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Gamified Training in Food Safety: Enhancing Compliance and Workplace Engagement in the Indian Food Industry

Lavanya M K[1], Dr. K. Sindhura[2]

[1]MBA Final-year student MEASI Institute of Management Royapettah, Chennai-14
[2]Assistant Professor MEASI Institute of Management Royapettah, Chennai-14

Abstract- This research investigated the efficacy of gamified training in improving food safety compliance, employee engagement, and knowledge retention within India's diverse food industry. Traditional training methods often struggle with low engagement and inconsistent application, necessitating innovative approaches. Employing a descriptive research design with a sample of 104 food industry professionals in India, the study utilized a structured questionnaire and statistical analyses including demographic profile of respondents and regression. Crucially, gamification elements emerged as the sole statistically significant predictor of food safety compliance, explaining 28.7% of its variance. This indicates that core game mechanics are highly effective in driving adherence to safety protocols. The study also found no significant impact of gender or educational background on training outcomes, suggesting broad applicability. This report underscores the transformative potential of gamified training as a scalable and inclusive solution to foster a robust culture of food safety in India.

Keywords: Gamified training, Food safety compliance, Employee engagement, Knowledge retention

1. Introduction

1.1 Background and Context of Food Safety

Food safety stands as a paramount concern within both global and national public health agendas, encompassing a comprehensive set of practices, procedures, and conditions designed to ensure that food is safe for consumption from its origin to the consumer's plate. This includes rigorous measures to prevent contamination from biological, chemical, or physical hazards across all stages of production, processing, storage, distribution, and preparation. The World Health Organization (WHO) consistently emphasizes food safety's critical role in safeguarding public health and fostering economic growth, a point particularly pertinent for nations with evolving food supply chains, such as India.

The food sector itself represents one of the world's largest and most essential industries, spanning the entire supply chain from agriculture to manufacturing, processing, packaging, logistics, retail, and hospitality. This expansive industry is not only vital for economic prosperity but also fundamental to upholding public health and nutritional standards globally. In recent years, the importance of food safety has escalated significantly, driven by increasing consumer awareness, more stringent regulatory requirements, and the accelerating globalization of food trade. Ensuring safety across such a vast and intricate industry necessitates the development and implementation of highly effective training solutions, which must be meticulously customized to a wide array of positions, ranging from frontline workers directly handling food to management personnel overseeing operations.

1.2 Challenges in Traditional Food Safety Training in India

Historically, food safety training in India has predominantly relied on conventional methods, such as classroom instruction, printed manuals, or video presentations. While these approaches have served as foundational elements, they frequently prove inadequate in effectively engaging participants, especially within the dynamic and often time-constrained environments characteristic of the food sector. This lack of engagement commonly leads to several critical shortcomings: inadequate information retention, subpar compliance with established safety protocols, and a heightened likelihood of food safety infractions.

In the unique context of India, the challenges associated with upholding food safety are particularly pronounced due to a confluence of factors. These include insufficient infrastructure, significant variations in literacy rates among the workforce, and inconsistent application of regulations across the diverse spectrum of food enterprises. These systemic barriers explain why traditional training methods often fall short. For instance, reliance on written manuals can be ineffective for employees with lower literacy levels, while classroom-based training may be impractical in settings with limited facilities or high employee turnover. The World Health Organization (WHO) estimates that India experiences over 100 million cases of foodborne diseases annually, a sobering statistic that underscores a critical gap in effective training and implementation, despite the regulatory

framework established by the Food Safety and Standards Authority of India (FSSAI). This persistent prevalence of foodborne illnesses highlights that simply having regulations and traditional training methods is insufficient; a more impactful and accessible approach is urgently required to bridge the gap between knowledge and consistent practice.

1.3 Emergence of Gamified Training as a Solution

In response to these pervasive challenges, organizations are increasingly exploring creative and captivating training methodologies. One particularly notable and promising approach is gamified training, which involves the strategic integration of game-design components—such as points, badges, leaderboards, progress indicators, and challenge tiers—into non-gaming environments. The fundamental aim of this integration is to significantly improve educational experiences and drive desired behavioural outcomes. In professional settings, gamification effectively transforms standard or obligatory training into dynamic and captivating experiences. It adeptly taps into intrinsic motivators such as the desire for achievement and competition, thereby demonstrably enhancing knowledge retention and learner engagement.

Gamified training proves especially beneficial within the food sector, an environment where the acquisition of practical skills, the ability to make rapid decisions, and strict compliance with protocols are absolutely crucial. This method aids employees in retaining vital safety information, simulating real-world situations for practical application, and maintaining the motivation necessary to consistently adhere to safety regulations. Furthermore, gamification offers immediate feedback and performance monitoring, empowering both learners and supervisors to pinpoint areas that require enhancement efficiently.

The increasing digital literacy and the widespread prevalence of mobile technologies in India provide a robust and fertile ground for the successful implementation of digital and gamified educational solutions. This technological readiness means that gamified training is not merely a pedagogical innovation but also a tool that can leverage existing technological trends to scale national food safety initiatives more effectively. Regulatory agencies, such as the FSSAI, are increasingly recognizing and encouraging digital learning and gamified training as highly effective means for compliance education. This alignment with technological infrastructure and policy support creates a synergistic environment, enabling gamified training to integrate seamlessly into broader national efforts like FoSTaC (Food Safety Training and Certification), the Eat Right India Movement, and Clean Street Food Hubs. This makes gamification a powerful instrument for achieving widespread food safety compliance and fostering a cultural shift towards safety across the diverse Indian food industry.

2. Research Objectives

- To examine the impact of gamified training on food safety compliance.
- To analyse employee engagement levels in gamified versus traditional training.
- To assess the effectiveness of gamified training in knowledge retention.
- To identify challenges and enablers in implementing gamified training across the food industry.

3. Theoretical Framework and Literature Review

3.1 Defining Key Concepts

To provide a clear foundation for the study, it is essential to define the core concepts central to this research:

- **Food Safety:** This term encompasses the practices, procedures, and conditions necessary to guarantee that food is safe for consumption from its origin to the consumer's plate. It specifically includes measures to prevent contamination from biological, chemical, or physical hazards throughout the stages of production, processing, storage, distribution, and preparation. The World Health Organization (WHO) underscores its critical importance for public health and economic growth.
- **Gamified Training:** This involves the integration of game-design components—such as points, badges, leaderboards, progress indicators, and challenge tiers—into non-gaming environments. The purpose is to improve educational experiences and behavioral results by converting standard or obligatory training into dynamic and captivating experiences that tap into intrinsic motivators like achievement and competition.
- **Compliance in Food Safety:** This refers to the strict adherence to all relevant laws, standards, guidelines, and regulations established by food safety authorities, such as the FSSAI (Food Safety and Standards Authority of India). It includes ensuring proper hygiene, applying hazard control systems like HACCP (Hazard Analysis and Critical Control Points), and providing ongoing staff training. Non-compliance can lead to severe repercussions,

including fines, diminished consumer confidence, and threats to public health.

- **Workplace Engagement:** This denotes the emotional and cognitive bond an individual has with their organization. In the context of food safety training, engaged employees are more inclined to implement acquired knowledge, uphold hygiene standards, and actively participate in safety initiatives. Gamified training enhances engagement by transforming the learning experience into an enjoyable, rewarding, and tailored process.

- **Interactive Learning:** This is an experiential, learner-focused methodology that involves participants actively interacting with the material through various activities, including simulations, quizzes, case studies, and feedback mechanisms. Gamification represents a subset of interactive learning that specifically promotes exploration and provides instant feedback, making it particularly beneficial in environments focused on skill development and safety training.

3.2 Review of Relevant Literature

The existing body of literature extensively explores the application of gamification in various training contexts, providing a robust foundation for this study. Research by Pepe, Oernskar, and Ahmed (2024) and Jozan et al. (2023) highlights how gamified HSE (Health, Safety, and Environment) training solutions enhance employee engagement and improve safety performance by mimicking real-world workplace environments and fostering critical thinking. Similarly, Boonchutima et al. (2024) explore gamified health communication interventions to address occupational health issues, demonstrating their potential to overcome linguistic and cultural barriers through engaging, culturally appropriate design.

Studies consistently show that gamification improves motivation, knowledge retention, and promotes positive safety cultures by providing real-time progress tracking, feedback, and fostering friendly competition and collaboration. Margheritti, Marcucci, and Miglioretti (2025) confirm that active learning approaches, particularly serious games and simulations, are highly effective in bridging the gap between theoretical knowledge and practical application in safety training. However, they also acknowledge challenges such as high initial implementation costs and technical complexities, which can impede widespread adoption.

Beyond safety, gamification has proven effective in enhancing broader workplace learning and development. Chaurasiya (2024) demonstrates how gamification improves employee learning, development, job productivity, satisfaction, and engagement by making learning interactive, providing immediate feedback, and fostering teamwork. Hussain et al. (2018) further support this, finding that gamification significantly improves employee engagement, retention, and organizational commitment. Maggio (2021) reinforces that effective gamification strategies require intelligent design aligned with user needs and corporate goals, emphasizing that emotional components like enjoyment and achievement are crucial drivers of persistent engagement. The focus on emotional components, such as enjoyment and achievement, provides a deeper understanding of the mechanisms through which gamification operates. It is not merely about superficial points or badges, but about tapping into intrinsic motivators and creating positive emotional associations with the learning process and safety practices. This emotional connection is critical for driving long-term behavioural change and sustained adherence, particularly in a domain like food safety where compliance can otherwise feel tedious or burdensome. For instance, Vignoli (2017) found that positive emotional experiences with personal protective equipment (PPE) use were strongly linked to greater motivation and adherence to safety protocols, suggesting that emotionally engaging content can significantly improve safety outcomes.

3.3 Research Gap

Despite the growing popularity and documented benefits of gamification in various workplace training contexts, its specific application within the food safety sector remains notably restricted and understudied. Most existing research tends to focus on traditional training approaches, which, as highlighted earlier, frequently fail to fully engage employees or ensure long-term compliance in the dynamic and high-stakes environment of food safety.

There is a significant dearth of empirical evidence specifically detailing how gamified training impacts employee behaviour, motivation, and, most critically, consistent adherence to food safety regulations. Furthermore, a substantial gap in knowledge exists regarding how such training can be optimally tailored to specific workforce groups—considering factors like differing literacy levels or cultural nuances—or to the diverse operational realities of various food business situations, ranging from small street vendors to large processing plants. The extent to which gaming components genuinely influence and shape the overall workplace culture within food services also remains largely unexplored. This absence of detailed, context-specific research represents a critical missing link for an industry where compliance directly impacts public health and economic stability. Simply applying generic gamification principles may not suffice; there is a

clear need for nuanced, evidence-based research to move beyond the theoretical potential of gamification to its practical, effective application in this vital sector. This study directly addresses this critical gap by providing empirical evaluation specific to the food safety domain in India.

4. Research Design and Data Collection

The target respondents for this study were carefully selected to ensure direct relevance to the food industry's operational realities. The sample included food handlers, quality control officers, and training managers, all actively working within the food industry, with a primary focus on food processing units in India. These individuals were chosen due to their direct involvement in food preparation, safety compliance, and employee training, providing firsthand perspectives on the effectiveness of training methods.

A convenience sampling technique was adopted for this study. This is a non-probability sampling method where the sample is drawn from the portion of the population that is most accessible or closest to the researcher. While convenience sampling offers practical advantages, particularly for pilot testing and initial explorations, it is important to acknowledge that it may introduce some selection bias, potentially limiting the direct generalizability of the findings to the entire food industry workforce across all geographical regions or broader roles beyond those specifically targeted.

A total of 104 respondents participated in the study, constituting the sample size. An ideal sample is defined as one that fulfills the requirements of representativeness, flexibility, effectiveness, and reliability, and the sample size must be optimal to ensure meaningful statistical analysis.

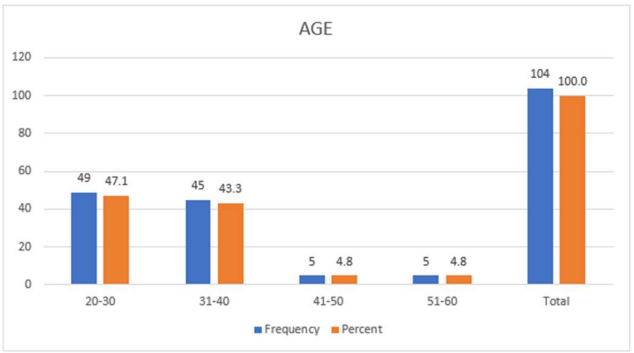
5. Results

5.1 Demographic Profile of Respondents

5.1.1 AGE OF THE RESPONDENTS

Age	Frequency	Percent
20-30	49	47.1
31-40	45	43.3
41-50	5	4.8
51-60	5	4.8
Total	104	100.0

Table 5.1.1



INTERPRETATION

The age of the respondents ranges from 20 to 60 years.

- Almost half of the people (47.1%) are between 20 and 30 years old.
- Around 43.3% of the people are between 31 and 40 years old.
- Only 4.8% of people are between 41–50 years old, and another 4.8% are between 51–60.
- Together, about 90% of the people are below the age of 40.
- Since most people are young, the study results will mostly reflect the views of a younger age group.

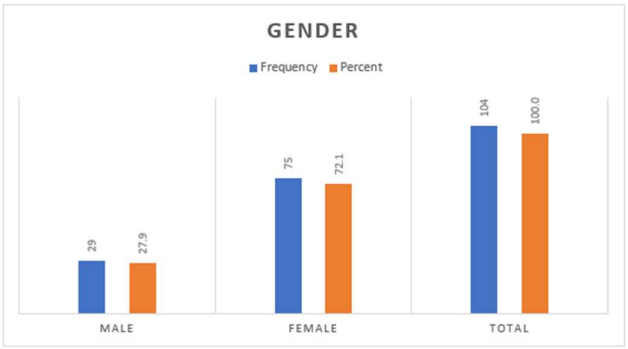
INFERENCE

- Most participants are aged between 20–40, making up over 90% of the sample. This indicates a strong representation of younger individuals in the study. The results are likely to reflect the views and preferences of a younger workforce.

5.1.2 GENDER OF THE RESPONDENTS

Gender	Frequency	Percent
Male	29	27.9
Female	75	72.1
Total	104	100.0

Table 5.1.2



INTERPRETATION

- 75 participants (72.1%) are female, forming the majority of the sample.
- 29 participants (27.9%) are male, representing just over a quarter of the sample.

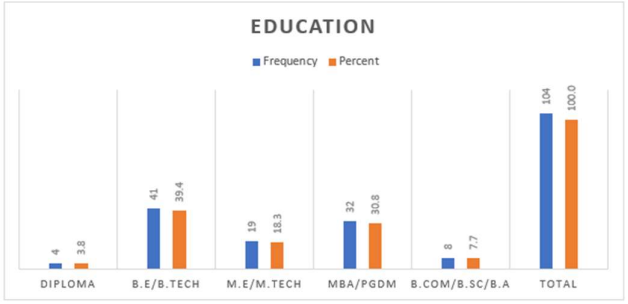
INFERENCE

There is a higher participation of females in the study compared to males.

5.1.3 TYPE OF EDUCATION

Education	Frequency	Percent
Diploma	4	3.8
B.E/B.Tech	41	39.4
M.E/M.Tech	19	18.3
MBA/PGDM	32	30.8
B.Com/B.Sc/B.A	8	7.7
Total	104	100.0

Table 5.1.3



INTERPRETATION

- B.E/B.Tech graduates make up the largest group, with 41 participants (39.4%).
- This is followed by MBA/PGDM holders with 32 participants (30.8%).
- M.E/M. Tech postgraduates account for 18.3%, while Diploma holders are the smallest group at 3.8%.
- B. Com/B.Sc./B. A graduates contribute 7.7% to the total sample.

INFERENCE:

- The majority of the participants have a technical background, mainly from engineering (UG & PG).
- A significant number also hold management qualifications, indicating a diverse professional base.
- This distribution suggests that gamified training in IT may appeal to both technically and managerially educated individuals.

5.2 Regression Analysis

A multiple regression analysis was conducted to determine the predictive relationships between Gamification Elements (GET), Interactivity Level (ILT), Employee Engagement (EET), and Knowledge Retention (KRT) as independent variables, and Food Safety Compliance (FSCT) as the dependent variable. The null hypothesis stated no relationship between these components and FSCT, while the alternative hypothesis suggested a significant relationship.

Table 5.2: Regression Analysis Model Summary, ANOVA and Coefficients

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.535[a]	0.287	0.258	0.26988	0.287	9.950	4	99	0.000

a. Predictors: (Constant), KRT, GET, ILT, EET
b. Dependent Variable: FSCT

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.899	4	0.725	9.950	.000[b]
	Residual	7.211	99	0.073		
	Total	10.110	103			

a. Dependent Variable: Food Safety Compliance
b. Predictors: (Constant), Knowledge Retention, Gamification Elements, Interactivity Level, Employee Engagement

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.952	0.469		4.164	0.000
	Gamification Elements	0.448	0.103	0.460	4.352	0.000
	Interactivity Level	0.100	0.144	0.090	0.692	0.490
	Employee Engagement	0.129	0.152	0.114	0.853	0.396
	Knowledge Retention	-0.128	0.110	-0.128	-1.164	0.247
a. Dependent Variable: Food Safety Compliance						

The **Model Summary** indicated a multiple correlation coefficient (R) of 0.535, signifying a moderate positive relationship between the predictors and Food Safety Compliance. The R-squared value was 0.287, meaning that 28.7% of the variance in Food Safety Compliance can be explained by the independent variables included in the model. The Adjusted R-squared was 0.258, providing a more conservative estimate of the population R-squared.

The **ANOVA table** for the regression model yielded an F-statistic of 9.950 with a significance (p-value) of 0.000. Since this p-value is less than 0.05, the overall regression model is statistically significant, confirming that the predictors as a group significantly explain the variance in Food Safety Compliance.

The **Coefficients table** provides insights into the individual contribution of each predictor:

- **Gamification Elements (GET):** The unstandardized coefficient (B) was 0.448, and the significance (p-value) was 0.000. This indicates that Gamification Elements is a statistically significant positive predictor of Food Safety Compliance. For every one-unit increase in Gamification Elements, Food Safety Compliance is predicted to increase by 0.448 units, holding other variables constant. Its standardized coefficient (Beta) of 0.460 further suggests it has the strongest unique contribution among the predictors.
- **Interactivity Level (ILT):** The p-value was 0.490, which is greater than 0.05. Therefore, Interactivity Level is not a statistically significant predictor of Food Safety Compliance in this model.
- **Employee Engagement (EET):** The p-value was 0.396, also greater than 0.05. Thus, Employee Engagement is not a statistically significant predictor of Food Safety Compliance.
- **Knowledge Retention (KRT):** The p-value was 0.247, greater than 0.05. Knowledge Retention is not a statistically significant predictor of Food Safety Compliance in this model, despite a slight negative coefficient (B = -0.128).

The regression analysis unequivocally indicates that **Gamification Elements is the sole significant predictor of Food Safety Compliance** in this model, demonstrating a robust positive relationship. While Interactivity Level, Employee Engagement, and Knowledge Retention showed correlations with Food Safety Compliance in the previous analysis, they do not serve as direct, significant predictors of compliance when controlling for other variables in this regression model. This is a crucial distinction for resource allocation and training design. It implies that the core gamification mechanics themselves (e.g., points, badges, leaderboards, immediate feedback) are the primary drivers of compliance, rather than just the general "interactivity" or "engagement" that might arise from any well-designed training. Organizations aiming to improve food safety compliance should prioritize the integration of robust gamified elements, as these appear to be the most effective levers for directly influencing compliance behavior.

6. Discussion

The study's findings provide compelling evidence for the effectiveness of gamified training in enhancing food safety compliance within the Indian food industry. The consistently high positive ratings observed across all measured variables—Food Safety Compliance (FSCT), Gamification Elements (GET), Interactivity Level (ILT), Employee Engagement (EET), and Knowledge Retention (KRT)—underscore a generally favorable perception and positive experience with gamified training methods among the workforce. This widespread positive reception suggests that gamified approaches resonate well with employees, making learning more enjoyable and potentially more effective.

The most significant finding is the predictive power of Gamification Elements (GET) on Food Safety Compliance (FSCT). The regression analysis clearly identified GET as the sole statistically significant predictor of compliance, accounting for a substantial 28.7% of the variance in compliance outcomes. This highlights that the core game mechanics, such as points, badges, leaderboards, and immediate feedback, are highly effective in directly driving adherence to safety protocols. This finding is crucial because it moves beyond mere correlation to establish a direct influence, indicating that these specific gamified features are primary levers for improving compliance.

While Interactivity Level (ILT), Employee Engagement (EET), and Knowledge Retention (KRT) demonstrated positive correlations with FSCT, they did not emerge as

direct, significant predictors in the regression model. This suggests a more nuanced relationship: these factors likely contribute to the overall positive training experience and may be outcomes or enablers of effective gamification, rather than independent drivers of compliance. For instance, gamification inherently fosters interactivity and engagement, which in turn might facilitate compliance. The strong intercorrelations between GET, ILT, and EET support this view, suggesting that these elements are highly intertwined and contribute to a holistic positive training environment. The absence of Knowledge Retention as a direct predictor of compliance is particularly noteworthy, challenging the intuitive assumption that simply knowing more leads to better adherence. This implies that for critical areas like food safety, training must go beyond mere information transfer to focus on behavioral reinforcement and practical application, which gamified elements are well-suited to provide through their interactive and rewarding nature.

7. Conclusion and Recommendations

7.1 Conclusion

This research unequivocally demonstrates that Gamified Training Elements exert a substantial and statistically significant impact on Food Safety Compliance within the food sector. Among all the variables examined, gamification was the sole factor that exhibited a statistically significant predictive relationship with compliance outcomes. This finding powerfully underscores the effectiveness of utilizing interactive and engaging training tools that seamlessly integrate components such as points, rewards, and progress tracking to motivate employees and reinforce safe practices.

While Interactivity Level, Employee Engagement, and Knowledge Retention displayed positive correlations with food safety compliance, they did not qualify as direct, significant predictors in the regression analysis. This suggests that while these elements undoubtedly enhance the overall learning environment and contribute to a positive training experience, they are not as influential in directly promoting compliance behavior as the core gamification mechanics themselves.

Furthermore, the analysis indicated that gender does not have a significant impact on the perception or response to training, suggesting that gamified training is broadly suitable for diverse employee demographics. Although perceptions of gamification varied among different groups, the overall training outcomes for other variables remained consistent, reinforcing the general applicability of this approach.

In summary, this research strongly endorses the integration of game-based strategies into food safety training programs as a viable and highly efficient method for enhancing compliance, boosting motivation, and fostering deeper engagement among employees in the food industry. This approach is instrumental in cultivating a robust and proactive culture of safety throughout food handling and production settings.

7.2 Recommendations

Based on the compelling findings of this study, the following recommendations are put forth for organizations within the food sector:

- **Prioritize and Integrate Robust Gamified Elements:** Given the substantial positive influence of gamified training on food safety compliance, organizations should prioritize incorporating interactive game elements such as point systems, badges, leaderboards, rewards, and progress tracking into their training initiatives. These specific gaming mechanics are proven to enhance motivation and promote ongoing participation, directly aligning with and reinforcing essential safety practices.
- **Tailor for a Digitally Savvy Workforce:** Recognizing that the study's participants were predominantly younger and digitally astute, training platforms should be designed with mobile optimization, user-friendly interfaces, and visually appealing modules. Integrating real-world industry scenarios, challenges, and narrative techniques into the content will significantly enhance its relevance and bridge the gap between theoretical knowledge and practical application, making the learning experience more relatable and impactful.
- **Strategically Embed Supporting Components:** While gamification is the primary driver of compliance, elements such as interactivity, employee involvement, and knowledge retention, though correlated, did not emerge as direct predictors. This indicates a need to more thoroughly embed these components within the gamified framework. This can be achieved through methods like collaborative activities, immediate and contextual feedback, and spaced repetition, ensuring they become integral to the gamified experience and better align with educational goals.
- **Implement Role-Specific Customization:** To maximize relevance and practical applicability, training modules should be tailored to specific job roles within the food industry, such as those in production, quality control, or management. This customization ensures that the content directly

addresses the unique safety challenges and responsibilities associated with each position.

- **Foster Continuous Reinforcement and Data-Driven Improvement:** Organizations should implement ongoing reinforcement strategies, including peer-led learning, collaborative challenges, and regular refresher quizzes, to sustain knowledge retention and behavioral change over time. Furthermore, consistently updating training content and leveraging data-driven insights from the gamified platform will allow companies to refine their strategies, thereby cultivating a dynamic and highly effective food safety culture at all organizational levels.

8. Scope for Future Research

The findings of this study open several promising avenues for future research to further advance the understanding and application of gamified training in food safety:

- **Long-term Impact and Behavioral Change:** Subsequent studies should focus on investigating the enduring effects of gamified training on actual employee behavior and real-world food safety performance over extended periods. This would involve longitudinal studies to observe how the training translates into sustained changes in practice and measurable improvements in safety outcomes, moving beyond immediate perceptions.
- **Integration of Advanced Technologies:** There is a significant opportunity to explore the incorporation of cutting-edge technologies into gamified training systems. This includes:
    - **Augmented Reality (AR):** For replicating real-time hazard identification and decision-making situations in a blended reality environment.
    - **Virtual Reality (VR):** To provide highly immersive learning experiences that simulate realistic food handling scenarios, thereby significantly boosting retention and engagement.
    - **Artificial Intelligence (AI):** For advanced compliance assessments and for personalizing training pathways based on individual performance and learning styles.
- **Customization and Personalization of Gamified Content:** Future research can delve deeper into tailored learning pathways that consider individual differences more comprehensively. This includes customizing content based on specific job roles, personal performance metrics, or individual learning speeds. AI can play a crucial role here by facilitating recommendations for particular modules or supplementary activities, drawing from prior interactions and assessment results to create a truly adaptive learning experience.
- **Blended Learning Models:** Investigating the synergistic impact of gamified training when combined with conventional approaches, such as traditional classroom instruction, one-on-one mentoring, or practical demonstrations, is another critical area. Gaining insights into how blended learning models measure against solely gamified or traditional methods could inform the development of more comprehensive and effective training systems.
- **Broader Generalizability:** While this study provides robust findings within its specific Indian context and target demographic, future research could aim for more diverse samples (demographically, geographically, and across different types of food businesses, e.g., small street vendors versus large corporations) to enhance the generalizability of findings beyond the current scope.

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