spanning general dermatology, skin cancer, and cosmetics, with an additional emphasis on affordability and accessibility for the user.

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With today's technology, it is easier than ever to access web-based tools that enrich traditional dermatology education. The literature supports the use of these innovative platforms to enhance learning at the student and trainee levels. A controlled study of pediatric residents showed that online modules effectively supplemented clinical experience with atopic dermatitis.¹ In a randomized diagnostic study of medical students,

practice with an image-based web application (app) that teaches rapid recognition of melanoma proved more effective than learning a rule-based algorithm.² Given the visual nature of dermatology, pattern recognition is an essential skill that is fostered through experience and is only made more accessible with technology.

With the added benefit of convenience and accessibility, mobile apps can supplement experiential learning. Mirroring the overall growth of mobile apps, the number of available dermatology apps has increased.³ Dermatology mobile apps serve purposes ranging from quick reference tools to comprehensive modules, journals, and question banks. At an academic hospital in Taiwan, both nondermatology and dermatology trainees' examination performance improved after 3 weeks of using a smartphone-based wallpaper learning module displaying morphologic characteristics of fungi.⁴ With the expansion of virtual microscopy, mobile apps also have been created as a learning tool for dermatopathology, giving trainees the flexibility and autonomy to view slides on their own time.⁵ Nevertheless, the literature on dermatology mobile apps designed for the education of medical students and trainees is limited, demonstrating a need for further investigation.

Prior studies have reviewed dermatology apps for patients and practicing dermatologists.⁶⁻⁸ Herein, we focus on mobile apps targeting students and residents learning dermatology. General dermatology reference apps and educational aid apps have grown by 33% and 32%, respectively, from 2014 to 2017.³ As with any resource meant to educate future and current medical providers, there must be an objective review process in place to ensure accurate, unbiased, evidence-based teaching.

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Well-organized, comprehensive information and a user-friendly interface are additional factors of importance when selecting an educational mobile app. When discussing supplemental resources, accessibility and affordability also are priorities given the high cost of a medical education at baseline. Overall, there is a need for a standardized method to evaluate the key factors of an educational mobile app that make it appropriate for this demographic. We conducted a search of mobile apps relating to dermatology education for students and residents.

Methods

We searched for publicly available mobile apps relating to dermatology education in the App Store (Apple Inc) from September to November 2019 using the search terms *dermatology education*, *dermoscopy education*, *melanoma education*, *skin cancer education*, *psoriasis education*, *rosacea education*, *acne education*, *eczema education*, *dermal fillers education*, and *Mohs surgery education*. We excluded apps that were not in English, were created for a conference, cost more than \$5 to download, or did not include a specific dermatology education section. In this way, we hoped to evaluate apps that were relevant, accessible, and affordable.

We modeled our study after a review of patient education apps performed by Masud et al⁶ and utilized their quantified grading rubric (scale of 1 to 4). We found their established criteria—educational objectives, content, accuracy, design, and conflict of interest—to be equally applicable for evaluating apps designed for professional education.⁶ Each app earned a minimum of 1 point and a maximum of 4 points per criterion. One point was given if the app did not fulfill the criterion, 2 points for minimally fulfilling the criterion, 3 points for mostly fulfilling the criterion, and 4 points if the criterion was completely fulfilled. Two medical students (E.H. and N.C.)—one at the preclinical stage and the other at the clinical stage of medical education—reviewed the apps using the given rubric, then discussed and resolved any discrepancies in points assigned. A dermatology resident (M.A.) independently reviewed the apps using the given rubric.

The mean of the student score and the resident score was calculated for each category. The sum of the averages for each category was considered the final score for an app, determining its overall quality. Apps with a total score of 5 to 10 were considered poor and inadequate for education. A total score of 10.5 to 15 indicated that an app was somewhat adequate (ie, useful for education in some aspects but falling short in others). Apps that were considered adequate for education, across all or most criteria, received a total score ranging from 15.5 to 20.

Results

Our search generated 130 apps. After applying exclusion criteria, 42 apps were eligible for review. At the time of publication, 36 of these apps were still available. The

possible range of scores based on the rubric was 5 to 20. The actual range of scores was 7 to 20. Of the 36 apps, 2 (5.6%) were poor, 16 (44.4%) were somewhat adequate, and 18 (50%) were adequate. Formats included primary resources, such as clinical decision support tools, journals, references, and a podcast (Table 1). Additionally, interactive learning tools included games, learning modules, and apps for self-evaluation (Table 2). Thirty apps covered general dermatology; others focused on skin cancer (n=5) and cosmetic dermatology (n=1). Regarding cost, 29 apps were free to download, whereas 7 charged a fee (mean price, \$2.56).

Comment

In addition to the convenience of having an educational tool in their white-coat pocket, learners of dermatology have been shown to benefit from supplementing their curriculum with mobile apps, which sets the stage for formal integration of mobile apps into dermatology teaching in the future.⁸ Prior to widespread adoption, mobile apps must be evaluated for content and utility, starting with an objective rubric.

Without official scientific standards in place, it was unsurprising that only half of the dermatology education applications were classified as adequate in this study. Among the types of apps offered—clinical decision support tools, journals, references, podcast, games, learning modules, and self-evaluation—certain categories scored higher than others. App formats with the highest average score (16.5 out of 20) were journals and podcast.

One barrier to utilization of these apps was that a subscription to the journals and podcast was required to obtain access to all available content. Students and trainees can seek out library resources at their academic institutions to take advantage of journal subscriptions available to them at no additional cost. Dermatology residents can take advantage of their complimentary membership in the American Academy of Dermatology for a free subscription to *AAD Dialogues in Dermatology* (otherwise \$179 annually for nonresident members and \$320 annually for nonmembers).

On the other hand, learning module was the lowest-rated format (average score, 11.3 out of 20), with only *Medical Student: Dermatology* qualifying as adequate (total score, 16). This finding is worrisome given that students and residents might look to learning modules for quick targeted lessons on specific topics.

The lowest-scoring app, a clinical decision support tool called *Naturelize*, received a total score of 7. Although it listed the indications and contraindications for dermal filler types to be used in different locations on the face, there was a clear conflict of interest, oversimplified design, and little evidence-based education, mirroring the current state of cosmetic dermatology training in residency, in which trainees think they are inadequately prepared for aesthetic procedures and comparative effectiveness research is lacking.⁹⁻¹¹

TABLE 1. Graded Review of Primary Resource Mobile Applications (Apps)

Format	Mobile App	Cost	Mean Score					Total Score
			Educational Objectives	Content	Accuracy	Design	Conflict of Interest	
Clinical decision support tools	Mohs Surgery Appropriate Use Criteria ^a	Free	2.5	3	3.5	3.5	4	16.5
	SUNTRAC4TXP ^a	Free	2	2	4	3.5	4	15.5
	Melanoma TNM8 ^a	Free	2	3	3	3	4	15
	Skin Lymphoma ^a	Free	2	2.5	3	3	4	14.5
	Naturelize ^b	Free	1	2	1	2	1	7
Journals	<i>British Journal of Dermatology</i> ^c	Free ^d	3.5	4	4	3	3	17.5
	<i>JEADV</i> ^c	Free ^d	3.5	4	4	3	3	17.5
	<i>Australasian Journal of Dermatology</i> ^c	Free ^d	3	4	4	3	3	17
	<i>CED</i> ^c	Free ^d	3	4	4	3	3	17
	<i>International Journal of Dermatology</i> ^c	Free ^d	3	4	4	3	3	17
	<i>Pediatric Dermatology</i> ^c	Free ^d	3	4	4	3	3	17
	<i>MyDermPath</i> ^c	Free	4	4	4	4	4	20
References	Dermatology Database ^c	Free	4	4	3	4	4	19
	VisualDx ^c	Free	4	4	4	4	3	19
	RightSite ^c	Free	3	2.5	3.5	3.5	4	16.5
	Fitzpatrick's Color Atlas ^c	Free ^d	3	4	4	3	2	16
	Usatine Medical Photo Library ^c	Free	2.5	2	3	2.5	4	14
	Cyberderm ^c	Free	3	3	3	2	3	14
	Dermie ^c	Free	2.5	2	2	3	4	13.5
	Animated Medical Dictionaries ^c	Free ^d	2	2	3	2	3	12
	A2Z of Dermatology ^c	\$1.99	2	2	3	1	3	11
	Podcast	AAD Dialogues in Dermatology ^c	Free ^d	3.5	4	4	2.5	2.5

^aSkin cancer category.^bCosmetic dermatology category.^cGeneral dermatology category.^dFree to download but contains in-app purchases.

TABLE 2. Graded Review of Interactive Mobile Applications (Apps)

Format	Mobile App	Cost	Mean Score					Total Score
			Educational Objectives	Content	Accuracy	Design	Conflict of Interest	
Games	Rash Decisions ^a	Free ^b	3	3	3	4	3	16
	DiagnosUs ^a	Free	3	2	2	3	4	14
	The Unusual Suspects ^c	Free	2	1	3	3	4	13
Learning modules	Medical Student: Dermatology ^a	Free	3	3	3	3	4	16
	Dermatology by Dr. Manish Soni ^a	Free ^b	3	3	3	1	2	12
	Anatomy: Integumentary System ^a	\$2.99	1.5	2	2.5	2	3	11
	Integumentary System Biology ^a	\$2.99	1.5	2	2.5	2	3	11
	Integumentary System Trivia ^a	\$1.99	1	2	2.5	2	3	10.5
Self-evaluation	iDoc Academy ^a	Free ^b	1	1	3	2	2	9
	DermScribe ^a	Free	3.5	3	4	2.5	4	17
	Dermatology Reviews ^a	Free ^b	3.5	2.5	4	3.5	2	15.5
	Dermatology Exam Review: Q&A ^a	\$2.99	2	2	2.5	1.5	3	11
	Learning Dermatology Quiz ^a	\$1.99	2	2	2.5	1	3	10.5
	Skin Exam Review: Quiz and Notes ^a	\$2.99	2	1.5	2.5	1.5	3	10.5

^aGeneral dermatology category.

^bFree to download but contains in-app purchases.

^cSkin cancer category.

At the opposite end of the spectrum, *MyDermPath+* was a reference app with a total score of 20. The app cited credible authors with a medical degree (MD) and had an easy-to-use, well-designed interface, including a reference guide, differential builder, and quiz for a range of topics within dermatology. As a free download without in-app purchases or advertisements, there was no evidence of conflict of interest. The position of a dermatopathology app as the top dermatology education mobile app might reflect an increased emphasis on dermatopathology education in residency as well as a transition to digitization of slides.⁵

The second-highest scoring apps (total score of 19 points) were *Dermatology Database* and *VisualDx*. Both were references covering a wide range of dermatology topics. *Dermatology Database* was a comprehensive search tool for diseases, drugs, procedures, and terms that was

simple and entirely free to use but did not cite references. *VisualDx*, as its name suggests, offered quality clinical images, complete guides with references, and a unique differential builder. An annual subscription is \$399.99, but the process to gain free access through a participating academic institution was simple.

Games were a unique mobile app format; however, 2 of 3 games scored in the somewhat adequate range. The game *DiagnosUs*, which tested users' ability to differentiate skin cancer and psoriasis from dermatitis on clinical images, would benefit from more comprehensive content as well as professional verification of true diagnoses, which earned the app 2 points in both the content and accuracy categories. *The Unusual Suspects* tested the ABCDE algorithm in a short learning module, followed by a simple game that involved identification of melanoma in a timed setting. Although the design was novel and

interactive, the game was limited to the same 5 melanoma tumors overlaid on pictures of normal skin. The narrow scope earned 1 point for content, the redundancy in the game earned 3 points for design, and the lack of real clinical images earned 2 points for educational objectives. Although game-format mobile apps have the capability to challenge the user's knowledge with a built-in feedback or reward system, improvements should be made to ensure that apps are equally educational as they are engaging.

AAD Dialogues in Dermatology was the only app in the form of a podcast and provided expert interviews along with disclosures, transcripts, commentary, and references. More than half the content in the app could not be accessed without a subscription, earning 2.5 points in the conflict of interest category. Additionally, several flaws resulted in a design score of 2.5, including inconsistent availability of transcripts, poor quality of sound on some episodes, difficulty distinguishing new episodes from those already played, and a glitch that removed the episode duration. Still, the app was a valuable and comprehensive resource, with clear objectives and cited references. With improvements in content, affordability, and user experience, apps in unique formats such as games and podcasts might appeal to kinesthetic and auditory learners.

An important factor to consider when discussing mobile apps for students and residents is cost. With rising prices of board examinations and preparation materials, supplementary study tools should not come with an exorbitant price tag. Therefore, we limited our evaluation to apps that were free or cost less than \$5 to download. Even so, subscriptions and other in-app purchases were an obstacle in one-third of apps, ranging from \$4.99 to unlock additional content in *Rash Decisions* to \$69.99 to access most topics in *Fitzpatrick's Color Atlas*. The highest-rated app in our study, *MyDermPath+*, historically cost \$19.99 to download but became free with a grant from the Sulzberger Foundation.¹² An initial investment to develop quality apps for the purpose of dermatology education might pay off in the end.

To evaluate the apps from the perspective of the target demographic of this study, 2 medical students—one in the preclinical stage and the other in the clinical stage of medical education—and a dermatology resident graded the apps. Certain limitations exist in this type of study, including differing learning styles, which might influence the types of apps that evaluators found most impactful to their education. Interestingly, some apps earned a higher resident score than student score. In particular, *RightSite* (a reference that helps with anatomically correct labeling)

and *Mohs Surgery Appropriate Use Criteria* (a clinical decision support tool to determine whether to perform Mohs surgery) each had a 3-point discrepancy (data not shown). A resident might benefit from these practical apps in day-to-day practice, but a student would be less likely to find them useful as a learning tool.

Still, by defining adequate teaching value using specific categories of educational objectives, content, accuracy, design, and conflict of interest, we attempted to minimize the effect of personal preference on the grading process. Although we acknowledge a degree of subjectivity, we found that utilizing a previously published rubric with defined criteria was crucial in remaining unbiased.

Conclusion

Further studies should evaluate additional apps available on Apple's iPad (tablet), as well as those on other operating systems, including Google's Android. To ensure the existence of mobile apps as adequate education tools, they should be peer reviewed prior to publication or before widespread use by future and current providers at the minimum. To maximize free access to highly valuable resources available in the palm of their hand, students and trainees should contact the library at their academic institution.

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