

PEER REVIEW HISTORY

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ARTICLE DETAILS

TITLE (PROVISIONAL)	Use of gamification strategies and tactics in mobile applications for smoking cessation: a review of the United Kingdom mobile app market.
AUTHORS	Rajani, Nikita; Weth, Dominik; Mastellos, Nikolaos; Filippidis, Filippos

VERSION 1 - REVIEW

REVIEWER	Joep van Agteren South Australian Health and Medical Research Institute, Flinders University. Australia.
REVIEW RETURNED	13-Dec-2018

GENERAL COMMENTS	<p>This study examines gamification methods for mHealth interventions for smoking cessation. Apps were downloaded for Android and IOS, and assessed using Cugelman's 2013 editorial on gamification and its relevance to behaviour change. It is an interesting topic to address, and targets and important aspect of mhealth interventions.</p> <p>The main part that I am missing is an indication of the quality of the apps that were used, using scales such as the MARS tool (https://mhealth.jmir.org/article/downloadSuppFile/3422/14733), for the reason that there are a lot of low quality apps developed; apps which are not evidence based and not in line with main smoking cessation guidelines. The literature on quality and smartness of apps in smoking cessation is quite extensive. Using the five star rating is a great start, but it is not sufficient to indicate the quality of the apps. It is important to know whether rigorously built and evaluated app score high on gamification (or not).</p> <p>Similarly, it would be good to have an indication of which of the included apps have a scientific background (IE are tested as part of a study/have manuscripts written about them). Having a list of all included apps would be recommended, preferably in the manuscript, but otherwise as part of online supplementary material. Some scientific smoking apps are developed in the UK and should be available in the UK market. Also, I'd like to see the 7 features of each app mapped out for each of the included studies in a supplementary file.</p> <p>While this requires considerable changes to your manuscript, the nature of your study (IE a review) should allow you to make these additional changes. I would recommend the article suitable for publication, but only if the overarching comments above, as well as the more detailed comments below are addressed.</p> <p>Abstract</p> <p>I am not sure if I would go as far as calling Cugelman's editorial a proposed framework: he examined whether gamification as a whole</p>
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	<p>can be a promising framework, and indicated strategies, tactics and criteria that one can consider.</p> <p>The abstract will need revising in line with the overarching comments mentioned above.</p> <p>Methods:</p> <ul style="list-style-type: none">• Add a sentence on how you determined low, medium and high gamification.• Explain the difference between strategies and tactics, although I am inclined to• You specify that you performed chi square tests, but did not report on any chi square results in the results. Either remove, or add information on difference between platforms <p>Strengths and limitations</p> <ul style="list-style-type: none">• The first bullet point is inaccurate. It only has been sparsely investigated in relation to gamification. There are dozens of studies on mHealth solutions for smoking cessation <p>Introduction</p> <ul style="list-style-type: none">• Ln 31: mHealth solutions do not eliminate the need for face-to-face support, but rather are a compliment to existing service offerings.• Ln13: are the games you mention scientific? IE do they have publications attached to them? If so, find the academic references. If not, try and find games that have a scientific backing. Anyone can make games that look like mHealth solutions, but quality control is important, which is substantially increased (although not guaranteed) when having academic publications attached to them.• Ln 36: add a reference to back up your claim that gamification is increasing. For instance, Edwards et al (https://bmjopen.bmj.com/content/6/10/e012447) do not agree with this notion. I suggest you refer to this article (perhaps even already in the previous paragraph where you talk about specific studies on gamification)• LN 43: reviews might not have assessed gamification, but they have tested functionality that is associated with gamification (e.g. social networking, goal setting). Please nuance your sentence• LN 45: Reviews are not THAT outdated. Some have been published within the last 1.5 years. Also, it contradicts your own methodology. You rely on a Cugelman's recommendations which were published in 2013, based on research conducted well before that. M- and eHealth development has advanced sincerely. <p>Methods</p> <ul style="list-style-type: none">• In 14: explain what 42matters does. The sentence is too abstract.• Ln28: define what an identification number is.• Ln56: what does 'app was irrelevant' mean?• Ln 56: why was hypnosis excluded? Provide reasoning• Ln 8: where any of the apps available on both platforms? If not, that is an interesting finding to report. If yes, please indicate.• General functionalities section: ensure it is written in past tense.• Ln51: are images and text the only way apps provided information (under item 4)?• Using the apps for only 30 minutes per day, and only reviewing it (for how long?) the next day is a limitation if the apps would have comprehensive multi-day programs included? Was this the case? Would you expect this to affect your scoring of gamification principles? <p>Results</p> <p>Other than the requested adjustments mentioned in the overarching comments focusing on including quality of the apps, whether they have a scientific basis, and what the difference is in scores on gamification between quality and non-quality apps, the following was noted.</p>
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	<ul style="list-style-type: none"> • Ln25: indicate the exact number of apps that used social communities. The use of social networks in smoking cessation is a big topic, so getting insight into how many would have used it is important <p>Discussion</p> <p>I'd like to see the discussion talk about the difference in quality and non-quality apps, and should be changed accordingly. Other points:</p> <ul style="list-style-type: none"> • Ln 16. There are papers on behaviour change techniques that have been applied to smoking cessation settings, e.g. one in COPD patients, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4253323/ . These also indicate self-monitoring and are therefore a more suitable reference than interventions for dietary and physical activity interventions • LN 57: add references on why social networks can drive user engagement. • Ln 8 to 17: this paragraph consists of two sentences that have been repeated a couple of times in different forms. Without any references. Please revise. • Ln 30: is it gamification that helps add to smoking cessation being a cost-effective method, or is it persuasive design in general (of which gamification is a part) that helps boost engagement? • LN52: I am not sure whether tobacco control policy maker are needed here. You should want to have qualified smoking cessation experts/researchers, as tobacco control experts do not always focus on smoking cessation. <p>The discussion is not very parsimonious: a lot of sentences are repeated in different forms. Try and make some of the sections more succinct. Also it needs bolstering with adequate references.</p> <p>Conclusion</p> <ul style="list-style-type: none"> • LN36: "is adopted amongst just over half of the smoking cessation apps" • Why do you leave 'tobacco control policy makers' out the conclusion, but mention them in the discussion.
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REVIEWER	Edwin Boudreaux UMass Medical School, USA
REVIEW RETURNED	18-Dec-2018

GENERAL COMMENTS	<p>Strengths: This paper focused on understanding the level of gamification present in commercially available smartphone applications to assist smoking cessation is well conceived, well written, and contributes to our understanding of the current state of mHealth and smoking. The screening process and eligibility criteria for the apps seemed to be appropriate. and resulted in a pool of apps likely to represent those apps readily available to and most likely to be downloaded by most smokers in the UK who are interested in a smoking cessation app. The use of Cugelman's model adds rigor, transparency, and replicability to the results.</p> <p>Weaknesses: (1) The exclusive focus on apps available in the UK weakens representativeness. Some understanding of how the UK market and markets in other countries would help to mitigate this weakness.</p> <p>(2) Only two days of testing might miss some features, a weakness that was acknowledged. A longer testing of some random sampling of those initially classified as low and moderate gamification may have strengthened thoroughness and understanding of differences between short and long term use. (3) No effort was made to correlate gamification scores with user</p>
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	<p>ratings. This may have been because of the truncated range that resulted in excluding apps with <4.0, but it still would have improved the impact of the study, especially since the hypothesis that gamification improves engagement and effectiveness of health related apps remains a speculative assertion not currently backed up with data.</p>
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VERSION 1 – AUTHOR RESPONSE

Reviewer 1: Joep van Agteren

This study examines gamification methods for mHealth interventions for smoking cessation. Apps were downloaded for Android and IOS, and assessed using Cugelman's 2013 editorial on gamification and its relevance to behaviour change. It is an interesting topic to address, and targets an important aspect of mhealth interventions.

The main part that I am missing is an indication of the quality of the apps that were used, using scales such as the MARS tool (<https://mhealth.jmir.org/article/downloadSuppFile/3422/14733>), for the reason that there are a lot of low-quality apps developed; apps which are not evidence based and not in line with main smoking cessation guidelines. The literature on quality and smartness of apps in smoking cessation is quite extensive. Using the five-star rating is a great start, but it is not sufficient to indicate the quality of the apps. It is important to know whether rigorously built and evaluated app score high on gamification (or not).

Response: The focus of the mobile app review was to examine the state and extent of gamification use amongst mobile apps for smoking cessation. Examining the overall quality of mobile apps is beyond the scope of our review. The five-star rating was not necessarily used as an indication of quality of the apps but rather to ensure that apps that are assessed in the review are those that are most likely to be used by smokers seeking to quit. Since we cannot re-assess apps (as apps have been updated, changed, or could also no longer be available since the time of download), we are not able to include an assessment of quality to our mobile app review, unless we conduct the entire review from scratch. The reviewer does make a good suggestion and we have now emphasized this as a limitation in the discussion section and mentioned it as a good avenue for future research. The inclusion of Five A guidelines (see next comment), together with the star rating may address some of the comments around the issue of quality.

Similarly, it would be good to have an indication of which of the included apps have a scientific background (IE are tested as part of a study/have manuscripts written about them). Having a list of all included apps would be recommended, preferably in the manuscript, but otherwise as part of online supplementary material. Some scientific smoking apps are developed in the UK and should be available in the UK market. Also, I'd like to see the 7 features of each app mapped out for each of the included studies in a supplementary file. While this requires considerable changes to your manuscript, the nature of your study (IE a review) should allow you to make these additional changes. I would recommend the article suitable for publication, but only if the overarching comments above, as well as the more detailed comments below are addressed.

Response: We did assess adherence to Five A guidelines during our data extraction phase. Five A guidelines are globally accepted as a tool to inform and develop health behaviour change interventions and have been extensively applied to smoking cessation. Although adherence to

guidelines is a topic that we have explored in a different manuscript (currently in press), we believe that the level of adherence to these guidelines serves as a good indicator for whether the included apps have a scientific background (i.e. are evidence-based). Therefore, we have now included the Five A guidelines in the methods, results and discussion. We also calculated correlation coefficients to see whether the level of gamification was associated to adherence to the Five A guidelines (i.e. scientific input) and we found weak relationships between the two. We have now reported these coefficients in the results section. We have also included a supplementary table which includes a list of all apps and the number of gamification tactics, strategies, and adherence to the Five A guidelines for each app.

Abstract

I am not sure if I would go as far as calling Cugelman's editorial a proposed framework: he examined whether gamification as a whole can be a promising framework, and indicated strategies, tactics and criteria that one can consider.

Response: Instead of framework, Cugelman's work has been referred to as architecture as this is what the author calls it in his paper. By identifying the active ingredients and strategies of gamification, Cugelman develops an architecture of gamification. We have removed the reference to Cugelman from the abstract to avoid confusion.

The abstract will need revising in line with the overarching comments mentioned above.

- Add a sentence on how you determined low, medium and high gamification.

Response: Due to the word count restriction, details on what constitutes low, medium and high gamification has been included into the methods section. Further information on the creation of these categories has now been added.

- Explain the difference between strategies and tactics, although I am inclined to

Response: Due to the word count restriction for the abstract, only a brief sentence has been included to indicate the difference between the two. A more detailed explanation is included in the main methodology section of the paper.

- You specify that you performed chi square tests, but did not report on any chi square results in the results. Either remove, or add information on difference between platforms

Response: Information regarding the difference between platforms through chi-square tests has now been included in the results section of the abstract as suggested by the reviewer.

Strengths and limitations

- The first bullet point is inaccurate. It only has been sparsely investigated in relation to gamification. There are dozens of studies on mHealth solutions for smoking cessation

Response: The bullet point has now been amended.

Introduction

- Ln 31: mHealth solutions do not eliminate the need for face-to-face support, but rather are a compliment to existing service offerings.

Response: This is now been amended to clarify that they do not eliminate but rather complement cessation services.

- Ln13: are the games you mention scientific? IE do they have publications attached to them? If so, find the academic references. If not, try and find games that have a scientific backing. Anyone can make games that look like mHealth solutions, but quality control is important, which is substantially increased (although not guaranteed) when having academic publications attached to them.

Response: All the mentioned apps have been studied empirically and are found in the literature. The citations for each of these are now included in the manuscript. Furthermore, we have expanded on two of the apps: Zombies, Run! and SPARX to emphasize that the apps have scientific backing, as suggested by the reviewer who makes a valid point regarding quality control.

- Ln 36: add a reference to back up your claim that gamification is increasing. For instance, Edwards et al (<https://bmjopen.bmj.com/content/6/10/e012447>) do not agree with this notion. I suggest you refer to this article (perhaps even already in the previous paragraph where you talk about specific studies on gamification)

Response: We have now added a reference (Lister et al., 2014) to back up our claim that the use of gamification in healthcare has been increasing. We referred to both Lister et al. 2014 and the paper suggested by the reviewer (Edwards et al., 2016) in the introduction as existing reviews on gamification use in health apps.

- LN 43: reviews might not have assessed gamification, but they have tested functionality that is associated with gamification (e.g. social networking, goal setting). Please nuance your sentence

Response: The statement refers specifically to mobile app reviews for smoking cessation apps available on the UK market. Adjustment has been made to ensure that there is clarity regarding this.

- LN 45: Reviews are not THAT outdated. Some have been published within the last 1.5 years. Also, it contradicts your own methodology. You rely on a Cugelman's recommendations which were published in 2013, based on research conducted well before that. M- and eHealth development has advanced

sincerely.

Response: We have removed the word outdated in the manuscript and adjusted the text accordingly to improve clarity.

Methods

- In 14: explain what 42matters does. The sentence is too abstract.

Response: A sentence to explain what 42matters does has been included in the manuscript.

- Ln28: define what an identification number is.

Response: Identification numbers were assigned by 42matters to identify each unique app. This has now been added to the manuscript to clarify what an identification number is.

- Ln56: what does 'app was irrelevant' mean?

Response: Apps were considered irrelevant when they had nothing to do with smoking cessation but were still captured by the software due to the inputted search terms. Examples of irrelevant apps include but are not limited to apps that are online vape shops, apps about restaurants or bars that specify in their description that they are non-smoking, apps that use the term smoking as an adjective etc. This has now been clarified in the manuscript.

- Ln 56: why was hypnosis excluded? Provide reasoning

Response: Hypnosis is not an evidence-based strategy for smoking cessation. The rationale for excluding hypnosis apps has been clarified in the manuscript.

- Ln 8: where any of the apps available on both platforms? If not, that is an interesting finding to report. If yes, please indicate.

Response: There are three apps which were found in both platforms (Quit Genius, Kwit and QuitNow!). Apps were still assessed independently by two reviewers as slight variations do exist for the same app on Android and iOS. We have now indicated this in the manuscript.

- General functionalities section: ensure it is written in past tense.

Response: This has now been amended.

- Ln51: are images and text the only way apps provided information (under item 4)?

Response: Images, text and any other information provided on the main webpage was used to apply preliminary exclusion criteria.

- Using the apps for only 30 minutes per day, and only reviewing it (for how long?) the next day is a limitation if the apps would have comprehensive multi-day programs included? Was this the case? Would you expect this to affect your scoring of gamification principles?

Response: We added how long the app was reviewed for the next day. As stated by the reviewer, this is a limitation and it could be that some gamification elements were not recorded as they were only presented by the app after longer use. Therefore, it is likely that our approach underestimated the extent of gamification that was present in the mobile apps. We have ensured that this weakness is clearly mentioned in the discussion and suggested how future research could address this issue.

Results

Other than the requested adjustments mentioned in the overarching comments focusing on including quality of the apps, whether they have a scientific basis, and what the difference is in scores on gamification between quality and non-quality apps, the following was noted.

Response: We have now described whether apps adhere to the Five A guidelines (i.e. an indicator of scientific basis), and checked to see whether there was a correlation between level of adherence to scientific guidelines and gamification. We found weak correlations between the two and have reported this in the results section.

- Ln25: indicate the exact number of apps that used social communities. The use of social networks in smoking cessation is a big topic, so getting insight into how many would have used it is important

Response: The exact number of apps has now been included in the manuscript.

Discussion

I'd like to see the discussion talk about the difference in quality and non-quality apps, and should be changed accordingly. Other points:

- Ln 16. There are papers on behaviour change techniques that have been applied to smoking cessation settings, e.g. one in COPD patients, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4253323/> . These also indicate self-monitoring and are therefore a more suitable reference than interventions for dietary and physical activity interventions

Response: We now included three additional references, including the one suggested by the reviewer, that are more suitable as they refer to research regarding smoking cessation.

- LN 57: add references on why social networks can drive user engagement.

Response: We have now referred to studies that have investigated the impact of social networking sites and features on user engagement. We have also discussed why social networks can impact health behaviour change.

- Ln 8 to 17: this paragraph consists of two sentences that have been repeated a couple of times in different forms. Without any references. Please revise.

Response: As suggested by the reviewer, we have now revised these lines. We have conveyed our point more concisely and we have also added scientific backing for our claim.

- Ln 30: is it gamification that helps add to smoking cessation being a cost-effective method, or is it persuasive design in general (of which gamification is a part) that helps boost engagement?

Response: We agree with the reviewer's comment and have edited the sentence to communicate that gamification may contribute to persuasive design, which in turns can boost engagement.

- LN52: I am not sure whether tobacco control policy maker are needed here. You should want to have qualified smoking cessation experts/researchers, as tobacco control experts do not always focus on smoking cessation.

Response: Since tobacco control experts do not always focus on cessation, we have now amended this in the discussion to include smoking cessation experts and researchers.

The discussion is not very parsimonious: a lot of sentences are repeated in different forms. Try and make some of the sections more succinct. Also it needs bolstering with adequate references.

Response: We have now made significant changes in the discussion to ensure that sentences are not repeated and arguments are made more concisely. We have also included several more references to back up our claims scientifically. Additionally, we have improved our section on the limitations of our study and included ways in which future research could address these limitations.

Conclusion

- LN36: "is adopted amongst just over half of the smoking cessation apps"

Response: This amendment has been made.

- Why do you leave 'tobacco control policy makers' out the conclusion, but mention them in the discussion.

Response: Tobacco control policy makers have been removed from the discussion as well.

Reviewer 2: Edwin Boudreaux

Please state any competing interests or state 'None declared': None declared

Strengths:

This paper focused on understanding the level of gamification present in commercially available smartphone applications to assist smoking cessation is well conceived, well written, and contributes to our understanding of the current state of mHealth and smoking. The screening process and eligibility

criteria for the apps seemed to be appropriate. and resulted in a pool of apps likely to represent those apps readily available to and most likely to be downloaded by most smokers in the UK who are interested in a smoking cessation app. The use of Cugelman's model adds rigor, transparency, and replicability to the results.

Weaknesses:

(1) The exclusive focus on apps available in the UK weakens representativeness. Some understanding of how the UK market and markets in other countries would help to mitigate this weakness.

Response: We were unable to find another mobile app review (focusing only on evaluating mobile apps) which looked at a different geographical app market and investigated the level of gamification in smoking cessation apps. Therefore, we were unable to make any direct comparisons regarding this aspect. We have amended the manuscript to put more emphasis on this weakness. Additionally, since there are some mobile app reviews focusing on smoking cessation apps outside of the UK, mostly focusing on general app characteristics and adherence to treatment guidelines, we have now included some comparisons.

(2) Only two days of testing might miss some features, a weakness that was acknowledged. A longer testing of some random sampling of those initially classified as low and moderate gamification may have strengthened thoroughness and understanding of differences between short- and long-term use.

Response: This is a valid point by the reviewer. We have acknowledged this in the discussion and put further emphasis on this limitation. We have now amended the manuscript to suggest how future research could address this weakness.

(3) No effort was made to correlate gamification scores with user ratings. This may have been because of the truncated range that resulted in excluding apps with <4.0, but it still would have improved the impact of the study, especially since the hypothesis that gamification improves engagement and effectiveness of health-related apps remains a speculative assertion not currently backed up with data.

Response: Our aim was to ensure that we evaluate apps that are the most popular and therefore most likely to be used by smokers seeking to quit. For that reason, we excluded apps that had a rating lower than 4 stars. Due to our exclusion criteria, we do not think that correlating gamification scores with user ratings would yield meaningful results, as the range of star ratings is rather narrow. However, this weakness is well-noted and we have amended the manuscript to include how future research could address this limitation. As mentioned in a previous comment by the other reviewer, we have estimated the association between gamification and adherence to cessation guidelines, which provides some additional value to our review.