

PREGLED MOBILNIH APLIKACIJ S PODROČJA ONESNAŽEVANJA OKOLJA

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Onesnaževanje okolja je težava, ki ne vpliva samo na okolje ampak tudi na zdravje ljudi. Za zmanjšanje negativnih vplivov je pomembno okoljsko ozaveščanje ljudi, tudi z uporabo široko dostopnih mobilnih aplikacij. Mobilne aplikacije smo pregledali v mobilnih trgovinah Google Play in iOS app z uporabo ključne besede »pollution«. Pri pregledu smo sledili priporočilom PRISMA. Aplikacije smo ocenili z uporabo vprašalnika Mobile Application Ration Scale (user version). Mobilne aplikacije so obsegale različne tipe onesnaževanja. Po pregledu smo izbrali 8 aplikacij, ki so se nanašale na onesnaževanje okolja. Ugotovili smo, da je splošna kakovost aplikacij dobra, pri čemer so bile dosežene ocene med 3.06 (± 0.23) in 4.35 (± 0.08). Najbolje ocenjena aplikacija je bila Earth Hero: Climate Change. Zaradi razširjenosti uporabe mobilnih aplikacij, jih je smiselno uporabljati za vzpodbujanje okoljske ozaveščenosti prebivalcev. V prihodnjih raziskavah bi se bilo smiselno osredotočiti na posamezne tipe onesnaževanja in oceniti kakovost pri uporabnikih.

Ključne besede:

onesnaževanje
okolja,
mobilne
aplikacije,
zdravje
ljudi,
negativni
vplivi,
priporočila

REVIEW OF MOBILE APPLICATIONS IN THE FIELD OF ENVIRONMENTAL POLLUTION

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Environmental pollution is a problem that affects not only the environment but also human health. To reduce the negative impacts, it is important to raise people's environmental awareness, including using widely available mobile applications. Mobile apps were reviewed in the Google Play and iOS app stores using the keyword "pollution". The review followed PRISMA recommendations. The apps were evaluated using the Mobile Application Rating Scale questionnaire (user version). Mobile applications encompassed different types of pollution. After screening, we selected 8 apps that were relevant to environmental pollution. We found the overall quality of the apps to be good, with scores ranging between 3.06 (± 0.23) and 4.35 (± 0.08). The top-rated app was Earth Hero: Climate Change. Given the widespread use of mobile apps, it makes sense to use them to promote environmental awareness among the population. Future research should narrow its focus to specific pollution types and assess user experience quality.

Keywords:
environmental
pollution,
mobile
applications,
human
health,
negative
impacts,
recommendations

1 Introduction

Environmental pollution is not new, but it is still the most serious problem and the most important environmental cause of morbidity and mortality (Ukaogo, et al., 2020). Pollution means the introduction of substances into the environment by humans, which may represent a danger to human health. Pollution can be classified in many ways, e.g. water pollution, air pollution, land pollution, food pollution, noise pollution and others (Appannagari, 2017). Many diseases are associated with environmental pollution. For some, the problem is the spread of diseases such as typhoid, while others are noncommunicable diseases such as asthma and cancer (Siddiqua, et al., 2022). Advances in mobile technologies could help users learn about the connections between pollution and health. Mobile applications are designed to be used on mobile devices that users often have with them and can reach (Delmas & Kohli, 2020). Mobile applications are important for raising awareness among the wider population, mainly because they are affordable, accessible, and easy to use. They are helpful not only to the general population, but also to researchers and policy makers in awareness and adaptation to climate change resulting from environmental pollution (Chakraborty & Chakravarty, 2017). Mobile applications often provide a feedback system and information regarding user behavior. They enable, for example, control of energy consumption or feedback on ecological driving and display of results or consequences of certain behavior (Brauer, et al., 2016). The authors of several papers evaluated mobile apps and suggested that there is a need for evaluation with reliable tools, as this can also promote the quality of information within mobile apps (Adam, et al., 2018; Bardus, et al., 2019). Evaluating mobile applications is also important, because the large number of applications makes it difficult to identify quality ones. Application popularity ratings and user reviews can often be subjective and do not provide enough information about the actual quality, so there is a need for evaluation with reliable tools (Stoyanov, et al., 2015). There are several mobile applications that are widely available and provide information on the topic of pollution. Our aim was to review the mobile applications in the Google Play and iOs app stores, select those that relate to different types of pollution and are freely available, and evaluate them using a questionnaire.

2 Methods

We conducted a review of mobile apps in the Google Play and iOS app stores using the keyword "pollution". During the review, we followed the PRISMA recommendations (Page, et al., 2021). We included mobile applications that related to the topic of pollution, were in Slovenian or English language and were freely available. We excluded paid applications, games and those that were technically or content inadequate.

In total, we found 783 applications that are related to pollution in general in mobile stores. We acquired 441 applications in the Google Play (227 on the phone and 214 on the tablet) and 342 applications in iOS app store (171 on the phone and 171 on the tablet). We removed 196 duplicates, leaving 587 apps that we reviewed by name and icon. This left 403 applications, the suitability of which was checked based on the description and assessed for eligibility. Based on the exclusion criteria (games, other foreign language, inappropriate content, and paid applications), we excluded 395 applications and included 8 in the final review (Figure 1).

Application evaluation was performed by three authors independently. We evaluated each item of each section. We calculated the average of the grades and the standard deviation for all of them. Based on the total evaluations, we determined the highest and lowest ranked mobile applications. To evaluate mobile applications, we used Mobile Application Rating Scale (user version). It contains engagement, functionality, aesthetics, and information mean score. The items are evaluated on a 5-point Likert scale from inadequate to excellent. Based on the mentioned scores, it is calculated app quality mean score. Section A (engagement) assesses entertainment, interest, customisation, interactivity, and target group. Section B (functionality) assesses performance, ease of use, navigation, and gestural design. Section C (aesthetics) includes layout, graphics, and visual appeal. Section D (information) contains quality of information, quantity of information, visual information, and credibility of source. Section E assesses app subjective quality, while section F contains the perceived impact items. We evaluated the application sections in Excel by calculating mean values.

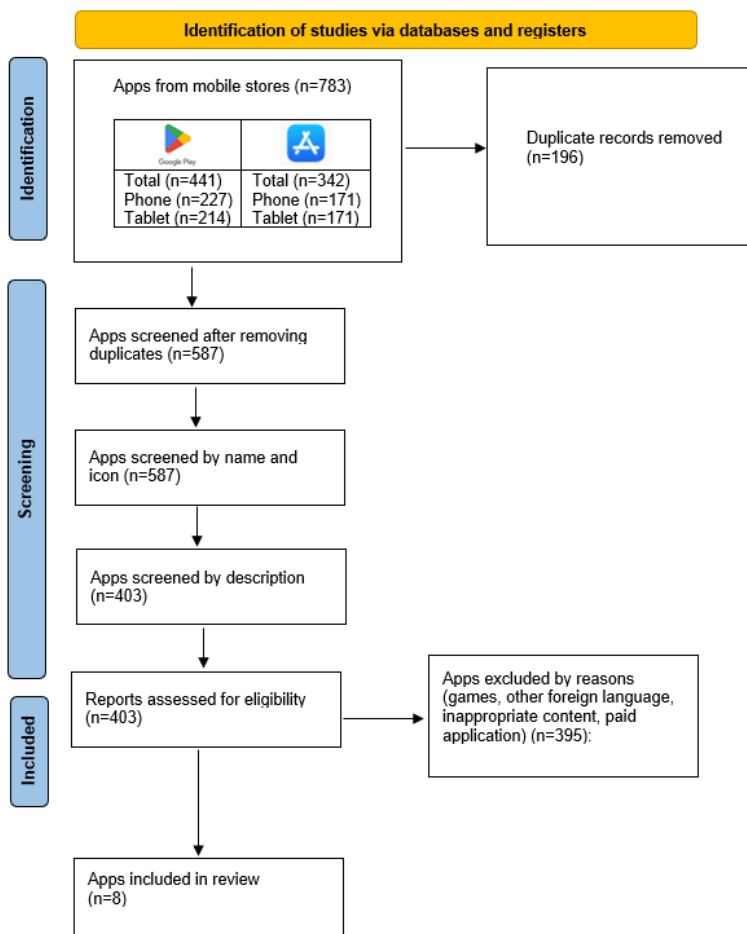


Figure 1: PRISMA flow diagram

Source: Page, et al., 2021



3 Results and discussion

The included applications were generally related to environmental pollution or to several aspects and not only to one type of pollution. Each application was evaluated by three reviewers using the Mobile Application Ration Scale questionnaire (user version). All included apps can be found in Google Play Store, while three of them (Environment Challenge, Environmental pollution, and Environmental Ecology)

are not in the iOS app store. Data on applications name and icon, first published, update, downloads, and user rating are shown in Table 1.

Table 1: Basic information about applications

Application name and icon	First published	Updated	Downloads	User rating
Earth Hero: Climate Change 	9 July 2019	9 December 2023	50.000+	4.8
Earth5R - The Environmental App 	27 January 2023	5 January 2024	10.000+	4.7
Environment Challenge 	4 July 2018	6 December 2023	100.000+	4.5
Environmental pollution 	19 September 2022	19 September 2022	500+	/
Climate Campaigners 	8 November 2022	9 February 2023	1.000+	3.6
Environmental Ecology 	14 December 2019	23 September 2022	10.000+	4.2
Pollution Reporter	9 September 2019	10 April 2022	100+	4.8

Application name and icon	First published	Updated	Downloads	User rating
				
Greenly - Carbon Footprint 	16 April 2020	20 August 2021	10.000+	3.7

Source: Own

Data on the mean scores of each section of the questionnaire by all three reviewers are shown in Table 2. The overall uMARS scores for the applications ranged from 3.06 (± 0.23) to 4.35 (± 0.08). Only one application achieved overall app quality above 4 (Earth Hero: Climate Change). Most applications received the highest score for functionality section, while most of them received the lowest score in engagement section.

Table 2: uMARS scores of the applications

Application name	uMARS section				
	Engagement mean score (SD)	Functionality mean score (SD)	Aesthetics mean score (SD)	Information mean score (SD)	Overall app quality (SD)
Earth Hero: Climate Change	4.47 (±0.31)	4.50 (±0.25)	4.44 (±0.38)	4.00 (±0.25)	4.35 (±0.08)
Earth5R - The Environmental App	3.53 (±0.31)	4.08 (±0.14)	3.67 (±0.00)	4.00 (±0.00)	3.82 (±0.09)
Environment Challenge	2.93 (±0.31)	3.92 (±0.38)	3.22 (±0.19)	2.83 (±0.38)	3.23 (±0.16)
Environmental pollution	2.40 (±0.53)	4.00 (±0.25)	3.33 (±0.58)	3.08 (±0.38)	3.20 (±0.28)
Climate Campaigners	3.53 (±0.12)	4.17 (±0.29)	4.00 (±0.00)	3.67 (±0.14)	3.84 (±0.07)
Environmental Ecology	2.27 (±0.70)	3.83 (±0.29)	3.22 (±0.19)	2.92 (±0.29)	3.06 (±0.23)
Pollution Reporter	3.87 (±0.42)	4.25 (±0.25)	3.33 (±0.00)	4.25 (±0.50)	3.93 (±0.17)
Greenly - Carbon Footprint	2.80 (±0.28)	3.63 (±0.18)	3.83 (±0.24)	3.38 (±0.18)	3.41 (±0.13)

Source: Own

Mobile applications have many options with which users can obtain reliable and fast information about pollution. In addition to mobile applications, there is already a mobile phone equipped with air pollution sensors that provides direct information from the environment (Nyarku, et al., 2018). More and more applications offer maps that show polluted areas and bring them closer to users. During the review of the applications, we noticed that many of them offer photos, graphic displays, and descriptions of the positive and negative impacts of environmental management. This is also noted by Wong, et al. (2021), who add that the active role and cooperation of users and the appropriate quality of information and photos are very

important for changes. As mobile applications develop rapidly, it is important to assess their quality (Agarwal, et al., 2021). Mobile Application Ration Scale questionnaire (user version) is often used, it was used e.g. to evaluate mobile applications for rheumatic patients (Lambrecht, et al., 2021), mobile applications to teach children basic life support (Fijačko, et al., 2021), mobile applications for calculating prostate cancer risk (Adam, et al., 2018), and mobile applications for weight management (Bardus, et al., 2019). Mobile applications that refer to environmental pollution and related content in articles are often not evaluated in terms of quality. We are, for example, found a review of applications relating to mobile phone data for the purpose of adapting cities to climate change (Dujardin, et al., 2020), a systematic review of mobile applications for sustainable waste management (Suruliraj, Nkwo & Orji, 2020), and monitoring ambient air pollution in asthmatic children by mobile applications (Lin, et al., 2023). Mobile applications are practical to use in everyday life and facilitate the monitoring and analysis of data relating to the environment and pollution (Akhmetov & Aitimov, 2015).

4 Conclusion

Due to their accessibility and increasingly widespread use, mobile applications are an effective tool for raising awareness about environmental pollution. Through the review of the applications, we found that they are generally of good quality and in most cases provide users with information related to environmental pollution. We believe that mobile applications are important for raising awareness, but at the same time it is important to continue to develop new ones that are equipped with quality sources of information. They should be evaluated with appropriate tools and questionnaires, because in this way suggestions for improvements are made. We also propose a review and assessment of mobile applications by individual types of environmental pollution, as this would make it easier and more transparent to provide information for users who are interested in more specific areas.

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