RESEARCH PAPER

Gamification with Codeathon for Productivity Toward Sustainable Development Goal 8 – Decent Work and Economic Growth

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ABSTRACT

Goal: This study aims to examine the Gamification application of Productivity with Codeathon, which can make employees more engaging at work. The growing presence of Information technology in the industry is increasing the demand for a skilled workforce and further making them productive. Gamification's growing popularity among the industry and academicians is bringing new emerging forms that are beneficial to influence the user experience. However, there are many areas in which gamification has yet to benefit the user experience. The study analyzed the gathered data using confirmatory factor analysis, and the later section detailed the study analysis using a structural equation method.

Design/Methodology/Approach: An online questionnaire gathered data from IT professionals to adopt the exploratory research, where respondents from Pune, India, were the study participants. The statistical approach adopted for this study was factory analysis followed by structural modelling with the help of tools such as IBM SPSS and Amos, which adds to the empirical Gamification contribution.

Results: The study indicated a relationship between Gamification and Productivity among IT employees, where Autonomy was a mediator factor.

Limitations of the investigation: This study primarily focused on the information technology sector among Generation Z and Y, but future research can explore other industries and countries.

Practical Implications: Gamification encourages the participants' motivation level, making them productive at work and bringing sustainability. Companies shall organize gamified events like Codeathon and encourage their employees' participation, and therefore, the human resources team shall include it as part of their annual budget and planning.

Originality/value: There is limited study in the Codeathon, and this research contributes by analyzing the Gamification aspects with Competition and Autonomy. It addresses the organization's emerging need for productivity issues, making it one of the limited studies in the Gamification with Codeathon. As a result, this study addresses the sustainable development goal 8 to bring and attain sustainability for work.

Keywords: Gamification; Software Engineering; Autonomy; Sustainable development goal SDG 8; Productive.

1 INTRODUCTION

The Information Technology (IT) industry relies on software coding from the software development team members, where programmers, developers, or coders are the key players. IT companies have different business units that focus on providing IT services in software development, operations, and support services. In developing countries like India, there are more than 170,000 IT companies. India has the largest population in the world shared in the 2023 report. The Indian GDP has different sectors contributing, but the fourth largest is the service sector, which is the strength. Per the latest Global Innovation Index (GII) report for 2022, India ranks 40th out of the 132 other countries (IBEF, 2023). The IT sector currently contributes up to 8% to the country's GDP.

It is forecasted to contribute up to 10% by the year 2025, which makes it one of the key contributors to the Indian fiscal rise (Statista, 2023). Hence, employee productivity will remain vital for the country's continued economic growth and sustainability. Productivity is a crucial concern as a workplace challenge among Fortune 500 organizations. According to reports, the business from IT can reach up to dollar fifty-one billion by 2023 as domestic earnings, and the Indian IT sector can cross $350 billion by the end of 2026 (Sun, 2023). Gamification complements employee engagement and enhances motivation, resulting in improved outcomes required for sustainable growth.

With such a rising need, the growth in the economy will also require companies to fill the position with the right talent and retain that talent. In the World Population Review Report of 2024, Luxembourg, Singapore, and Ireland are the top three most productive countries (World Population Review, 2024). On the contrary, in the world GDP rank of 2024, India is the fifth largest economy after the US, China, Germany, and Japan. Despite India being the most populated, the GDP and productivity ranking gap reflect the need for productivity. Gamification brings different techniques, methods, and theories to engage users in various tasks or activities (Helmefalk *et al.*, 2022). However, other modes of gamification seem prevalent in the banking and financial sectors of literature. In the IT industry, gamification can be visible through gamified activities such as Codeathons and training. Codeathon aims to bring the players together and solve problems using a method that results in software (Rajeshwari *et al.*, 2021). Thus, the problem proposed in the Codeathon can belong to any subject requiring a software-driven approach. It becomes an open and fair challenge to the participants to solve the problem. Gamification aims to unite the players or users in a non-serious game format. Codeathon gives the player an experience of innovation, which results in discovering solutions to a problem. Gamification can engage the players where different designs, elements, theories, and mechanisms get implemented in the industry for varying intent.

The Codeathon event primarily focuses on building software using any software programming language such as Python, Machine learning, HTML, or any other language. Intuit's company, in the year 2020 launch, marks its footprints by launching its first Codeathon, where participants enrol virtually (Intuit, 2020). Morgan Stanley has conducted a Codeathon gamified event in India's IT capital city, Bangalore, specifically for female participants, supporting them in boosting diversity in the Competition and talent acquisition. It resulted in more than 600 female participants, distributed in 25 teams. Lowe's, a North American, conducted their Codeathon in 2021, later by companies like IBM, Cisco, and Informatica. In 2020, Hindustan Times, one of the leading Indian newspapers, arranged a Codeathon for nearly two months as they had different levels for the participants to cross levels and engage. These Codeathon gamified events resulted in new projects and new opportunities. Although the Codeathon concept is comparatively new, companies are slowly realizing its value. Gamification continues to be helpful in marketing, and brands benefit from building a customer base. Education 4.0 combines theory and practical learning experiences, allowing students to learn through experiential learning (Pinto and Da Cunha Reis, 2022). SDG 8 refers to decent work and economic growth, aiming to boost employee productivity, which is attainable with gamification as it engages while motivating individuals. Gamification for senior and non-senior roles supported better engagement and productivity at work (Gerdenitsch *et al.*, 2020).

The Millennials, popular with Generation (Gen) Y terminology, are the digitally skilled generation, the early technology enabler and adaptor. In literature, they are found to be focused on learning and self-development and remain attentive to opportunities to grow, collaborate, and work differently. This generation also embraces innovation while keeping a healthy work-life balance. Generation (Gen) Z is the next digital generation born after the millennials, who are also dig savvy. The existing study mentions that by 2025, the Gen Z population will contribute to one-quarter of its Asia Pacific population. Being digital natives in literature, they are technically skilled, fast learners, and talented, strengthening the workforce gap. Several studies, including Forbes, reflect key points for Gen Y and Z in an organization as they are more adaptable to change, which is not limited to changing jobs or taking risks. A Forbes study in 2024 reflects the importance of Autonomy, which both Gen Y and Gen Z look forward to in the workplace, and the key reason for them to corporate opt-out (Kelly, 2024). Hence, keeping both generations engaged is crucial for the firms. Gamification offers several examples in the literature where Autonomy enables engagement (Riar *et al.*, 2022). While in the growing economy, there is a scope to explore and understand Gamification. India, a developing country, has over fifty percentage of the Gen Y and Z population, more than the average of 47% globally. Gen Y and Z will continue to lead in the growth of the IT sector in India, making them pertinent for this study.

Gamification makes users feel motivated with the intrinsic or extrinsic motivation method defined in the self-determination theories in the literature (Luarn *et al.*, 2023). Codeathon is a gamified event that has started gaining global momentum but is still in its early stages of popularity.

Other existing studies explain the impact of organizational culture on employee performance (Elifneh and Embilo, 2023). Productivity is among the key topics discussed in McKinsey, where its contribution can result in sustainable growth (McKinsey, 2024). Now a popular topic, gamification, many areas are slowly gaining the spotlight among academicians and industry (Bakhanova *et al.*, 2023). Gamification has gained a strong presence and will continue to require more empirical development, and this study complements it. However, the existing literature limits the study of Codeathon, which brings the author's attention to study and analysis. Thus, the author attempts to fill that research gap by conceptualizing and exploring Gamification in Codeathon with Competition, Autonomy, and Productivity for sustainable development goals. As Gen Y in IT moves towards leadership roles, the next Gen Z will be crucial IT workers supporting different roles (Gabrielova and Buchko, 2021). Hence, both generations are essential to the development of India's economy. The authors discuss the subsequent sections in this study as a literature review and provide the concept overview, and the rest of the section includes the research analysis. The study in the later part consists of the conclusion and future opportunities in this area.

2 LITERATURE REVIEW

To attempt the literature review, the author searched for the existing records in the global repository. The author searched in Jun 2023 in the international database of high-quality records, and the search query and the keyword used was 'Codeathon,' which resulted in seven publications. The search concluded with six Scopus records, one duplicate in Scopus, one from the ScienceDirect repository, and zero records from the IEEE database. Hence, six records resulted from the initial search, among which five were open access, which the author analyzed and listed in Table 1. The current studies in Codeathon are limited in the database, identifying it as a gap in the literature for conducting this research study. Based on initial analysis, those six records were primarily in healthcare and one in education between 2019 and 2022, leaving a gap in the information technology (IT) sector for this study. In Table 1, the Codeathon studies conducted by researchers were in nations like Africa and the United States. Further, there is a lack of studies on gamification aspects, which is another gap in the existing research studies in Table 1. The presence of technology and the cultivation and growth of Gamification also offer the opportunity to make this topic suitable for study.

Table 1 - Summary of the Records in Literature

First Author of paper & Reference	Title	Type	Year	Industry	Source
Rissy M. Wesonga, Refer (Wesonga and Awe, 2022)	An assessment of traditional and genomic screening in newborns and their applicability to Africa	Article	2022	Healthcare	Science Direct
Sanjay Soundarajan, Refer (Soundarajan *et al.*, 2022)	SPARClink: an interactive tool to visualize the impact of the SPARC program	Article	2022	Healthcare	Scopus
K Rajeshwari, Refer (Rajeshwari *et al.*, 2021)	Classroom to Industry: A Pathway of a Student to Be an Engineer	Conference Paper	2021	Education	Scopus
Joan Martí-Carreras, Refer (Martí-Carreras *et al.*, 2020)	NCBI's Virus Discovery Codeathon: Building "FIVE" —The Federated Index of Viral Experiments API Index	Article	2020	Healthcare	Scopus
Matthew N. Bernstein, Refer (Bernstein *et al.*, 2020)	Jupyter notebook-based tools for building structured datasets from the	Article	2020	Healthcare	Scopus

	Sequence Read Archive				
Bastien Llamas, Refer (Llamas *et al.*, 2021)	A strategy for building and using a human reference pangenome	Article	2019	Healthcare	Scopus

2.1 Gamification

Gamification in different fields, such as learning, training, and health, has gained different viewpoints and established its concept. In literature, Gamification can bring engagement and drive the players' purpose. Different conceptual elements are available and studied by scholars and academicians, such as rewards, levels, or virtual ranking, which intersect with the theories of Gamification (Ciuchita *et al.*, 2023). The framework included in Gamification brings the user engagement and motivation towards goals with the change in user attitude. Gamification has no limitations, but the design-build must follow its purpose for the highest benefit. The literature suggests that Gamification can improve user motivation and attitudes. Recent studies indicate rewarding or encouraging user loyalty through different gamified techniques. In retail, Gamification has benefited the consumer purchasing methods on different web-based platforms. In recent years, gamification has grown in education and changed the learner's interest in engaging in learning. Designing with several Gamification elements can be arranged for different goals, which can help drive participation in any activity (Miri and Macke, 2022). Gamification offered with the Codeathon technique can drive the result based on the goal defined for the event. Therefore, based on the requirements, Gamification can support the team's effectiveness and make it appealing to encourage participation in different challenges.

The academicians suggested using a tailored approach based on user preferences to implement Gamification. With the presence of technology and emerging ones, the roots of Gamification are growing in the digital setup and on different technology gadgets (Rodrigues *et al.*, 2022). Although the motivation may vary from individual to individual, the different gamified theories and motives can support change in the outcomes and participation. Gamification brings the urge to compete among the other players or participants, and in the gamified events, it becomes the competitive mode among different teams. It directs the participants' more participatory action as it makes them achieve a positive cognitive action, allowing them to interact with other participants (Bakhanova *et al.*, 2023). The different experiences of Gamification also bring moments of joy, entertainment, and appeal, which are also motivational affordances (Miri and Macke, 2022). The existing theory refers to motivation as intrinsic and extrinsic, where Autonomy is the fundamental cognitive need to enable user motivation (Luarn *et al.*, 2023). However, a study on gamified apps for learning resulted in limited Autonomy (Botte *et al.*, 2020). For any task fulfilment, an individual must be motivated to have better productive results.

In literature, Gamification results in blending its elements and metaphors with many mechanisms, such as non–game theory and its application. It results in several forms of gamification usage applied and to be applied in the future. Although many theories have gained attention and adoption with Gamification, some are popular but not limited to self-determination, self-efficacy, and goal-setting theory. The companies are using gamified practices in e-commerce among Gen Y and Gen Z to foster consumer engagement and image perception (Rodrigues *et al.*, 2024). Academicians have studied gamification effects for suitable and non-suitable implications, suggesting taking informed actions based on its trade-off with benefits (Almeida *et al.*, 2023). The researchers have discussed the Gamification implementation among Gen Y and Gen Z through learning where badges, levels, and leaderboards are popular (Hong *et al.*, 2024). Employee engagement is critical, where human resource (HR) teams adopt gamification mechanisms in the IT industry through training and new employee onboarding. The digital growth toward technology transformation requires Gen Y and Gen Z in IT to be available and retained for organizational development.

Gartner's study also highlighted the work engagement and motivation to bring productivity that can result in growing business outcomes (Gartner, 2024). Therefore, employees must experience a human-centric and engaging work environment to improve their job satisfaction. The World Economic Forum discussed the different workplace engagement strategies for both these generations, where Autonomy, belonging, and mastery are crucial and based on the self-determination theory (Oh, 2020). In the existing literature, academicians refer to Competition and Autonomy impact as having pros and cons towards productivity. And if enforced, it can result in work burnout or limited outcomes. Therefore, its usage and purpose will drive productivity in non-

gamified and gamified setups. Gamification intends to drive pleasure and satisfaction in individuals, which motivates user engagement. A gamified setup can result in fruitful results that benefit individuals and organizations. Therefore, academicians suggest properly implanting gamified elements and design principles for better results. This study tests the gamified approach of Codeathon with Competition and Autonomy for productivity.

2.2 Codeathon

Codeathon word gets a mixed version coming from the two words Code, which originated from Coding, and Athon, which originated from Marathon. The gamified approach of the Codeathon event is a continuous activity that lasts for hours. Codeathon primarily focuses on identifying the skills of individuals, including technical, problem-solving and teamwork (Rajeshwari *et al.*, 2021). The companies and the interested participants first advertise the Codeathon activity and contact the event organizers for their enrollment. Therefore, participation in this event is self-driven rather than enforced. The event will have a theme clearly defined to encourage participation, and then the groups will be formed later so that everyone becomes part of a team (Llamas *et al.*, 2021). The organizers explained the activity rule to the participating coders and gave them a set timeline, such as a day or more than a day to complete the activity. There will be an identified panellist who will be checking the progress of every team, and all the teams are required to present their plan that covers the technology used, prototype, or design. Since the team members work on a tight timeline, collaboration and partnership can result in the winning team. The outcome of this activity can be a POC (proof of concept), prototype, or the actual software, which can be at the initial level or working software.

As a result, the organization gained popularity, and the sponsoring company became more famous among the coders. The winning team outcome of the Codeathon is also to transfer the software into the MVP, also known as Minimum Viable Product. Codeathon is a gamified path of bringing collaboration and innovation from the users participating in this event. The users who participate in this gamified activity can be any technology software programmers, freelancers, experienced professionals, or even employees of the same company organizing the Codeathon. Thus, participants vary in their experiences, skill sets, age groups, genders, and professional backgrounds. The Codeathon is a coding event for coders in the software world, allowing them to demonstrate their skills and work. The private and public sectors are both organizing Codeathon events. Companies reward the team in different ways, such as monetary rewards, job opportunities, internships, or an opportunity to convert the Codeathon work into actual project work. Researchers have identified that the HR team can reform employees' connection with their firms by arranging activities to make them more engaged and empowered to achieve long-term corporate goals (Kavyashree *et al.*, 2023).

2.3 Sustainable Development Goals 8

Sustainable Development Goal 8 refers to decent work and economic growth to enable employment productivity and good working conditions for all employees. In SDG 8, 16 indicating parameters are illustrated with 12 targets that explain the metrics (Nation, 2023). As per the latest report on SDG 8, the world is currently around one-third of the way to achieving this goal and completing this goal is too far to be visible (Organization, 2023). In the last year, the global unemployment count of the United Nations (UN) was around 192 million people. The reports show higher unemployment among the adult generation with the age of 25 years or more, and only one in every four youngsters is in education, learning, or employment. Therefore, a solution to fix the global employment situation is to create good opportunities for youth that match their skill set based on the market conditions. India's score for SDG 8 is 63.5 and ranks 112 among the 166 countries ranked in SDG 8, which is significantly behind in achieving the goal accomplishment (Report, 2023). The global target is to achieve SDG 8 to its full potential by attaining employment and offering a decent working environment and fair pay for all genders. Hence, the government can attempt to support through policies and build better relationships on global platforms to generate new employment opportunities. Similarly, the organization shall look for alternative techniques for the SDG 8 core purpose.

Gamification usages are visible in studies that enhance and promote sustainability, such as energy and tourism (Souza *et al.*, 2020). A study conducted in Peru among Gen Y and Gen Z discussed responsible consumption for better sustainability towards society (Ramirez Lozano *et al.*, 2024). These generations keep concerns and interest in sustainability and are keen to build awareness. They believe in the importance of work-life balance, opportunities for growth, and fair income to have social security for themselves and their family, aligning with SDG 8's core. In contrast, the Gamification technique Codeathon brings all genders and generations together with

fair engagement and opportunity as a bridge for sustainability. Gamification includes many elements, components, and theories adaptable for different purposes. Codeathon adapts the gamification principles of Competition and collaboration and offers equal chances to all participants. The existing study about Gamification refers to it as enhancing employee motivation and engagement. Such employees shall result in better productivity and contribute to improving organizational outcomes and economic growth, leading toward SDG 8.

2.4. Hypotheses and Conceptual Framework

Different organizations are looking for better methods to derive suitable solutions for diverse issues. Gamification derived from its elements for use in different goals can bring the true meaning of engaging the user, which is goal-driven. The COVID-19 situation has changed their employees' job requirements and expectations globally. The purpose of Gamification is not to make it a game but to incorporate the best from the many theories that support and enhance the experience once attained (Ciuchita *et al.*, 2023). Different generations demand different HR management techniques to bring the best from them, and Gamification can support those objectives. Codeathon, a gamified approach, can result in many participant opportunities at work, including employee hierarchical growth, social and personal growth, learning, and collaboration, which are Gen Y's and Gen Z's aspirational goals. As a result, both these generations are suitable participants for this study. This study aims to analyze the Gamification approach with Autonomy to understand Productivity. Figure 1 describes the research model adopted and the literature review for conducting this study. The SPSS tool performed the factor analysis and then was tested with AMOS to run the confirmatory analysis. This study has three constructs: Gamification dimension as Competition (COM), Autonomy (AUT), and Productivity (PRO) as the dependent variable. Based on the literature studies this study adopted, list the below hypotheses that are further statistically tested using SPSS and AMOS tools.

2.4.1 Competition

The human nature of being part of the group and collaborating encourages COM and connection in gamified environments to improve engagement and performance (Ho *et al.*, 2022). In the literature, combining gamified elements in the professional setup of engineering team members can drive worthwhile results (Al-Readean, 2019). An individual desire for COM is often associated with valuing AUT as the human driving force (Riar *et al.*, 2022). Hence, the study hypothesis proposed is below:

H_1 – Competition has a significant impact on Autonomy.

Among the different gamified elements used for design purposes, COM is among the top listed elements used (Rozi *et al.*, 2019). The literature referred to gamification as supporting employees' PRO for work-associated activity through a gamified habit track app (Gerdenitsch *et al.*, 2020). Here, the hypothesis proposed is:

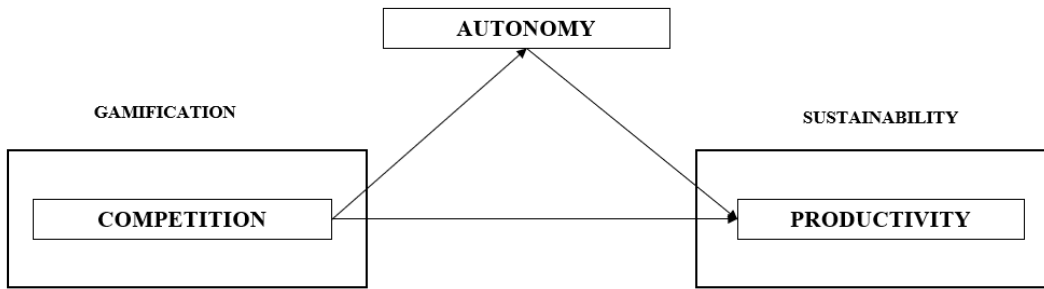H_2 – Competition has a significant impact on Productivity.

2.4.2 Autonomy

AUT in literature refers to psychological individual choice, part of the theory of basic psychic needs (Riar *et al.*, 2022). It relates to the intrinsic motive that allows the self to engage for satisfaction. AUT is essential among Millennials and Gen Z as they prefer to work independently, which is imperative for them (Gabrielova and Buchko, 2021). The gamified platform for learning that incorporates the game elements elaborates on AUT as a basic essential need, which gets integrated with the gamification framework (Botte *et al.*, 2020) (Rozi *et al.*, 2019). Hence, the study hypothesis proposed is:

H_3 – Autonomy has a significant impact on Productivity.

2.4.3 Productivity

In Gamification, intrinsic intent supports the AUT, making individuals self-managed and enabling better work engagement (Miri and Macke, 2022). Integrating gamified elements at work can boost user motivation, satisfaction, enjoyment, and performance outcomes that enhance PRO. In group involvement, a need for cooperation arises with COM that can support and enable individual PRO (Riar *et al.*, 2022) (Roczniewska *et al.*, 2021). Among knowledge workers, AUT is crucial for individual PRO (Tapasco-Alzate *et al.*, 2022) (Alsunki *et al.*, 2020). Hence, the hypothesis proposed for the study is:

Figure 1 – The model based on the theory formed to conduct the study.
Source: The authors work.

H$_4$ – Autonomy has a mediating significant impact on Competition and Productivity.

3 METHOD

3.1 Research Design

The industry has started adopting gamification techniques for engagement purposes. In contrast, Codeathon is emerging as a contemporary gamified technique among IT employees. Thus, the author attempted this study using an exploratory research methodology and adopted convenience sampling. The web survey gathered the study data, accessible on all electronic devices in English, and required the participants to use the internet to submit and snowball. Moreover, with convenience sampling, the data gathering was swift for the target location and online survey method. The study collected responses from Pune, Maharashtra, where Maharashtra is the top contributor to the Indian GDP and is leading the Information Technology (IT) sector. The IT sector's exponential growth persists in Pune city, making it among the top three contributors from Maharashtra in IT. Among Indian cities, Pune stands in the top ten cities in information and communication technology (ICT). Therefore, the study participants were from Pune, which was significant for this research study.

3.2 Sampling Procedure

There were 311 responses from nearly 400 distributed surveys, among which 205 participants shared their complete responses as they had participated in the gamified event Codeathon. Therefore, the other respondents from responses who had never participated or had not filled out the complete form were not eligible. Hence, this study statistically analyzed these responses to test the hypotheses required to conduct the research. The survey included the Likert scale ranging from 5 as the highest to 1 as the lowest, which supported the analysis of the cognitive participant's responses. The initial survey section primarily collected demographic-related information, and the later section captured the study results. Table 2 elaborates on the literature review for the construct considered for this study and the statistical analysis of the data by the tool. The academic literature suggests considering the items count for the sample adequacy to consider at least five times (Hair *et al.*, 2010). The survey included 17 items, and among these, 12 items primarily gathered the data for the statistical analysis since the rest were demographic and the sample size was adequate for this study. The survey response was 205, which was suitable for statistical study.

**Table 2 -** Literature Adopted for variables

| Constructs	Quantity	Literature reference
Competition (COM)	4	(Ho *et al.*, 2022), (Rozi *et al.*, 2019), (Al-Readean, 2019)
Autonomy (AUT)	4	(Riar *et al.*, 2022), (Botte *et al.*, 2020), (Rozi *et al.*, 2019)
Productivity (PRO)	4	(Tapasco-Alzate *et al.*, 2022), (Roczniewska *et al.*, 2021), (Alsunki *et al.*, 2020)

3.3 Descriptive Analysis
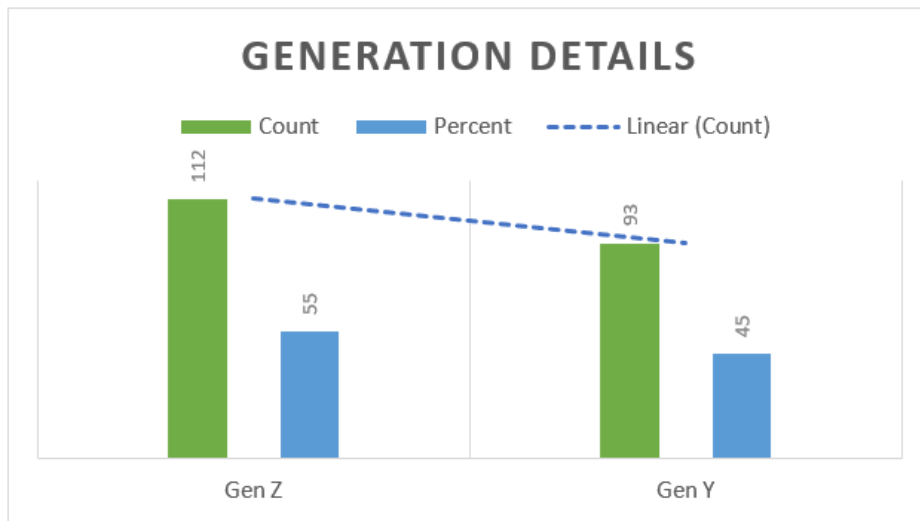
Chart 1 – Generation wise details
Source: The authors work.

In this study, the demographic location was Pune, Maharashtra state in India, where the IT employees were the participants. The descriptive analysis of the participants detailed their demographics. The sum of 205 respondents, among which the gender disburse was 125 male and 80 female, primarily Generation Z and Generation Y. Chart 1 explains the generation distribution of the participants in this study. Generation Z, born between 1995 and 2015, contributed to the survey with 55% and 112 responses. On the other side, Generation Y contributed 45%, 93 responses, born between 1980 and 1994, also known as Millennials. The literacy levels of the participants were post-graduate, graduate, and diploma. Most participants had graduation as their education background contributed to 58%, post-graduation contributed 28%, and diploma level added 14%, as listed in Chart 2. Since the participants vary in experience, Chart 3 explains the experience level-based participation in this study. The study has four categories of participants with experience levels from zero to more than ten years of experience. The participants of the fresher category were 43 respondents, which addressed 21% of the survey data. The experienced category with up to 5 years of experience was the leading participant, contributing 34% with 70 respondents. The experience category of between 5 and 10 years was the second highest contributor at 30%, with 61 respondents. Lastly, participants with more than ten years of experience comprised 15% of the respondents, with 31 respondents.
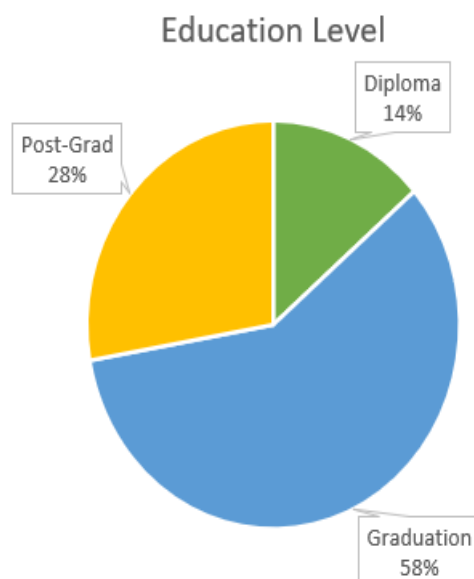
Chart 2 – Education level details
Source: The authors work.
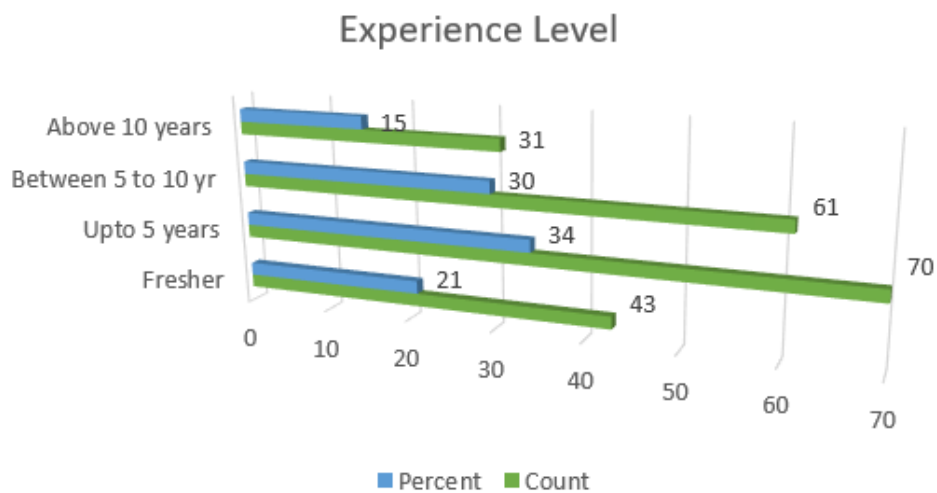
Chart 3 – Experience level details
Source: The authors work.

4 RESULTS & ANALYSIS

The study's statistical analysis begins with a small test of the first fifty survey data, which was reliable after checking the Cronbach Alpha. Therefore, the data gathering continued and resulted in 311 respondents, of which 205 had participated in the gamified event Codeathon earlier. The study primarily used the IBM SPSS tool for the initial and factor analysis and later utilized the IBM AMOS tool for the confirmatory purpose. Firstly, the data analysis was required to run with the tool to check the reliability and validity of the items by running the exploratory test and then the confirmatory test, which ended with the structural test.

4.1 Test for Reliability and Validity

The study first conducted the Exploratory factor analysis (EFA) on the research factors to analyze the construct validity and then the loadings on the study factor. The SPSS tool resulted in the Kaiser-Mayer-Olkin, also known as KMO, with a 0.910 value higher than 0.7, which reflects internal consistency. Barrletts's analysis shows significance with a value of 1695.874. Therefore, based on the KMO and Sphericity test, the study concludes that there was a correlation with sample consistency among the variables in this study (Kaiser and Rice, 1974). Therefore, the SPSS tool can further perform the exploratory analysis, and the Cronbach alpha will test the scale's reliability and validity.

4.2 Test for Factor Analysis

The SPSS tool runs the Principal Component Analysis (PCA), which results in the different factors and loadings being more than the recommended 0.5 value (Hair Jr. *et al.*, 2014). The test resulted in factors with a minimum of one eigenvalue to consider for analysis, indicating 76.9% of the variation of this study. Table 3 displays the resulting factor loadings, which get rotated, and Cronbach Alpha of the latent constructs is more than 0.7, reflecting that it was predictive and thus passes scale reliability (Hair Jr. *et al.*, 2014).

Table 3 - Matrix of Factor Analysis

	GAM	AUT	PRO
COM 4	.874		
COM 3	.875		
COM 2	.821		
COM 1	.795		
AUT 4		.814	
AUT 3		.822	
AUT 2		.807	
AUT 1		.788	

PRO 4			.810
PRO 3			.813
PRO 2			.748
PRO 1			.752
Cronbach Alpha (α)	.909	.892	.894

Source: The authors work.

4.3 Test for Model Fit – Goodness

The AMOS tool tests the confirmatory factor analysis (CFA) to measure the model and whether the study variables reflect the latent constructs and to check the correlations among items (Hair *et al.*, 2010). The goodness test checked the different values to see if they were acceptable for exploring model fit. The three area indices' values reflect the Goodness fit, ranging from the incremental and absolute indexing areas to the parsimony values (Hooper *et al.*, 2008). The model fit indices are in the acceptable range in Table 4, which lists all the values. The Chi-Square/df value is 1.271, which was less than three and was acceptable (Schreiber *et al.*, 2006). The GIF, TLI, and CFI are all greater than 0.9, which was sufficient (Schreiber *et al.*, 2006). The RMSEA value was less than 0.5, showing the model fit's acceptability (Hair *et al.*, 2010). Hence, the results are excellent and pass the model fit test.

Table 4 - Fit Indices

Name of Indices	Value
Chi-Square/df	1.271
Root Mean Square Error of Approximation (RMSEA)	0.036
Goodness of fit (GIF)	0.950
Tucker-Lewis Index (TLI)	0.989
Comparative Fit Index (CFI)	0.992
Adjusted Goodness of Fit (AGFI)	0.924

Source: The authors work.

4.4 Test of Convergence Validity and Reliability

Table 5 - Convergence Validity

	Composite Reliability (CR)	Average Variance Extracted (AVE)
COM	0.857	0.717
AUT	0.893	0.676
PRO	0.852	0.679

Source: The authors work.

The researcher tests the validity of instruments through convergence validity, which tests the validity of factors with the AVE and CR values (Vooris and Clavio, 2017). In Table 5, the CR values are higher than 0.7, and the AVE was more than 0.5, which was acceptable for further study and thus affirmed the instrument's reliability (Hair *et al.*, 2010). The author checked the reliability validity with the MSV value, and in Table 6, they are lower than the AVE values in Table 5, which was acceptable (Hair, *et al.*, 2016).

Table 6 - Reliability Metrics

	Maximum Shared Variance (MSV)
COM	0.359
AUT	0.520
PRO	0.520

Source: The authors work.

4.5 Test of Discriminant Validity

Discriminant validity is another test in which the two types of entries in the Table are diagonal and off-diagonal: AVE square root and constructs correlation values (Siekpe, 2005). Table 7 shows that the discriminant validity was acceptable since the diagonal values are higher than the off-diagonal values (Fornell and Larcker, 1981). The AMOS tool tested the formed hypotheses to understand if they were accepted or rejected for this study.

Table 7 - Discriminant Validity

	COM	AUT	PRO
COM	0.847		
AUT	0.489	0.822	
PRO	0.599	0.721	0.824

Source: The authors work.

4.6 Test of Structural Equational Model

The Structural Model test was run on the AMOS tool using the SEM (Structural Equational Modelling) technique. After the validity test of the measurement model, the SEM technique tested this study's hypothesis. Table 8 shows the construct's relationship and its coefficients and the standardized regression weights with their significance level that explains the direct effect. The Gamification element Competition significantly impacts Autonomy, where the values in Table 8 (β = 0.489, p-value = 0.00) are significant. Another hypothesis for the Gamification element is that Competition significantly impacts Productivity, where the values in Table 8 (β = 0.563, p-value = 0.00) are significant. Lastly, Autonomy significantly impacts Productivity, where the values in Table (β = 0.323, p-value = 0.00) are significant. Therefore, H1, H2, and H3 were significant and supported the study. As a result, gamification positively impacts productivity in the information technology sector, and organizations should utilize the gamified approach of Codeathon.

Table 8 - Hypothesis testing based on the Structural model path

Constructs Relation	Unstad. Weights	S.E	t-value	Stad. Weights	p-value
COM ---> AUT	0.477	0.072	6.629	0.489	***
COM ---> PRO	0.485	0.066	7.396	0.563	***
AUT ---> PRO	0.272	0.057	4.76	0.323	***

Source: The authors work.

Figure 2 is CFA, and Figure 3 is SEM, explaining the significance of the relationship among the three variables of COM, AUT and PRO. The AMOS tool calculates the final H4 hypothesis with the mediation analysis with the bootstrapping procedure (2000 samples and 90% confidence interval). The last hypothesis in Table 9, where the direct, indirect, and total effects that support the H4 were significant, was that Autonomy mediates among the Gamification element Competition and Productivity where the p-value was significant (*** refer as <0.001). This study concluded that Gamification with Codeathon significantly impacts productivity, so firms should adopt this technique.

Table 9 - Test for Mediation

Relationships	Direct Effects	Indirect Effects	Total Effects
COM ---> AUT ---> PRO	0.272***	0.232***	0.503***

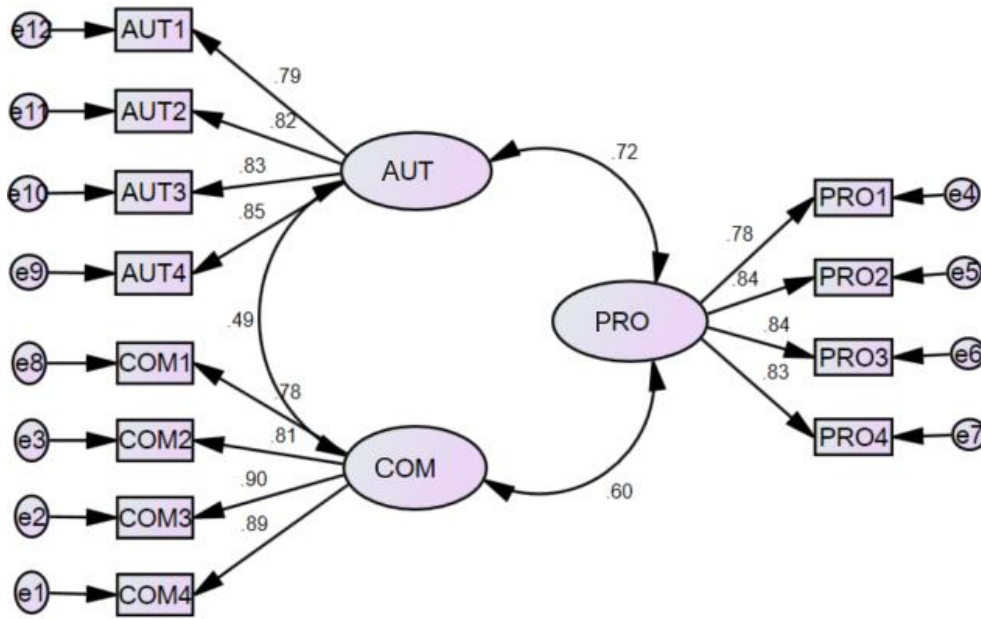**Source:** The authors work.

Figure 2 – Measurement Model (CFA)
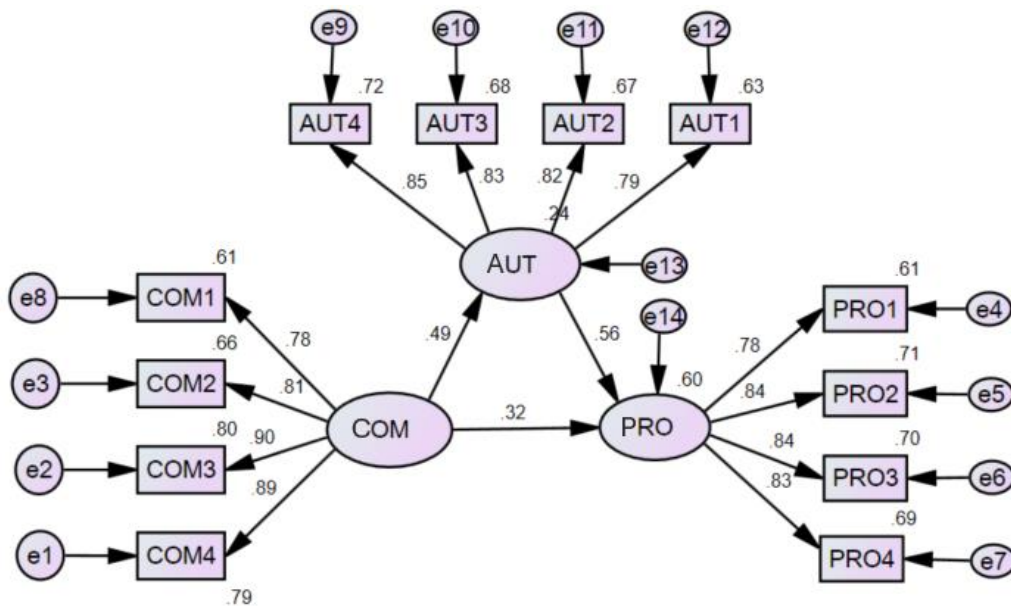**Source**: The authors work.

Figure 3 – Measurement Model (SEM)
Source: The authors work.

5 DISCUSSION

Gamification is prominent in motivating a user in non-game mode, where the user feels an urge to participate, creating engagement. This study has three variables, Competition (COM), Autonomy (AUT), and Productivity (PRO), tested statistically with structural equational tools. The COM in Codeathon creates a sense of Competition among the participants, where the AUT engages in the activity. Gamification embraces its mechanism and dynamics through COM and AUT as intrinsic factors. Many HR studies have discussed the importance of AUT, and gamification offers intrinsically. The COM as a gamified element had a significant relationship with AUT, resulting in PRO. This gamified event also resulted in pioneering ideas adding to the looming Industrial Revolution. In this study, AUT resulted in PRO, where AUT mediates the relationship between

gamification and productivity. Gen Y and Gen Z are highly knowledgeable workers, and AUT is essential to their PRO. This study resulted in gamification contributing to productivity in IT employees. The organization would require gamification techniques to keep them motivated and competitive as a future IT workforce. The Pandemic, remote work and immense office expectations allowed IT employees to be highly productive, resulting in work burnout and the beginning of the Great Resignation era in 2021. Gamification in literature has established an influence on motivation, and this study complements the association with productivity. Gamification also suggests the responsible implementation of its element and meticulous observation of its result (Riar *et al.*, 2022). Therefore, academicians refer to gamification's purpose and expected outcome as varying and requiring mindful applications.

A Gartner 2024 study mentions the importance of collaboration skills required to resume transition in future work (Gartner, 2024). An IT firm may require an employee to interact with any other global employee, where social skills are niche and sometimes lag among these digital generations. A Codeathon supports competitive collaboration and social skills development through AUT and self-esteem, which is essential for Gen Y and Gen Z. The existing studies reflected the lack of a gamification study with Codeathon in the information technology sector in India's developing country. With the persistent and forecasted IT growth in India, other cities will emerge in the IT sector, and this study's findings will be helpful to them. Gamification attempts to engage users, where COM and AUT result in crucial factors that benefit PRO. PRO is the critical enabler for an organization's progress, allowing them to contribute to the growth of the national economy. This gamified technique also brings equal growth opportunities to an individual. A balanced approach with Gamification can result in productivity, and too much COM or AUT may not result in the PRO. Its careful usage and purpose will drive productivity, and as a result, Codeathon is beneficial. Thus, SDG 8 aligns with Gamification for decent work and economic growth to gain employee productivity.

5.1 Theoretical Implications

The study attempted to enable the fundamental theoretical indications from different prospects. Firstly, this study sets the theoretical foundation of Gamification in the Codeathon, a novel technique that adds to the existing literature. Furthermore, the other implication of this study is the crucial result concerning gamification, which results in motivational affordance in the event setup. The existing studies are very limited in the context of Codeathon Gamification, and this study is among the few. It attempted to fill the research gap towards Gamification in Information Technology with the Codeathon. The author explored the gamification framework through the Codeathon, which is a gamified event, and this study investigated the relationship between the gamification motives, which made a substantial theoretical and empirical contribution.

In the literature area, similar studies are limited to the Gamification and Codeathon aspects of Information Technology, which this study adds to. Gamification aims to bring the non-game objectives into the gameful context, where the design can whirl around changing user attitudes. Therefore, organizations can take the initiative to gamify engagement. Another key challenge when the individual works in the team is collaborating with others, and Gamification can induce it. Although humans have a social element, bringing individuals together to work for a common goal at a time is critical. Also, this study laid the foundation for Gamification through the Codeathon events, which organizations can utilize for their employees. As per the NASSCOM report, remote working will remain needed for the business even in future years. With the growing trend of remote working as a step towards digital employment and the requirement for high employee motivation, this gamified approach will be helpful since the Codeathon can be organized virtually or in person.

5.2 Managerial Implications

Codeathon also offers the participants an experiential learning experience as they can collaborate among a diverse crowd. As other Gen Z complete their higher education, getting a job in the post-pandemic market is the biggest challenge, with uncertainty and impacting mental health. Therefore, if any participant is new to the IT industry, they will have early experience built through these gamified events. It would also give the hands-on experience required for any new joiner in any IT project. Moreover, a Codeathon experience adds value to the resume and professional network platforms like LinkedIn, and an individual starts gaining experience without working for any IT corporations. Thus, such candidates would require less time because of the prior learning experience, which speeds up the onboarding time required for any new organizational projects. This gamified technique would also enhance an individual's interpersonal and networking skills. Also, it becomes easier for the HR team to consider such potential candidates in the interview selection process as they stand out. This gamification technique of Codeathon can act as a bridge

between the two generations, Gen Y and Z. Depending on the organization's goals, and they can also consider the Codeathon winners eligible for the next level of organizational growth or new project opportunities.

It will continue to make an organization attractive to Gen Y, who looks forward to self-developing goals. In contrast, Gen Z will remain engaged with the fair opportunity through this gamified opportunity. Participation in it creates social achievement and status among users, generating motivation. Productivity is a common concern among the IT companies. However, the post-pandemic state of working from home has revised the employees' Productivity. Since the organization's overall growth also depends on employee productivity, it's among the top agendas of the HR team. Thus, the organization would need to look at gamified methods to encourage employees' motivation and make them feel motivated in the workplace. This study demonstrates one of the Gamification engagement techniques to promote employee productivity, a common workplace challenge. The HR team defines annual budgets with different engagement strategies to improve employee productivity, and Codeathon can become part of their plan.

6 CONCLUSION

Gamification aims to bring collaboration and better engagement among the participants' players. However, its theories and strategies also help elevate user performance. This gamified pathway can open innovation paths and offer a skill demonstration platform. Pursuing Gamification with Codeathon also encourages the self-participation of individuals and collaborative work on the goal given. The existence of Gamification in the current industry also opens different research areas for future researchers. The author suggests that IT and non-IT organizations consider this gamified mode as the medium to bridge the employee motivation gap. Codeathon is emerging, and universities can organize it as a platform and encourage student participation to bring the right talent during campus hiring. Different IT companies can sponsor it and hire the top winners, demonstrating collaboration among the universities and corporations. As a result, it will open a new hiring mode for freshers looking for a job after their university studies. Hence, firstly, this study adds to the Gamification with Codeathon context for productivity among Gen Y and Gen Z. Secondly, it adds to the research gap in IT among developing countries, including India. This study resulted in a significant relationship between Gamification and Productivity, where Autonomy mediates the relationship. Gamification with Codeathon brings motivation and satisfaction that drive Competition and Autonomy, which results in productivity contributing to SDG 8.

Since the demand for software developers and coders is growing, the HR team looks for talent from a diverse perspective. With the rising senior resignations and layoffs amid the global economy turbulence, such a gamified event can also act as a new job opportunity. Thus, future studies can also consider other late Generation X or Baby Boomers transitioning into software coding. They can be potential Codeathon participants who bring similar or different industrial experiences. With software coding, they can attempt to build software that may disrupt the industry. This gamification approach with Codeathon offers to attain SDG 8 as it gives fair, equal opportunity to demonstrate their talent and displays as a strategic employment way. Codeathon is also a diversified method for boosting employee productivity. SDG 8's goal is to stimulate job creation, and the Codeathon approach allows non-employees to take advantage of job creation. Codeathon will also, in the future, become an employment chance for non-working staff or freshers looking for jobs; as a result, it will be a chance for them to get equal pay. Therefore, the gamified method of Codeathon gives an equal chance for participation and a valuable method of getting work opportunities. In changing times, productivity will remain the focus of IT organizations, where such a gamified approach can be the game changer.

6.1 Direction for Future Research and Limitations

Future studies can test them as different mechanisms of Gamification continue to emerge. They can elaborate on various countries and different industries. With this study, the author opened other emerging areas to explore with Gamification. Moreover, this study was limited to Pune in India, and future researchers can explore other countries with different cultures and working practices. Also, with India's IT growth forecast, future academicians can explore other cities to generalize the study. This study included three constructs, and future studies can extend the other gamification elements and factors. Another challenge in the industry is hiring the right people with the correct skill set, which is also tricky at times to assess in the interview process. The organization can identify the emerging workforce with the right skills as they participate in the event. As a result, this activity also becomes a talent testimony chance for the participants. India holds the service industry as its strength, and leveraging it with Gamification will boost the economy.

The public and private sectors can support and promote these gamified initiatives among

youths, as they are the country's future. The post-pandemic, global recession lingering effect is also impacting the psychic health of Indians working abroad. Gen Y and Gen Z, who moved abroad resulted in brain drain, can participate in virtual gamified events, which can be a future agenda. Also, the company HR can reach out to potential vital Codeathon participants for future work opportunities that will reduce new hiring time. Moreover, with the rising availability of Artificial Intelligence (AI), the author sees it as a gap for future studies where participants use AI for the Codeathon event. Another future research project could focus on the Artificial Intelligence AI marathon, and the author named this event Alathon. Since the current AI tools and applications can write the Code on behalf of humans and with the rising usage of AI, new skills are required among the employees to use the AI effectively. As a result, this skill of AI practical usage gets tested through such gamified techniques.

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