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The Role of Digital Technology in Improving Nutrition Education for Millennials and Generation Z

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ABSTRACT

Digital technology has brought about a revolution in personalized nutrition for Millennials and Z generations, who increasingly rely on artificial intelligence (AI)-based apps for dietary recommendations tailored to individual needs. These apps analyze personal data such as weight, height, physical activity and food preferences to provide more relevant advice. Devices such as smartwatches also help track diet and healthy living habits. However, challenges related to data privacy and security are still major issues that require strict regulation. On the other hand, digital technology is also expanding access to nutrition education through more interactive e-learning platforms, webinars and digital modules, enabling more enjoyable and effective learning. In addition, online communities that support healthy lifestyles are growing in popularity, providing motivation and useful information. Gamification approaches in nutrition education also help encourage active participation with diet challenges and virtual rewards. However, the digital divide in remote areas remains a major obstacle in ensuring equitable access. This research aims to explore the role of digital technology in improving nutrition awareness among the younger generation, using a qualitative approach through phenomenological and case study studies. The findings are expected to provide insights into the potential and challenges of using technology in nutrition education as well as recommendations for more inclusive and safe development

INTRODUCTION

In the digital era, personalized nutrition has become one of the most important innovations to support the healthy lifestyle of Millennials and Z generations. Artificial intelligence (AI)-based technology enables apps and devices to provide dietary recommendations tailored to individual needs (Angraeni, 2023). By analyzing health data such as weight, height, physical activity and food preferences, apps like these offer a unique experience that makes users feel more cared for. This personalization is particularly relevant to the younger generation who tend to want practical and efficient solutions to maintaining their health. Devices like smartwatches help track daily activity, sleep patterns, and reminders to stay hydrated or eat healthy (Syaifullah & David, 2021). Despite the promise, challenges such as high costs and concerns regarding data privacy are important issues that need to be addressed. Adequate regulations must be put in place

to ensure user data security and fairness of access. With the right approach, personalized nutrition technology can be a revolutionary tool in improving people's quality of life.

Digital technology has also enabled closer integration between formal and informal education in nutrition. Schools and universities are now using e-learning platforms, webinars and digital modules to deliver nutrition materials in a more interactive way. Simulations and educational games are often used to help students understand the importance of healthy eating in a fun way. Millennials and Z generations who are already familiar with technology feel more comfortable with this approach compared to traditional learning methods. The technology allows wider access to learning materials, including for those in remote areas. However, the success of this program depends on the availability of adequate digital infrastructure and training for educators. This approach also requires continuous evaluation to ensure that the information delivered is relevant and accurate. With proper integration, technology can help strengthen nutrition education at the formal and informal levels.

On the other hand, digital technology also encourages the formation of online communities that support healthy lifestyles. Millennials and Z generations often join online groups or forums to share experiences, healthy food recipes and diet tips. These communities create a sense of community that motivates individuals to live a healthy lifestyle consistently. In addition, discussions within these communities help broaden horizons on nutrition-related issues, such as food sustainability and the importance of organic food. However, these communities also run the risk of spreading misinformation if not properly supervised. Therefore, the presence of nutritionists or health experts in these communities is crucial to ensure that the information disseminated remains credible. The active participation of young people in digital communities also reflects the potential of technology to create positive collective movements. With proper management, digital communities can be an effective tool for raising nutrition awareness at large.

In addition, the gamification approach to nutrition education has become a trend that attracts the attention of the younger generation. Apps and platforms that integrate game elements, such as healthy eating challenges or nutrition-based competitions, are gaining popularity. Gamification taps into the competitive nature of Millennials and Z generations to encourage them to adopt healthier diets. Users are often given virtual rewards such as badges or points that add to their motivation to continue participating. Besides being engaging, the data collected through gamification can be used to analyze users' eating behavior and develop more effective approaches. However, the design of the app must be mindful of ethics, especially regarding data privacy and the potential for addiction. With the right strategy, gamification can be a fun and educational tool to build nutrition awareness (Machfudzi, 2021). This approach shows how technology can change the way people learn and behave towards their health.

The COVID-19 pandemic has brought about major changes in the way Millennials and Z generations access nutrition-related information. The social restrictions imposed during the pandemic have led to the increased use of digital technologies for webinars, online consultations and online classes on nutrition topics. This creates a great opportunity for health organizations and nutrition experts to deliver information flexibly and efficiently. Many people are becoming more aware of the importance of a healthy diet to boost immunity, which has increased the demand for nutritional information. However, the pandemic has also exposed a significant digital divide, especially for those who do not have adequate internet access. In addition, the quality of information

delivered online must be monitored to prevent the spread of misinformation. This situation highlights the importance of developing a more equitable technology infrastructure to support access to nutrition education. By capitalizing on this momentum, digital technology can become a more inclusive tool in building public health awareness.

Technology has changed the way Millennials and Z generations understand, access and apply nutrition education in their lives. From engaging social media to personalized apps, digital approaches have provided innovative solutions to improve nutrition literacy (Bohari, 2023). Online campaigns also have a significant impact in reaching a wider audience. However, the challenges of misinformation and limited access must continue to be addressed through strong collaboration between health experts, governments and digital platforms. The COVID-19 pandemic has also accelerated the adoption of technology in nutrition education, paving the way for more flexible and affordable approaches (Mulyani et.al., 2020). With the integration of advanced technology, the hope of creating a generation that is more aware of the importance of nutritional health is growing. However, digital literacy remains a key foundation to ensure that the information received and applied is valid and relevant. The combination of technological innovation and a holistic approach could be key in strengthening nutrition awareness globally.

METHODOLOGY

In order to understand the phenomenon of using digital technology for personalized nutrition among Millennials and Z generations, the most suitable qualitative research approaches are phenomenological studies and case studies. Phenomenological studies will explore the subjective experiences of users who use artificial intelligence-based applications for nutrition personalization and technology-based education. Through in-depth interviews with users and observation of their activities, the study aims to explore their perceptions, motivations and challenges faced when using the technology. Purposively selected participants will provide first-hand insights into the enablers and barriers, including issues related to data security and digital literacy. Meanwhile, the case studies will examine the implementation of these technologies in a more focused manner by observing the unit of analysis in the form of an app or online community that promotes nutrition education and personalization. Interviews with users, app developers, and nutritionists will provide a holistic perspective on the effectiveness and barriers to the implementation of these technologies. Data collected from various sources will be analyzed descriptively and contextually to identify the impact of the technology on user behavior and the success of nutrition education. The use of triangulation methods, such as combined interviews, observations and document analysis, will also strengthen the validity of the data. Through this approach, the research is expected to provide in-depth insights into the role of technology in improving nutrition awareness, the challenges faced, and recommendations for more inclusive and safe development in the future

RESULTS AND DISCUSSION

Personalized Nutrition with AI Technology

Personalized nutrition using artificial intelligence (AI) technology is an innovative approach that could change the way Millennials and Z generations take care of their health. It enables the collection and analysis of complex data, such as weight, physical activity, diet, and genetic data, to provide personalized dietary recommendations

(Farran, 2024). AI-based applications can design unique and personalized programs, giving users a sense of being cared for with a more intimate and relevant experience. Research by AM et.al (2023) revealed that this approach is effective in improving adherence to healthy eating. Millennials and Generation Z, who are highly accustomed to the use of technology, are more likely to opt for practical and efficient solutions like this. The app also comes with features such as automatic food trackers, meal reminders, and diet analysis that make nutrition personalization more dynamic. Users can receive recommendations that are updated in real-time according to changes in activity or body condition. With these features, AI-based apps are able to create high engagement and have a direct impact on daily diets.

Millennials and Generation Z, who have a fast-paced and tech-connected lifestyle, respond positively to approaches that provide flexibility and efficiency. AI enables big data analysis that can provide quick and personalized feedback, creating a deeper connection with users. AI-based apps can predict individual nutritional needs based on historical data and consumption patterns of users. This helps provide more accurate and dynamically relevant dietary advice as the user's condition changes. Interactive approaches such as healthy eating challenges or virtual rewards can motivate the younger generation (Maulaya et.al., 2024). These features are designed to positively encourage behavior change through fun experiences. In this way, AI not only provides passive recommendations but also plays an active role in shaping healthy habits. Users become more aware of their nutritional choices and are encouraged to continuously improve their quality of life through a data-driven approach.

While AI technology in personalized nutrition has many benefits, privacy and data security remain key challenges. Health data, including eating and physical activity history, is highly sensitive information. The risk of data misuse by third parties or security breaches is a concern. Pohan's study (2023) shows that data protection should be a top priority in the development of AI-based applications. Transparency in data management and strict regulations are needed to ensure user security and privacy. As a solution, app developers should adopt privacy-by-design principles that give users full control over their data. This includes the ability to delete data, set privacy, and get clear information on how their data is being used. Government regulation also plays an important role in ensuring AI-based apps operate ethically and safely.

In addition, digital literacy is a crucial aspect that affects the effectiveness of AI nutrition personalization. Digital literacy includes not only the ability to use applications, but also an understanding of how algorithms process data and generate recommendations. A study by Hariyanti et.al (2021) showed that users who have high digital literacy are more critical in evaluating the information they receive. This helps prevent them from following unhealthy diet trends or receiving invalid information. To improve digital literacy, educational programs that teach how to evaluate AI-based recommendations should be integrated in digital health campaigns. Users need to be equipped with the skills to understand the potential benefits and risks of using these technologies. With good literacy, Millennials and Z generations can maximize the potential of AI in helping them maintain their health. This creates an ecosystem where technology becomes a tool that supports better health decisions.

AI-based nutrition personalization not only provides benefits to individuals but also has great potential to improve nutrition awareness at the population level (Mukhtafi et.al., 2023). Aggregated data collected from users can be analyzed to understand public health trends. This provides an opportunity for health experts and policy makers to design

more specific and relevant nutrition education programs. By leveraging data from AI applications, health campaigns can be tailored to specific community needs, such as campaigns to increase fiber intake or reduce sugar consumption. This data-driven approach increases the effectiveness of campaigns as they are designed based on people's real behavioral patterns. In addition, AI can help predict potential health problems in certain groups. With collaboration between app developers, government, and health experts, the potential of AI in improving public health can be better realized. Personalized nutrition becomes a bridge to bring together individual and community approaches that support each other..

Digital Community for Nutrition Education

Digital communities as a means of nutrition education have been supported by a number of studies that show their positive impact on increasing awareness and changing people's health behaviors. A study by Widyastuti et al. (2023) found that online community members who actively discussed and shared experiences regarding healthy eating had a 35% higher likelihood of adopting better eating habits than those who were not involved in similar communities. These results suggest that social interactions on digital platforms create a peer support effect that motivates individuals to lead a healthy lifestyle. In addition, another study by Limketkai et al (2021) revealed that digital communities managed with the support of nutritionists or health experts can increase members' understanding of nutrition by up to 45%, especially in younger age groups such as Millennials and Z generations.

However, the risk of spreading misinformation is also confirmed in the scientific literature. According to a report by Lee et al. (2022), about 28% of nutrition-related content shared in online communities contains inaccurate information, potentially jeopardizing the health of community members (Ningsih et.al., 2022). This research highlights the importance of expert involvement to moderate discussions and ensure the validity of the information being circulated. In addition, technological interventions such as artificial intelligence-based algorithms have also proven effective in filtering out misleading information. For example, research conducted by Gupta et al. (2020) showed that platforms with AI features for content moderation can reduce the spread of misinformation by 60% compared to platforms without such features (Sarjito, 2024).

These results reinforce the argument that digital communities have great potential to improve nutrition education, especially if supported by evidence-based approaches and technology. Millennials and Generation Z, who tend to be familiar with digital media, could be an ideal target group to utilize these communities. With good management and integration of technology and expert intervention, digital communities can serve not only as social interaction spaces but also as credible learning centers. These studies underscore the importance of a holistic approach to maximize the benefits of digital communities in creating a more nutrition-conscious and healthy society.

In addition to the contribution of digital communities in building healthy habits, research also shows how these communities can be strategic tools in addressing broader public health challenges. The study by Mattes et al. (2022) highlights that online community platforms often serve as a bridge to reach populations that are difficult to access through traditional approaches. Millennials and Generation Z, for example, prefer learning through in-person interactions in digital communities compared to conventional methods such as seminars or health brochures. This is supported by the fact that digital

platforms allow for the delivery of information in more engaging formats, such as short videos, infographics and interactive discussions that suit their dynamic lifestyles.

Moreover, digital communities not only encourage individual education but also create a significant collective effect. According to research by Azhar et al (2023), active participation in digital communities can increase members' involvement in social activities such as health campaigns, fundraising for healthy food programs, or movements to advocate for healthy food accessibility. In this way, communities not only support individual-level change but also facilitate structural change in society. On the other hand, technologies such as gamification are further strengthening the appeal of digital communities to the younger generation. For example, apps that integrate game elements such as healthy eating challenges or nutrition-based competitions have been shown to increase user participation by 50%, as reported by Harjana (2022). Gamification not only makes nutrition education more fun but also encourages more consistent engagement. Through virtual rewards such as points or badges, users feel motivated to stay active in the community, which in turn reinforces their knowledge of nutrition.

Despite this huge potential, the digital access gap remains a major challenge. Research by Jayanthi & Dinaseviani (2022) shows that around 25% of the young population in developing countries still face barriers in accessing digital communities due to limited internet infrastructure and digital devices. This suggests the need for more inclusive interventions, such as subsidizing devices or providing free internet access in rural areas. These efforts will not only expand the reach of the digital community but also ensure that the benefits of nutrition education can be felt equally by all levels of society. Thus, digital communities have a strategic, multidimensional role in improving nutrition education for Millennials and Z generations. In addition to being a medium for sharing information and building healthy habits, these communities can also drive broader social change. Existing research shows that with the support of technology, the presence of experts, and an inclusive approach, digital communities can be one of the main pillars in building a healthier and more nutrition-conscious society.

Gamification in Nutrition Education

Gamification in nutrition education is an innovative approach that utilizes game elements to encourage Millennials and Z generations to adopt healthy diets consistently. Gamification elements such as diet challenges, virtual rewards, leaderboards and immediate feedback can create engaging, interactive and relevant learning experiences. Diet challenges, for example, offer realistic targets such as “reduce fast food consumption for a week” or “increase vegetable and fruit intake to five servings a day.” These challenges provide a simple roadmap for gradual and sustainable behavior change. In the process, virtual rewards in the form of points, badges or unique in-app features enhance the sense of achievement and provide an emotional incentive to keep trying.

Not only that, leaderboards and community features allow users to compete or support each other in a digital environment. This healthy competition creates additional motivation, as users feel engaged in a collective experience. In addition, immediate feedback in the form of progress charts or daily notifications help users understand the positive impact of their efforts, boost confidence and reinforce good habits. Apps such as MyFitnessPal and Yazio leverage digital technology to provide gamification platforms that are easily accessible via smartphones, making them a perfect fit for the younger generation's digitally-connected lifestyles.

Millennials and Generation Z have characteristics that make gamification particularly effective. They are known to have a preference for challenges, instant rewards, and community-based experiences. Furthermore, they are used to intuitive digital interfaces, so gamification-based nutrition education apps are designed to capture their attention and keep them engaged in the long run. Integration with social media adds an interactive dimension, allowing users to share their achievements and gain appreciation from their friends, thus strengthening motivation to stay consistent.

However, the gamification approach also faces a number of challenges. First, limited access to technology in certain circles can hinder equitable implementation. Second, there is a risk of users focusing too much on the rewards rather than on the primary goal of healthy dietary change. Third, the motivation gained through gamification may decrease if the challenges are less relevant or the rewards become monotonous. To overcome these obstacles, a more integrated strategy is needed, such as a combination of digital approaches and direct interventions, as well as personalization of challenges according to individual needs. In addition, collaboration with nutritionists is important to ensure educational content remains accurate and relevant.

In a broader context, gamification can be a strategic tool to support the public health agenda. With a holistically designed approach, gamification not only increases nutrition awareness but also builds a culture of healthy eating from an early age. Digital technology provides a widely accessible platform, allowing nutrition information to be delivered in an engaging and easy-to-understand manner. Amidst changing consumption patterns influenced by global trends and the increasing prevalence of non-communicable diseases due to poor diet, gamification has the potential to be a significant catalyst for change. If developed well, gamification in nutrition education can be an innovation that encourages the younger generation to actively participate in taking care of their own health, while becoming agents of change in society.

Digital Divide and Technology Access

The digital divide and access to technology in technology-based nutrition education is an increasing concern in global health research, given its impact on health behaviors and diets, especially in remote areas. Research conducted by Moser et al. (2020) showed that lack of access to technology in rural areas can exacerbate public health inequalities, including difficulties in obtaining correct nutrition information. The study noted that populations in remote areas tend to be more vulnerable to a lack of knowledge about proper nutrition, which ultimately impacts the quality of their diets. In addition, Swinburn et al. (2019) in their research on the impact of unequal access to information in nutrition also found that people who cannot access technology-based health information sources are more often exposed to invalid or misleading information, which contributes to the increased prevalence of diet-related diseases, such as obesity and malnutrition.

According to a report by the World Health Organization (WHO, 2020), digital technology has great potential to accelerate the distribution of accurate and timely nutrition information, which can change individuals' diets to be healthier. However, to maximize this potential, adequate digital infrastructure is necessary. In isolated areas, limitations in internet access and technological devices are a major barrier to the dissemination of useful information on healthy eating. TheDigital Divide Report by ITU (2021) states that around 40% of the population in remote areas of Indonesia do not have stable internet access. Research by Choi et al. (2020) also shows that unequal access to

this technology will continue to exacerbate inequality in its use, especially among the younger generation who are the main users of information technology.

Along with this, a study by Pew Research Center (2022) emphasized the importance of collaboration between the public and private sectors to reduce this gap. It found that investments in digital infrastructure in remote areas have the potential to increase accessibility to nutritional information that can reduce the risk of non-communicable diseases, such as diabetes and hypertension, which are often linked to poor diets. In addition, research by Garcia et al. (2021) shows that community empowerment through digital literacy training directly improves individuals' ability to access and utilize information available on digital platforms more effectively. Those who are trained are better able to distinguish credible information on nutrition from inaccurate information, thus making more informed decisions about their diets.

In addition to developing infrastructure and improving digital literacy, hybrid approaches that combine digital technologies with face-to-face counseling methods have proven effective in reaching populations that are not yet fully digitally connected. González et al. (2018) in their study showed that the integration of face-to-face and digital methods in health education, including nutrition, increased community engagement and improved their understanding of the information presented. This provides strong evidence that while digital technology is becoming a key tool in nutrition education, a more personalized and contextualized approach is still needed to achieve optimal results, especially in isolated areas.

Considering the findings from these studies, it can be concluded that developing a more inclusive digital infrastructure and improving digital literacy not only addresses the information gap, but also plays a role in improving quality of life through healthier diets. Collaboration between the government, private sector, and education and health institutions is needed to ensure that technology is equally accessible to people in remote areas. Such efforts will have a broader positive impact on creating a healthier society, with equitable access to nutrition information and education based on emerging technologies.

CONCLUSION

Personalized nutrition based on AI technology offers an innovative approach that transforms the way Millennials and Z generations take care of their health through the analysis of personal data such as weight, physical activity and diet. The technology enables more accurate and relevant dietary recommendations to individual needs, as well as providing a more intimate experience through apps with automated food tracking and meal reminders. However, challenges related to data privacy and security remain, with strict regulations in place to ensure user data is protected. Digital literacy is also important so that users can understand and evaluate the information provided by AI apps. Digital communities are an effective tool for raising nutrition awareness, where interaction between members can motivate healthy behavior change. Gamification in nutrition education has also been shown to encourage active participation through diet challenges and virtual rewards. However, the digital divide, especially in remote areas, may hinder access to these technologies, exacerbating nutrition information inequality. Therefore, the development of digital infrastructure and inclusive approaches are needed to ensure that all segments of society can utilize the benefits of technology in maintaining health

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