PESQUISA AGROPECUÁRIA GAÚCHA

AquaSafe: Aquaculture occupational safety and health in the palm of your hand

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Abstract - The main objective of this study was to develop a freely available mobile health software application and education platform in health and safety for aquaculture workers and managers. The application, called AquaSafe, was created in Portuguese and English for the Android system using the Java 8 programming language and the Android Studio development environment. AquaSafe content focusses on the identification of hazards and health risks, hazardous sources and preventive measures for occupational health and safety in the aquaculture sector. It has three predominantly interactive user interfaces to reinforce the main messages, which include games in the form of compliance checklists, quizzes and question-answer tools. The software is designed to act as a platform for assessment and management of occupational hazards, guide decision-making on simple techniques or measures to prevent injuries, diseases and fatalities during aquaculture activities. It is envisaged that the AquaSafe mobile software will contribute to the prevention of occupational injuries and diseases in aquaculture.

Key-words: Worker education. Mobile-health (m-health). Aquaculture risk prevention. Occupational hazards.

AquaSafe: Segurança e saúde ocupacional na aquicultura na palma da sua mão

Resumo - O principal objetivo deste estudo foi desenvolver um aplicativo de educação profissional disponível gratuitamente em saúde e segurança para *stakholders* de aquicultura. O aplicativo, chamado AquaSafe, foi criado em português e inglês, em sistema Android usando a linguagem de programação Java 8 e o ambiente de desenvolvimento Android Studio. O conteúdo do AquaSafe concentra-se na identificação de perigos e riscos para a saúde e medidas preventivas para saúde e segurança ocupacional no setor de aquicultura. Possui três interfaces de usuário predominantemente interativas para reforçar as principais mensagens, que incluem listas de verificação de conformidade, questionários e ferramentas de resposta a perguntas. O software foi projetado para atuar como uma plataforma para avaliação e gerenciamento de riscos ocupacionais, orientar a tomada de decisões técnicas ou medidas simples para evitar lesões, doenças e fatalidades durante as atividades laborais. AquaSafe pode ser uma ferramenta para a prevenção de lesões e doenças ocupacionais na aquicultura.

Palavras-chave: Educação do trabalhador. Aprendizagem móvel. Prevenção de risco em aquicultura. Perigos ocupacionais.

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Introduction

According to the United Nations Food and Agriculture Organization (FAO), it is estimated that 59.6 million people worked in the primary fisheries and aquaculture sector in 2016, with 19.3 million people engaged in aquaculture (FAO, 2018). The US National Institute for Occupational Safety and Health (NIOSH) Center for Maritime Safety and Health Studies estimated the marine aquaculture occupational fatality rate to be 15.1 per 100,000 workers and the occupational injury and illness rate at 6,051 per 100,000 workers (2011 to 2016) (NIOSH, 2018). Data from Brazil are scarce and underreported when available; between 2013 and 2015, 548 aquaculture related occupational incidents were reported (MINISTÉRIO DA FAZENDA et al., 2015).

Occupational health and safety (OHS) risks in aquaculture activity are diverse and include deaths from drowning, asphyxiation, chemical poisoning, crushing, electrocution; many types of injuries including slips/trips/falls and needlesticks from vaccinating fish; and occupational diseases such as musculoskeletal disorders due to poor ergonomics; skin and respiratory diseases; zoonotic infections; decompression illness and noise-induced hearing loss; illnesses related to extreme temperatures; and mental ill-health linked to working long hours in isolated and remote settings (NGAJILO; JEEBHAY, 2018). As a rapidly expanding sector, aquaculture still lacks specific and well-established industry programs for the use of health and safety equipment (OLIVEIRA et al., 2016). Aquaculture workers are more vulnerable to occupational injuries and diseases due to inadequate health and safety management systems and lack of OHS preventive protocols in this sector. Furthermore, governments in low-income countries are somewhat indifferent to instituting adequate OHS measures (MYERS; DURBOROW, 2012; OLIVEIRA et al., 2017). A cornerstone of prevention is the anticipation, recognition, evaluation and control of risks in the work environment (GUERTLER, 2017). Ongoing worker education and training aims to modify the behavior and work culture in relation to OHS risks.

Recent developments in mobile health (m-health) technologies, suggest that smartphone platforms can facilitate recognition and access to information, especially in remote settings such as aquaculture, thereby enhancing greater adherence to improved OHS practices (HALE; CAPRA; BAUER, 2015). Mobile learning, or M-learning, essentially entails learning through mobile and portable devices that promote unlimited access to information without restricting the locality of the individual (OZAN; YAMAMOTO; DEMIRAY, 2015). This allows for access to pedagogical resources, regardless of time and place (CLEOPHAS et al., 2015). M-learning could increasingly be used as one of the modalities for teaching and training in OHS practices as has been shown in other aquaculture work contexts (SEIXAS et al., 2015; POOCH et al., 2018).

The development of specific tools for the aquaculture sector using newly emerging technologies is timely, as it has the potential to directly affect improvements in not only worker health and safety but also productivity, worker quality of life, and has the potential to reduce costs of production. The main objective of this project was to develop an educational smartphone software to promote OHS practices in aquaculture.

Methodology

A freely available OHS educational mobile health software application on OHS practices was developed to be used in a smartphone by workers and managers involved in aquaculture. The software is currently available in Portuguese and English.

The content information on which the application is based was obtained through a detailed appraisal of the global scientific literature in relation to aquaculture health and safety. The application developed three interactive user interfaces, to promote learning through a quiz, a risk assessment checklist to guide improved health and safety management in the particular context of the user and a question-answer tool to identify the root cause of the OHS problem in a hierarchical manner (BAMFORD; GREATBANKS, 2005). The content, design and layout were developed by the project core team and piloted prior to finalization.

The application was developed for smartphones and tablets with an Android system, using the programming language Java 8 and the development environment of Android Studio (POOH et al., 2018). The selection criteria for choosing the operating system was also based on the Android platform as it was considered to be more cost-effective having , freely available software (Google Play Store). The initial version of this mobile application was based on the Android 4.0.3 Application Programming Interface (Ice Cream Sandwich) that reaches approximately 100% of active users based on data from the Google Play Store (ANDROID DEVELOPERS, 2018). The graphical interface was designed and developed according to Material Design's (GOOGLE DATABASE, 2017) metrics and recommendations for the application using standards already established in application development (POOH et al., 2018).

Results

The Aquasafe software application is freely available in Google play store (https://play.google.com/store/apps/details?id=br.gov.rs.ddpa_seapi.aquasaude.aquasafe).

It presents the main risks, personal protective equipment, and the legal requirements for workers and management on the main landing page (Figure 1). Users further navigate hazards icons to obtain more detail on what a risk entails, a classification of risks, and the hierarchy of control measures to mitigate these risks. Individual and collective protective equipment for use in aquaculture is included and a brief explanation of

each is provided for each measure. The workplace icon presents information on how to manage health and safety risks in the workplace (ILO, 2010). Information on the representation of workers in promoting health and safety is also described, outlining the main role and function of trade union representation and worker health, safety and environment (HS&E) representation, as well as the rights and obligations of governments, employers and workers related to HS&E (Figure 2). To increase awareness around child labor, AquaSafe also has warnings in relation to the prohibited use of child labor for aquaculture activities.

Interaction with the user takes place through three major interactive environments using the checklist, the quiz and the question-answer control tool. The checklist is divided for use by three main groups viz: general, management and workers. The general checklist has a set of guidelines provided according to the options selected by the user based on current working conditions prevalent at the workplace. Management checklists relate to the specific activity performed such as diving, chemicals and other risks, and advises the user on relevant corrective actions when these actions are not identified in the workplace. The checklist for workers has a focus on workers' rights and actions and also directs the user to relevant corrective measures. The quiz is designed as a series of questions in 'serious game' format, to support and facilitate learning.

Figure 1. Image of the application with different icons including risks, PPE and CPE, Checklists, Quiz.
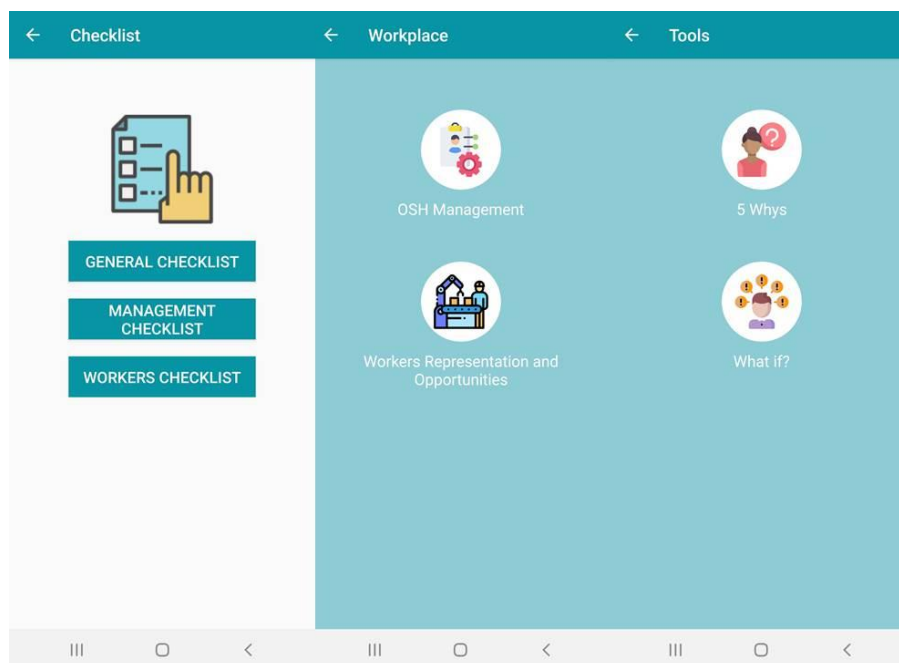
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Figure 2. Image of the screen with checklists, workplace and tools menu.

Two question-answer tools assist in making decisions and in finding the root cause of a problem. The 'five why tool' simply asks "Why" to a problem that has occurred, providing input to the root cause of the problem. Following from the root cause identification, the user identifies the appropriate action to reduce the probability of the problem happening again. "What if" is a simple technique for identifying and preventing risks. It entails evaluating the process flow conducted by individuals who are very familiar with the activity. For each activity evaluated, an adverse event is identified, and the software suggests possible causes and consequences and preventive measures to avoid or control the particular risk.

Discussion

The FAO Aquaculture Committee has identified Aquaculture Occupational Health and Safety (AOHS) as a global key priority as evidenced by the report commissioned to understand this sector to guide prevention and promote positive actions. Within this development, AquaSafe represents an important initiative to increase awareness and promote AOHS education and training among aquaculture workers, managers and apprentices using mobile technologies, particularly in low-income countries where such information is not easily accessible. To our knowledge this is the first mobile-health software application with a specific focus on aquaculture OHS globally.

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AquaSafe uses a platform to increase worker health care in aquaculture. Through a guided assessment and evaluation of occupational hazards, it supports decision-making in the methods and techniques chosen to minimize risks and contribute towards preventing occupational injuries or diseases as well as fatalities in the sector. Furthermore, it represents actions based on information, education, research, extension, development and transfer of technologies to advance health, with a primary focus on aquaculture OHS.

The software application was officially released and made available in the Google Play Store in February 2019. Within one week of released, the software application was downloaded by 178 users (83% of the downloads from Brazil). We are unable to assess the impact of the software application on individual workplaces or workers' awareness at this early stage.

AquaSafe is the first application that addresses aquaculture OHS and is currently available in English and Portuguese. The contents of the software application were developed using international standards. Nonetheless the differences in the legislative requirements of each country will have to be addressed for AquaSafe to have widespread application. The experiences from other international bodies (such as OSHA and NIOSH) involved in general occupational health and safety could also be applied to agricultural and aquaculture safety and health to further update the contents of the software application (REYES et al., 2016).

Mobile apps can help users self-monitor and motivate them to improve their workplace health and safety. In addition, mobile health apps have the potential to overcome compliance issues by interacting with the user frequently, promoting widespread and permanent accessibility. Therefore, workplace health promotion programs can be implemented through these applications (MELZNERA; HEINZEA; FRITSCHA, 2014).

Conclusion

AquaSafe, a freely available mobile health software application used as an educational platform, has the potential to become a valuable tool to contribute to the availability of reliable information for workers and managers in the aquaculture industry. Furthermore, the free and unrestricted availability of the mobile application could provide facilitated health and safety support to operators in the aquaculture industry who have access to smartphones.

Acknowledgements

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