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The gamification as a tool to increase employee skills through interactives work instructions training

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Abstract

Lean practices, because of their importance and effects on production processes, have contributed significantly to changes in the processes where they are successfully implemented, promoting the initiation of a process of cultural change within the organizations that have resulted in best practices in search of excellence operational. The combination of lean practices and the process of gamification enabled us to explore aspects related to the teaching-learning process through interactive and collaborative methods to boost knowledge of the teams and, so to speak, the organization. The case study of this work intends to share practical results of the adoption of the gamification processes, which allowed, through the integration and involvement of the work teams, the development of automated document control systems and self-assessment processes in the scope of the productive processes, as well as interactive training, as a component associated to the lean practices adopted by the company object of this study, and its contributions to the results of the organization in the scope of quality management, production, and management teams.

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1. Introduction

In the scope of the production process has been perceived the need to incorporate new practices in its habitual routines, with the intention of improving its results, in addition to being strategically aligned with the organization. In addition to investigating waste in production processes, it has become necessary to extend the application of this concept to other areas of the organization in order to identify new forms of improvement opportunities that influence the performance of the organization, but which are not easily perceived. Once such improvements are conceived in their original processes, new opportunities are identified, promoting the continuity of this cycle of improvements.

In this sense, the continuous automation of the productive processes led to the adoption of new measures, with the great support of intelligent computational tools, which culminated in the automation of routines and procedures in the production process through interactive software. Also, enables them to be accessed by collaborators faster, are easy to access and contribute to version update control. In addition, they allow the self-assessment of employees and identify their skills for a particular process, as well as giving managers the skills necessary for the employee to perform a certain function within the organization.

Indeed, the concept of gamification has become relevant since it aims to apply gaming techniques in several areas, such as business, health, and social life since it promotes engagement and challenges the creativity of users, typical proposals of an interactive game, as sustained by [1], [2],[3], and [4] .

What is intended to use the concept of gamification is to make use of the characteristics that a game has to set up how to betray users, not the creation of a game itself. What is wanted, besides the stimulated engagement, is to promote the commitment of the individuals, to focus on the participating objectives and to reward them for it.

In this sense, exploiting the techniques of gamification to boost the qualifications of an organization's employees can be a common practice within companies, since, by proposing a challenge, and rewards for success, it stimulates curiosity, sets challenges and rules, so that you complete the task successfully.

However, this concept has been explored in the context of promoting more interactive and collaborative learning environments, which makes this technique widely exploited to generate value and knowledge within organizations.

The present study aims to develop a better understanding of the experiential value derived from gamified experience throughout the employees' journey. Four research questions are addressed:

RQ1. What are the motivations for production employees and staff to use gamified learning systems?

RQ2. What are the forms of experiential value derived from gamified learning systems?

RQ3. What are the positive/negative outcomes derived from employee's engagement through the use of gamified learning systems?

RQ4. Which factors influence the effects of engagement on positive and negative outcomes of gamified learning systems?

These research questions are addressed in an extensive study of employee's experiences throughout their "productivity journey" in organizations that employ gamified learning systems, and contributes to the production and quality literatures, with a focus on the production training and self-assessment context.

In the following sections, theories regarding to automated work instructions and industry 4.0, are reviewed, and the gamification concept is presented. Subsequently, the data collection and analytical methods are described. The findings will be discussed, and a summary of the findings is shown.

The study concludes with a discussion of the results, opportunities for future research, and managerial implications.

2. Theoretical background

The Industrial Revolution provoked the emergence of the factories and the appearance of the industrial company and, with that, caused the following period changes, as such replacement of the artisan by the skilled worker; first experiences in business administration; consolidation of administration as an area of knowledge and, beginning of the industrial age, among others contributions.

In the scope of industrial processes, several tools and methodologies have already been proposed, all with the aim of promoting better results, in either cost reduction, productivity increase, team building, or better ways of managing a process. From the control of activities, to statistical methods and automatic controls, we now experience the era of total engagement, and one of the mechanisms used to achieve results through team collaboration and interaction is associated with the exploration and use of gamification concepts.

Regarding the historical aspects of the different industrial revolutions, we have:

- The first Industrial Revolution occurred from 1780 to 1860, based on the iron and coal revolution.
- From 1860 to 1914, the second Industrial Revolution took place, based on steel and electricity.
- The third Industrial Revolution began in the mid-1940s, based on the increasing use of advanced technological resources (automated systems, computers and industrial robots), and energy sources (based on oil, hydroelectric, nuclear and wind) in the industrial production system.
- The fourth Industrial Revolution is a term that encompasses some technologies for automation and data exchange and uses concepts of cyber-physical Systems, Internet of Things and Cloud Computing.

2.1. Industry 4.0

The term Industry 4.0 stands for the fourth industrial revolution which is defined as a new level of organization and control over the entire value chain of the life cycle of products [5]. The need of industry 4.0 is to convert the regular machines to self-aware and self-learning machines to improve their overall performance as well maintenance management with the proper interaction [4].

Industry 4.0 is a collective term for technologies and concepts of value chain organization. Within the modular structured Smart Factories of Industry 4.0, CPS (Cyber-Physical Systems) monitor physical processes, create a virtual copy of the physical world and make decentralized decisions. Over the IoT, CPS communicate and cooperate with each other and humans in real time. Via the IoS, both internal and cross-organizational services are offered and utilized by participants of the value chain [6].

As a derivation of these concepts, we have the following principles: Interoperability, Virtualization, Decentralization, Real-Time Capability, Service Orientation and Modularity.

The authors resume these principles as follow:

- *Interoperability* means how CPS and humans are connected over the IoT and the IoS.
- *Virtualization* is related to how CPS are able to monitor physical processes, and the data are linked to virtual plant models and simulation models.
- *Decentralization* is related to CPS to make decisions on their own.
- *Real-time capability* means that sensor data is collected and analyzed in real time, and preventing major influences in the process.
- *Service Orientation* means that the services of companies, CPS, and humans are available over the IoS, and can be utilized by other participants, being available both internally and across company borders.
- *Modularity* means that modular systems are able to adapt to changing requirements by replacing or expanding individual modules, and they can be easily adjusted in case of seasonal fluctuations or changed product characteristics.

As the industry concept 4.0 has become relevant lately and has brought significant changes in organizations, institutional and government support has occurred. Many governments are also supporting the development of such solutions, especially the European governments, the United States and the Japanese governments, confirming that this new Industry era is viewed as strategic by the major industrial powers and players [4].

Although in some countries the internal regulations can be a constraint to the adoption of the concepts advocated by industry 4.0 in its entirety, the solutions presented consolidate the already known and implemented lean manufacturing tools. Therefore, Industry 4.0 applications can stabilize and support lean principles [7].

2.2. Automation of work instructions

With the advancement of computer resources and their combination with lean practices aiming at the identification of waste, in the context of the production process it was necessary to re-evaluate the systematics of trainings on the job, the existence of procedures and instructions of work, as well as point-to-point lessons and specific instructions made available throughout the process.

In order to reduce or eliminate the amount of information available in the physical environment, organizations have adopted mechanisms that are more intelligent and more reliability for the dissemination and preservation of information, through the automation of routines and working instructions necessary for the productive processes.

The current processes have as demand automated work instructions, easy access, security in the preservation of information, as well as ease of version control, where such information can be previously produced and collected automatically for later viewing.

The increasing demand for highly customized products requires flexible, reactive and adaptive manufacturing systems, and accurate and up-to-date information about the processes is a strict requirement to meet these needs [9].

The need to automate routines and work instructions are not limited only to the productive environment and can be extended to the most diverse processes of the departments of an organization, as exemplified by different researchers [10-12].

In production industry assembly instructions are often in need of improvement, and are often text based and are used only when learning assembly, and due a high product variety the instruction quality need to be perceptual in order for the operator to make fast and correct decisions [13].

2.3. Gamification

Over the years, several methodologies and techniques have been developed to drive improvements in processes and capacity building of teams. The increasing automation of processes has led to changes in production management, especially through the creation of continuous improvement environments.

In this sense, gamification has been widely used as an alternative to involve teams in the search for results recommended by different methodologies (for example, those in lean thinking and lean manufacturing), invigorating them and broadening their scope.

The development of industry and the advancement of Technology drive new learning strategies, one of which is gamification. Gamification is a tool that makes use of elements that belong to games in various contexts that, when applied in an innovative way, can encourage the interest and the learning of employees [14].

In another approach, maintains that a complete game-related experience requires four fundamental aspects (aesthetics, history, mechanics and technology) and, through this, can transmit a message to the player, Promote employee engagement and behaviour changes if taken advantage of by organizations [15].

Gamification's mechanisms typically include scoring systems, levels, and emblems to indicate individual participant progress through specific tasks and report their status to other participants in order to create interactivity [16].

In addition, they cite that the engagement strategy differs from others by the way it introduces a competition component as a motivator to encourage behavioural and emotional responses, working exactly with two principles that connect Experience and engagement: dynamics and emotions.

The gamification refers to the use of gamification's mechanics to create a gamification experience and influence behaviours and emotions in traditionally non-game-related contexts.

What is intended to use the concept of gamification is to make use of the characteristics that a game has to set up how to betray users, not the creation of a game itself. What is wanted, besides the stimulated engagement, is to promote the commitment of the individuals, to focus on the participating objectives and to reward them for it [1, 2, 14].

The majority of contemporary applications of "gamification" are based on providing tangible, external rewards in the form of attaining badges, levels, and leader boards, and in certain scenarios, the concept of external rewards

works perfectly well but to be benefit to the employee the “gamification” system needs to address the internal motivation of an employee [2].

The gamification approach can be relatively easily harnessed by organizations to achieve benefits through employee and general consumers’ engagement and promoting behaviour change and a key challenge of contemporary organizations is how to effectively motivate employees to contribute their knowledge distributed throughout the organization, and it means that engaged employees display desirable behaviour and attitudes at work [14-18]. From an organizational perspective, the primary driver of gamification is to trigger and incentivize responses such that customers exhibit behaviours and experience emotions, as faced in a gameplay engagement culminating in positive relational outcomes, loyalty and relationship development [16].

The gamification, associated with lean thinking, has the potential to motivate students to get involved in the classroom, provides the best teachers tools to take a practical sense and applied to the students and makes the students take the pursuit of learning [18].

Gamification creates a unique environment with singular aspects, such as a game narrative, continuous reflection, competitiveness, teamwork, challenges, emotion, rewards, fun and pleasure, which originate in the interaction between employees through the healthy competition of to make daily tasks more stimulating. In the perspective of the educational process, the potential of gamification is high and relevant, since it provides the awakening of interest, increases participation, develops creativity and autonomy, promotes dialogue and solves problem situations.

3. Case study

This case study was carried out in a company of electronics industry based in the Industrial Pole of Manaus. Technicolor Brasil is a company that creates, manages and delivers entertainment content worldwide, with an extensive portfolio of products focused on imaging and sound technologies, manufacturing electronic products for the multimedia area.

The methodology of this work is to evaluate the systematic development, control and storage of instructions and work routines, as well as the types and formats of training offered, in order to identify the mechanisms of learning and knowledge transfer to employees. Thus, it intends to use the concepts of gamification to make the training processes automatic, interactive, intuitive and therefore personalized, giving more versatility, besides the involvement and engagement of employees.

Regarding the training process of the organization, this takes place according to the need of the areas. It means that is linked to the planning and execution of the existing skills development plan for each employee of the different departments of the organization.

This study was concerned with addressing the systematics present in the management of production processes.

However, it is observed that the instructions and routines are all available in printed form, following the classic model of instructions dedicated by product and process, which are always available to the employees in their respective workstations, as shown in Fig. 1.



Figure 1 - Work station and Instructions

Once such documents are available in printed form, the risks inherent to their disuse, loss, obsolescence and expired validity are enhanced. In addition, there is a risk that nonconformities will be identified during the quality audit process for the different reasons already mentioned.

In addition, there is no guarantee that the employee is fully qualified to perform the activities required for a particular job, can be an agent that causes quality problems originating from the production process due to lack of training for the activity to be performed, insufficient training or lack of knowledge of the process.

It was then identified opportunities for improvements that have impacted on different company processes, from those directly related to employee training as well as those related to the quality system of the organization.

In fact, in order to develop a modern and permanent platform, it was decided to broaden the concepts recommended by Industry 4.0 regarding the management of production data, its collection, analysis, treatment, access and disposal.

For this, the premises of gamification were used as strategy for the development of the new training platform, giving greater value to the teaching-learning process of the organization as shown in Fig. 2.



Figure 2 - Training sessions

4. Results

This case study proposed the implementation of a new novel training system that makes use of gamification as a strategy for employee engagement. This approach allows the involvement of users with some aspects, such as the narrative of the game, continuous reflection and competition, which is directly linked to the recognition in the industrial organization, that occurs in the form of awards, materials or not, contributing to the personal motivation regarding the fulfillment of the goals pre-established by the company's sectors.

As a result of the studies carried out, an automatic training system was developed, with easy access to registered employees. From the training developed for each process, the collaborator is able to proceed with the necessary studies on the subject and, after finishing it, progresses to the next stage, which consists of the evaluation of learning. As in a game, there is a goal to be achieved and the employee sets their goals to advance the necessary steps to reach the goal achieved and get the associated awards.

In this context, within a productive process, the employee's goal is related to his / her effective participation in a given process. As an objective to achieve such goals is to develop skills and abilities, the degree of knowledge and training that he must possess to develop activities related to this process are required steps. Once all phases are completed successfully, this employee is a potential resource for participation in the project, as well as gathering the necessary skills and knowledge for possible functional progression.

In addition, this can be linked to the process of functional evaluation, and it depends on how the organization will use this information on its merit and promotion platforms, for example, just as it is done in the maximum stage of a game, which is recognition for finalizing all the steps successfully. In order to create a simple and easy device, allowing the best use and sharing of the resource, the system has the following sequence of operation:

- (a) Operator accesses the Tech FFIT module;
- (b) A list of instructions is displayed on the screen;
- (c) Choose the routine in which to carry out the studies / training;
- (d) After finishing the study / training, performs the test of verification of learning - QUIZ;
- (e) Terminates the test, indicating the final result;
- (f) Terminates access to the module.

In addition, the employee's training history is created, also allowing identification of potential future training demands based on the skills to be developed.

The developed system is shown in Fig. 3.

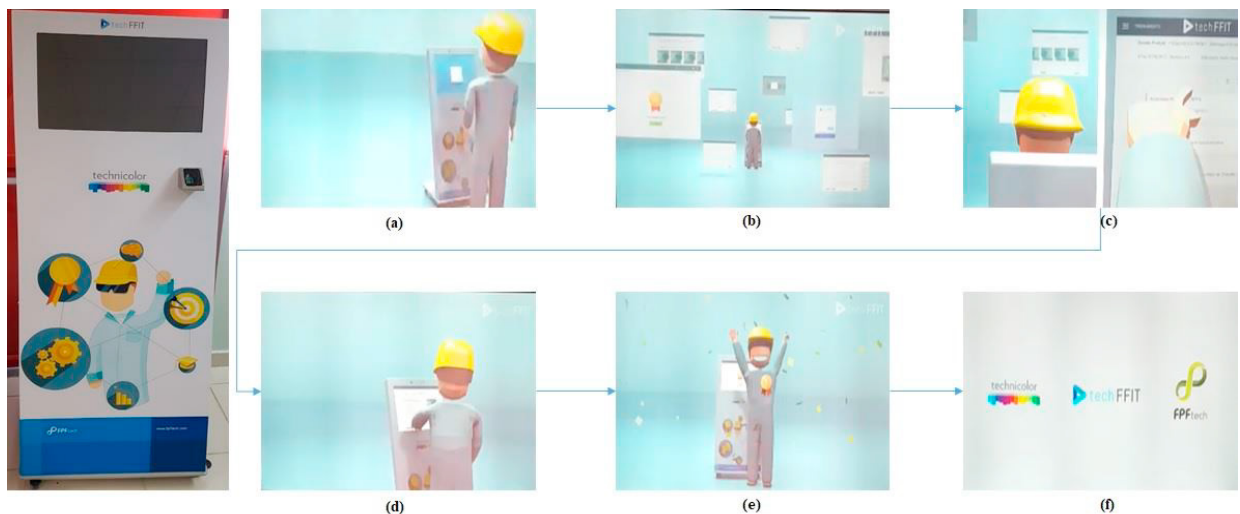


Figure 3 – techFFIT Module

5. Conclusions

The objective of this case study was to share practical results of the adoption of the gamification processes, which allowed, through the integration and involvement of the work teams, the development of automated document control systems and self-evaluation processes.

The production sector realizes the need to incorporate new practices into their usual routines, in order to improve their results and to be aligned strategically with the organization.

In this sense, the automation of the routines and procedures in a productive process, through interactive software, allows them to be accessed by employees more quickly, they are easy to access and contribute to the control of version update.

In addition, they allow the self-assessment of employees and identify their skills for a given process, as well as transmit to the managers the skills necessary for the employee to perform a particular role within the organization.

The system developed, besides creating an innovative environment regarding training management in the organization, also allowed to contribute with improvements as follow: (i) in the areas of process control; (ii) systematization of activities; (iii) standardization of routines and work instructions; (iv) document version control;

(v) improvements in the learning processes; (vi) identification of future training needs; (vii) the mapping of the skills, and abilities of the employees to the needs of the organization.

In practice, by broadening the understanding and application of lean thinking through the assumptions of gamification, it has the potential to motivate employees to become involved in the organization, provides managers with better tools to make a practical and applied sense to employees, and that the employees are led to search for learning.

In order for this to happen with complete success, and in order to achieve the planned goals and objectives, lean games need to be well chosen and adapted to align with the dynamics of a productive environment, as well as with limited experience in the various methodologies and tools available.

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References

- [1] Hammedi, W., Leclercq, T., & Van Riel, A. C. R. (2017). "The use of gamification mechanics to increase employee and user engagement in participative healthcare services." *Journal of Service Management*, **28**(4), 640–661. <https://doi.org/10.1108/JOSM-04-2016-0116>
- [2] Insley, V., & Nunan, D. (2014). "Gamification and the online retail experience." *International Journal of Retail & Distribution Management*, **42**(5), 340–351. <https://doi.org/10.1108/IJRDM-01-2013-0030>
- [3] Man, J. C. De, & Strandhagen, J. O. (2017). "An Industry 4.0 Research Agenda for Sustainable Business Models." *Procedia CIRP*, **63**, 721–726. <https://doi.org/10.1016/j.promfg.2017.03.315>.
- [4] Barreto, L., Amaral, A. & Pereira, T. (2017). "Industry 4.0 implications in logistics: an overview." *Procedia Manufacturing*, **13**, 1245–1252. <https://doi.org/10.1016/j.promfg.2017.09.045>.
- [5] Vaidya, S., Ambad, P., & Bhosle, S. (2018). "Industry 4.0 - A Glimpse." *Procedia Manufacturing*, **20**, 233–238. <https://doi.org/10.1016/j.promfg.2018.02.034>
- [6] Hermann, M., Pentek, T., & Otto, B. (2015). "Design Principles for Industrie 4.0 Scenarios: A Literature Review." Technische Universität Dortmund. <https://doi.org/10.13140/RG.2.2.29269.22248>.
- [7] Wagner, T, Herrmann, C. & Thiede, D. (2017). "Industry 4.0 impacts on lean production systems." *Procedia CIRP*, **63**, 125–131. <https://doi.org/10.1016/j.promfg.2017.02.041>.
- [8] <http://embedded-computing.com/white-papers/white-0-challenges-solutions-storage-devices/>
- [9] Bauters, K., Cottyn, J., Claeys, D., Slembrouck, M., Veelaert, P., and Van Landeghem, H. (2018). "Automated work cycle classification and performance measurement for manual work stations." *Robotics and Computer-Integrated Manufacturing*, **51**, 139-157. <https://doi.org/10.1016/j.rcim.2017.12.001>.
- [10] Amirov, A., Baimuldin, M., and Shakirova, J. (2014). "Automation working place head of department." *Procedia - Social and Behavioral Sciences*, **131**, 193-197. <https://doi.org/10.1016/j.sbspro.2014.04.103>.
- [11] Onnash, L. (2015). "Crossing the boundaries of automation - Function allocation and reliability." *International Journal of Human-Computer Studies*, **76**, 12-21. <https://doi.org/10.1016/j.ijhcs.2014.12.004>.
- [12] Panfilov, P., & Salibekyan, S. (2014). "Dataflow computing and its impact on automation applications." *Procedia Engineering*, **69**, 1286-1295.
- [13] Mattsson, S., Fast-Berglund, & Li, D. (2016). "Evaluation of Guidelines for Assembly Instructions." *IFAC-PapersOnLine*, **49**(12), 209-214. <https://doi.org/10.1016/j.ifacol.2016.07.598>.
- [14] Sarangi, S., & Shah, S. (2015). "Individuals, teams and organizations score with gamification." *Human Resource Management International Digest*, **23**(4), 24-27. <https://doi.org/10.1108/HRMID-05-2015-0074>.
- [15] Paravizo, E., Chaim, O. C., Braatz, D., Muschard, B., & Rozenfeld, H. (2018). "Exploring gamification to support manufacturing education on industry 4.0 as an enabler for innovation and sustainability." *Procedia Manufacturing*, **21**, 438-445. <https://doi.org/10.1016/j.promfg.2018.02.142>.
- [16] Harwood, T., & Garry, T. (2015). "An investigation into gamification as a customer engagement experience environment." *Journal of Services Marketing*, **29**(6/7), 533-546. <https://doi.org/10.1108/JSM-01-2015-0045>.
- [17] Suh, A., & Wagner, C. (2017). "How gamification of an enterprise collaboration system increases knowledge contribution: an affordance approach." *Journal of Knowledge Management*, **21**(2), 416-431. <https://doi.org/10.1108/JKM-10-2016-0429>.
- [18] Deif, A. (2017). "Insights on lean gamification for higher education." *International Journal of Lean Six Sigma*, **8**(3), 359–376. <https://doi.org/10.1108/IJLSS-04-2016-0017>.
- [19] <http://www.techtudo.com.br/noticias/noticia/2016/07/o-que-e-gamificacao-conheca-ciencia-que-traz-os-jogos-para-o-cotidiano.html>.