Revolutionary Approach: Leveraging Artificial Intelligence and Gamification to Enhance the Capacity of Community Health Workers in Pakistan

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Abstract

Globally, artificial intelligence through gamification has shown remarkable progress in the field of health and medicine, especially in education and training; yet it still needs to be widely explored. In Lower-middle-income countries such as Pakistan, healthcare workers play an essential role in primary healthcare by delivering healthcare services at the doorstep. However, a greater challenge remains at hand for training and capacity building of health worker mainly due to limited resources and multiple other barriers. This scientific communication explores and recognizes the beneficial aspects of utilizing artificial intelligence and gamification for building the capacity of community health workers in Pakistan. It draws a comparison of medical training *versus* community health workers by analyzing the trends and existing literature over the course of 10 years. It has reported that the potential for improving performance and tackling challenges related to handling gadgets and devices. Moving forward, efforts need to be centered on building consumer-friendly and lightweight smartphones for integrating artificial intelligence and gamification through pilot projects and implementing them into existing Governement level Public Health Programs.

Keywords: *Healthcare workers, primary health care, gamification, capacity building and training, artificial intelligence.*

BACKGROUND

Community health workers (CHWs) play an essential role in delivering primary health care services at the grassroot level within the community in achieving Universal Health Coverage (UHC) and attaining Sustainable Development Goal (SDG). In Pakistan, CHWs, primarily known as Lady Health Workers, have now recognized worldwide as the foremost established CHW program. Through this program, more than 100,000 LHWs have been deployed in remote areas to deliver family planning services, maternal and child health care services, and conduct health education at the community level [1]. As depicted, CHWs vitally reduce inequities and disparity in access to essential health care services by catering 70 % of rural and periurban population. They have significantly improved immunization uptake and maternal and child health indicators.

However, in achieving UHC, there's a shortage of CHWs, particularly in Low- and Middle-Income Countries (LMICs), for instance, Sub-Saharan Africa has a shortage of 1.8 million health workers. At the same time, Uganda and Bangladesh also face deficits of CHWs below the WHO's recommended threshold [1]. Given the significance of the shortage, WHO and international partners have agreed that CHW programmes need to be strengthened and expanded by integrating standardized training and a robust monitoring system [1].According to the WHO's forecast, by 2030, there will be a global shortage of 18 million health workers [2]. LMICs such as Pakistan face a health worker shortage, relying on community cadres like Lady Health Workers (LHWs) and Community Midwives (CMWs) to fill gaps left by limited nurses and physicians. About 102,000 LHWs and only 12,000 CMWs are deployed, and, above all, LHW coverage is declining. Less than 60% of the target population receives services [3].

Furthermore, the training and capacity building of CHWs persists as a major challenge due to resource constraints and limited financial support, especially in Lower-Middle-Income Countries (LMICs) such as Pakistan. Globally, artificial intelligence through gamification has shown remarkable progress in the field of health and medicine, especially in education and training; yet it still needs to be widely explored [1]. Although to improve the quality of care at the community level, CHWs training remains insufficient, particularly within the weak health system of Pakistan [4, 5], due to financial challenges, compromised infrastructures, and ambiguous training plans [6]. Training and capacity building of CHWs still relies on traditional approaches like workshops, hands-on field experiences, and in-person modular sessions, although these methods are expensive, inefficient, time-consuming, shortage of skilled trainers and are problematic in scaling-up. Recent technology has evolved in medical and health sciences for tackling the barriers and structuring standardized training modules in resource-constrained areas [7]. Artificial intelligence in the field of medicine has improved diagnostic accuracy to 20 %, specifically in training [8]. AI- integrated modules and training programs provide customized training, feedback, monitoring, and learning process results in 25% enhancement in knowledge [9]. Moreover, gamification has incorporated innovative gaming

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mechanisms like interactive points and leaderboards in higher education system. Also, adapted for corporate training to not only motivate learners but also support them in achieving their learning goals effectively [10].

In a similar vein, AI-driven Gamification has shown promise in medical education and training. In light of their benefits, Brain Refresh Lab developed an AI-driven game, Fanta Training®, which remained effective in medical simulation and training in gynaecology and pediatric obstetrics [8]. Despite the widespread use of AI and gamification in medical training and education, their application in CHW training and capacity building remains underexplored. This scientific communication aimed to assess an approach to capacity building for health workers through AI and gamification. The communication compares the capacity-building of CHWs and medical training in Pakistan by analyzing trends in the existing literature over the last 10 years.

The findings of the study provide practical value to policy-makers and stakeholders by informing evidence-based decisions on integrating low-cost AI tools, enhancing the CHW training plan, and strengthening the community outreach primary care program in hard-to-reach areas, especially in low-resource settings. It guides towards effective, technology-driven CHWs capacity-building strategies.

METHODS

A Google Scholar search analysis was conducted using a search query based on Boolean operators (AND, OR), quotation marks (“”), and round brackets (), and a filter for publication year (*i.e.*, from 2015 to 2024), to assess the extent of research on AI and gamification in training and compare the CHW and Medical Training, key benefits and challenges for implementing in Pakistan over the past 10 years.

The search aimed to explore the use of AI, an umbrella terms for a wide-ranging set of technologies like Machine Learning (ML), Deep Learning and Natural Language Processing (NLP), and gamification in training contexts within Pakistan, and in the first step, studies were identified on training based on AI and gamification for CHW in Pakistan using the query, “Artificial Intelligence” AND “Gamification” AND “training” AND (“CHW” OR “community health worker”) AND “Pakistan”, which yielded 33 studies, then a related search focusing on medical training in Pakistan, using “Artificial Intelligence” AND “Gamification” AND “training” AND “medical training” AND “Pakistan”, resulted in 82 studies. In the next step, to understand the key benefits of implementing AI and gamification in CHW training, several targeted searches were conducted using combinations of benefit-related terms, the following numbers of studies were found: “Motivation” (45 studies), “Engagement” (58), “Performance” (54), “Flexibility” (19), “Adaptability” (14), and “Confidence” (44). In the end, searches were performed to identify implementation challenges associated with AI and gamification in CHW training *via* keywords related to challenges, the results showed “Connectivity” (17 studies), “Limited resources” (5), “Device” (38), “Usability” (34), “Acceptance” (47), and “Maintenance” (18).

DISCUSSION

AI-Gamified Learning for Skill Retention in Medical Trainees

Findings from a Google Scholar search indicate that most research on AI and gamification focuses on medical training rather than CHW training, highlighting a significant research gap. Despite the gap, it has been observed that research on AI and gamification for training was conducted after COVID-19, as indicated in Fig. **(1)**.

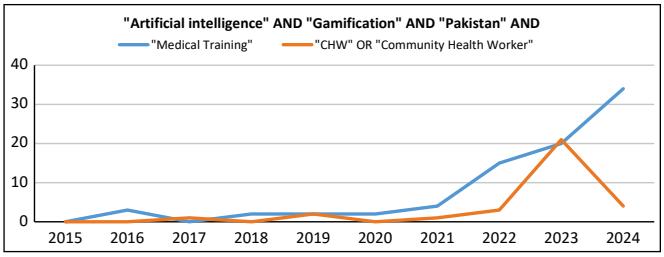

Fig. (1): Trends in AI and gamification in training: medical training *vs* community health workers (CHWs).

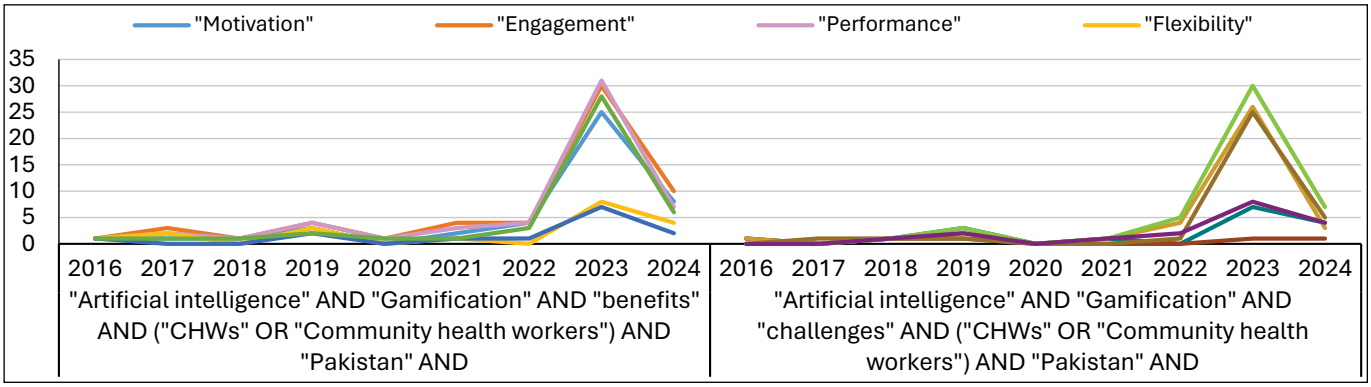

Fig. (2): Trends in the benefits and challenges of implementing AI and gamification in CHW training.

Table 1: Benefits and implementation challenges of AI and gamification in CHW training.

Challenges	Keyword	Definition
Benefits of AI and Gamification in CHW Training	Motivation	Learner's reason to become and remain engaged in activity related to learning [11]
	Engagement	Learner's level of involvement that is exhibited toward the learning process [11]
	Performance	Completing a specific task or an objective during the learning process or a near-absolute knowledge change that solidifies the successful transfer and retention of knowledge [12]
	Flexibility	Providing options in the educational environment, and tailoring a specific course considering the individual students' needs [13]
	Adaptability	Adjustments of individuals' cognition, emotion, and behavior, in response to uncertain and/or novel situations, conditions, and circumstances [14]
	Confidence	The sureness in oneself, and one's abilities and powers [15]
Implementation Challenges of AI and Gamification in CHW Training	Connectivity	Any reliable and secure link between devices [16].
	Limited Resource	Desired supplies, but have inadequate availability to the user [17].
	Device	An equipment with the ability to communicate, and able to sense and utilize data [18].
	Usability	Quality attribute that measures how easy User interfaces are to be used [19].
	Acceptance	The willingness of individuals and organizations to utilize and integrate technologies, such as AI, into their processes of decision-making [20].
	Maintenance	All the essential actions to restore or maintain an item to a specified state to perform a required function [21].

Benefits and Implementation Challenges of AI and Gamification in CHW Training

Findings from a Google Scholar search indicate the benefits of implementing AI and gamification in CHW training, along with the implementation challenges. Key features with impactful training include motivation, engagement, performance, and confidence, as compared to flexibility and adaptability, as explained in Fig. **(2)**. In the same way, the key implementation challenges of AI and gamification in CHW training are highlighted in the literature, with high attention given to acceptance, device, and usability. In comparison, maintenance, connectivity, and limited resources are less highlighted challenges, as indicated in Fig. **(2)**.

The potential benefits reported include improvements in performance, engagement, confidence, and motivation, despite challenges related to acceptance, devices, and usability for implementation and scaling, as depicted in Table **1**.

CONCLUSION

Before COVID-19, structured CHW training programs, including those under LHW program of Pakistan, were already involved in improving early disease detection, counseling related to maternal-child health, and adherence to community-based preventive practices, and all of these gains were linked to better retention of CHW knowledge, timely household follow-ups, and increased trust of community; however, most of these programs relied on traditional training methods with limited adaptability, tracking of the performance tracking or repetition.

The current communication reflects that while AI and gamification have demonstrated clear benefits in medical education, in the context of improved engagement, more substantial competency acquisition, real-time feedback, and better adherence to clinical protocols, but these innovations remain largely absent in CHW training systems, and by integrating such tools could directly enhance CHW performance by reinforcing critical behaviors, like recognition of danger signs or quality of counseling, standardizing competency checks, and increasing learning motivation, particularly in the context of low-literacy.

RECOMMENDATIONS

Moving forward, future programs need to be centered on AI-enabled tools for microlearning of CHWs tasks and training on prevention or outbreak of disease, surveillance, maternal and child health education. To ensure usability in remote and resource-constrained settings, digital innovation is required for building consumer-friendly, offline training modules and lightweight smartphones for integrating artificial intelligence and gamification through pilot projects and implementing them into existing Government level Public Health Programs. Prioritize funding dedicated to digital training innovations to ensure scalability beyond pilot phases and to embed digital training tools within existing government platforms, such as the National LHW Program, to enable institutional support, standardized supervision, and sustainable financing. To conclude, these steps can help bridge existing training gaps, reinforce CHWs' competencies, and ultimately strengthen population-level health outcomes in Pakistan and similar low-resource settings.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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