

# An Evaluation of the Participants' Perception of a Gamification to solve Problems of Software Process Improvement in the Educational Context

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**Abstract**— This Research to Practice Full Paper presents that Software Process Improvement (SPI) is seen as the fundamental approach to improving software products in software development organizations, being used to improve software quality and reliability, employee and customer satisfaction and return on investment, among other factors. Specialized studies report that organizations face several problems and difficulties in conducting software process improvement initiatives. Among the existing factors are issues related to the attitudes of individuals, for example, resistance to change, lack of motivation, support and commitment of those involved in the initiatives. In this context, it is important that organizations adopt approaches and strategies to facilitate the implementation of the SPI initiatives, since the lack of adequate treatment and consequently the occurrence of problems is something that leads to the failure experienced in the improvement initiatives. Many companies have used game strategies to motivate and engage the employee, not only in productivity and fun, which inevitably improves the work environment, but also to encourage innovation and development of their tasks. Thus, the use of gamification in the context addressed can stimulate people's motivation and commitment to effectively join and participate in SPI initiatives. Gamification has been used to assist in the teaching-learning process, and can be applied in the educational area or in companies, to stimulate a learning and work climate through the motivation of the people involved. Thus, this paper considered the context of problems and difficulties that occur in the software process improvement. To evaluate the strategies developed to minimize or treat these problems, a dynamics with gamification elements was applied in a research laboratory. It is noteworthy that gamification has been used to assist in the teaching-learning process, and can be applied in the educational area or in companies, to stimulate a learning and work climate through the motivation of the people involved. In view of the above, this paper aims to evaluate the perception of the participants who acted in the dynamics, in order to obtain feedback regarding the strategies applied to the problems, if they promoted the learning and engagement necessary to develop the activities necessary to achieve the results of the improvement. Thus, in the participants' perception, the use of gamification elements contributes as a mechanism to stimulate people's motivation and commitment to adhere and effectively participate in SPI initiatives.

**Keywords**—*software process improvement, gamification, teaching and learning, problems and difficulties.*

## I. INTRODUCTION

The current teaching context highlights the need to adjust and adopt new practices and strategies to the teaching-learning process, which favors the search to stimulate learning through multi and transdisciplinary means in order to increase the levels of motivation and engagement

of individuals, and consequently provide effective and relevant experiences to those involved [1].

In this context, a recurring challenge is perceived in the teaching of Software Engineering related to engaging those involved to experience the professional practices of software engineering so that they can understand what knowledge and techniques are necessary to use in different situations [2].

This study considers learning in a subarea of Software Engineering called Software Process Improvement (SPI). This subarea guides that, in order to develop quality software, it is necessary that the steps for its development are accompanied by planned and managed activities, in order to minimize costs and optimize the performance of tasks [3].

Pressman [4] emphasizes that the lack of adoption of methods, tools and procedures in software development has led to significant numbers of unfinished projects, and completed projects that do not meet customer needs. This highlights the importance of considering methods and techniques in the processes proposed in SPI initiatives, to facilitate the implementation, and thus, minimize the negative effects perceived by those involved in the process [5].

In view of the above, it is noticeable the need to use mechanisms to address or minimize the problems or difficulties present in SPI implementations. Thus, a strategy that can help in this problem is the use of gamification elements, since it covers the use of game mechanisms and systems to solve problems related to motivation and engagement of a particular audience [6]. Domínguez et al. [7] emphasize that the context of games is capable of promoting playful and fictional contexts in the form of narratives, favoring the learning process.

Thus, the objective of this paper is to evaluate the perception of participants who acted in a dynamic with gamification elements suitable for the treatment of SPI problems or difficulties, in order to obtain feedback regarding the strategies applied to the problems, if they promoted learning and the engagement needed to develop the activities necessary to achieve the improvement results.

Schmitz, Klemke and Specht [8] exemplify that in the learning process gamification contributes both to motivation and to the cognitive development of the person involved. Its use contributes to the creation of a unique learning environment, with effectiveness in retaining attention, where motivation is based on the articulation of the experiences lived by individuals [9].

In addition to this introductory section, this paper is structured as follows: Section II presents the research methodology, Section III presents the application of gamification, Section IV presents an evaluation of the participants' perception, Section V presents the discussion of the results and Section VI presents the conclusions.

## II. RESEARCH METHODOLOGY

The developed gamified dynamics involves three profiles of participants, and each of these must have skills and competences to act in the dynamics, the description for each profile is presented in Table I.

TABLE I. DESCRIPTION OF THE PERFORMANCE PROFILES IN THE DYNAMICS.

Participant Profiles	
1. Operations Instructor	
Skills	<ul style="list-style-type: none"> <li>- <b>Interpersonal understanding:</b> being able to create and maintain a good relationship with those around us, because the better the relationship between the employees of an organization, the more productive their coexistence will be.</li> <li>- <b>Empathy:</b> knowing how to put yourself in the shoes of others is completely necessary in order to better understand their feelings, attitudes and avoid hasty judgments about their way of being, thinking and acting in order to make appropriate decisions.</li> <li>- <b>Assertive communication:</b> refers to the ability to express oneself appropriately, that is, it represents listening and being heard, which allows creating an environment of respect, where people are able to exchange ideas, knowledge and experiences in a reciprocal way.</li> <li>- <b>Problem and conflict management:</b> refers to the ability to manage and seek the correction of problems, conflicts or crises that may affect the smooth running of activities in the organization.</li> </ul>
Competences	Be an expert in the SPI and / or be an expert in the Gamification.
2. Heroes	
Skills	<ul style="list-style-type: none"> <li>- <b>Creativity:</b> it is related to the ability to propose more efficient, economical and innovative solutions and ideas for existing problems or situations.</li> <li>- <b>Flexibility and adaptation:</b> having the ability to learn and adapt flexibly to constantly changing situations. This understanding helps to deal with the unforeseen, to overcome moments of crisis and to face new challenges with confidence.</li> <li>- <b>Ability to work in a team:</b> having the ability to work collaboratively to solve a common goal or problem. Collective action can generate positive results where internal competitiveness gives way to cooperation, so that the</li> </ul>

	<p>organization achieves the expected results.</p> <ul style="list-style-type: none"> <li>- <b>Proactivity:</b> it is evidenced when the person has initiative, is active in their actions and takes responsibility with conscience without someone having to ask them to act. That is, it is the ability to identify a problem or challenge, anticipate a solution or decision, and assume responsibility, effort and action control.</li> </ul>
Competences	Team of employees of the Organization, who act directly in the actions necessary to improve the desired process.
3. Government Representatives	
Skills	<ul style="list-style-type: none"> <li>- <b>People management:</b> being able to understand the personalities of the people around you and adapt interactions with them to their needs.</li> <li>- <b>Leadership:</b> having the ability to delegate, motivate, guide, communicate and positively influence those involved in the process.</li> <li>- <b>Assertive communication:</b> refers to the ability to express oneself appropriately, that is, it represents listening and being heard, which allows creating an environment of respect, where people are able to exchange ideas, knowledge and experiences in a reciprocal way.</li> <li>- <b>Problem and conflict management:</b> refers to the ability to manage and seek the correction of problems, conflicts or crises that may affect the smooth running of activities in the organization.</li> </ul>
Competences	Representatives who work in the Organization's Senior Management who have a holistic view of the organization's needs and processes.

The dynamics is divided into missions, shown in the "Secret Processes Map" (as can be seen in Figure 1), the objective of each mission will be explained below, but the detailed description of the steps is presented in [10].

In Mission 1, "Develop Strategies", those involved must present proposals and solutions, in order to clarify and establish guidelines to guide the missions and operations that must be performed along the heroes' journey, according to organizational needs, with actions directed to the objectives and goals in the SPI aligned with the organization's business objectives. The gamification elements involved in this mission are: i) Rockstar Effect, ii) Elitism, iii) Narrative and iv) Building from scratch.

Mission 2, "Authorize Strategies", aims to analyze and validate the strategies conceived in Mission 1 in order to formalize a structure that can meet or assimilate the suggested needs together with the missions and that are appropriate to the SPI and the organization's objectives. The gamification elements involved in this mission are: i) Building from scratch, ii) Tutoring and iii) Narrative.

Mission 3, "Train Hero", aims to instruct / enable the hero in relation to the SPI, the desired model, concepts and

terms, as well as necessary tools, in order to raise awareness and prepare the hero in the development of their activities during the missions. The gamification elements involved in this mission are: i) Tutoring and ii) Progress bars.



Fig. 1. Secret Process Map [10].

In Mission 4, “Develop Operations”, the heroes are intended to perform the activities that were agreed in Mission 2, necessary to implement the desired improvement model, the development of these activities ensures the hero to participate in the special operations that this mission has. Instructors must manage and coordinate special activities and operations in order to ensure that they are carried out. The gamification elements involved in this mission are: i) Free Lunch, ii) Rockstar Effect, iii) Brilliant Choice, iv) Symbols of Conquest, v) List of Rewards / Lottery and vi) Mystery Boxes.

In Mission 5, “Evaluate Mission”, the Operations Instructors have the objective of carrying out and providing an evaluation in relation to the performance obtained by the heroes in the missions according to the adopted strategies. And they must also obtain feedback from those involved (heroes and government representatives) regarding the dynamics of actions established in the mission, considering the ARCS (Attention, Relevance, Confidence, and Satisfaction) Model [11] to evaluate the stakeholder's motivational factor. The gamification elements involved in this mission are: i) Nomination Dynamics and ii) Progress Bars.

And finally, in Mission 6, “Evaluate Journey”, the Operations Instructors must obtain feedback from those involved (heroes and government representatives) regarding the dynamics of actions established along the journey in relation to SPI issues. In this mission, there was no use of a gamification element, as it is a mission that seeks to obtain feedback from those involved in relation to the applied dynamics.

Therefore, for the evaluation stage present in this study to occur, firstly, the application of the dynamics that integrates all the gamified elements in relation to the problems involved in the improvement initiatives [12]. And at the end of the dynamics, in Mission 6, the participants' feedback was collected, and from the data collection it was

possible to evaluate the perception of those involved in the face of the applied dynamics.

To evaluate the perception of those involved, a qualitative analysis was carried out, where feedback from those involved was obtained on the gamification strategies applied to SPI problems in a Brainstorming, using the 'Satisfaction Report - SPI Problems'. This report is based and developed with questions aimed at the use of gamified strategies to mapped SPI problems.

Therefore, this study is characterized as a qualitative research, since the analyzed data are not numerical and aim to produce information instead of quantifying its results [13]. In this type of research, the concern is to obtain information from the point of view of individuals and the interpretation of the environment in which they work, which is the research environment.

### III. APPLICATION OF GAMIFICATION

To evaluate the application of the proposed gamification dynamics, an Experience Report was carried out in the SPI, where we sought to evaluate the applicability of the dynamics as well as the effects of its use. Thus, to carry out the SPI dynamics, the Laboratory belonging to the SPIDER (Software Process Improvement: Development and Research) group, at the Institute of Exact and Natural Sciences of the Federal University of Pará (UFPA) in Brazil, was selected.

Subsequently, the points of improvement that the laboratory needed were verified, so that the improvement model could be defined that would be adopted to meet the needs for improvement in the context of the research laboratory. Thus, it was verified that the needs were supported from the implementation of the Customer and Market (CM) dimension belonging to the MOSE® (Model Guiding for Success in Enterprises) Competence. MOSE is composed of five dimensions of competence: Society and Sustainability, Human Talent, Quality, Customer and Market and Innovation. However, the study considered only the implementation of the CM competence dimension, given the existing needs in the laboratory context.

According to Rouiller [14], the purpose of the Customer and Market competence is to address questions about the structuring of the enterprise to satisfactorily serve its customers (internal or external), market analysis (and / or environment), relationship with customers (current and potential), as well as the impact of the goods and services generated therein.

Therefore, the implementation of the CM competence dimension, in the context of SPIDER, considered the expected results in the 4 Competence Goals of a small business unit, CM.1 to CM.4.

The application in a small scenario is justified by the number of employees who participated in the dynamics, a total of seven. This amount underlies the group as a small profile, which according to Rouiller (2017) is commonly represented when they have 2 to 25 employees and represent enterprises that are normally, but not restricted, in the early stages of the business, demanding urgency for the its own survival.

Table II presents the description of the goals and expected results in the CM competence dimension for small organizations.

TABLE II. DESCRIPTION OF THE CM COMPETENCE DIMENSION.

CM Competence (Goals)	Expected Results
CM.1. Agreements with customers are established and managed.	It is expected for this practice that agreements with customers are obtained, maintained, and managed to completion.
CM.2. Customer demands are met.	For this practice, products and services are expected to be developed in accordance with the agreements previously established in the practice of CM.1.
CM.3. Sales actions are carried out.	It is expected for this practice that actions are carried out to promote the sale of the organization's products and services and that these are, preferably, registered.
CM.4. Trust relationship with the customer is established and sustained.	This practice is expected to implement ways of relating to the customer in order to guarantee, in particular, a good image of the organization and its loyalty.

As for the period of the dynamics application, this performed in the interval between 06/24/2021 to 07/29/2021, on Thursdays, from 3:00 pm to 6:00 pm. The meetings took place remotely through the Google Meet tool and with the necessary adaptations to the remote context, due to the restrictions imposed by the COVID-19 pandemic, with the application of social isolation measures. Thus, the materials needed to perform the procedures of each mission were made available as materials or as activities to participants in Google Classroom (a tool used to centralize and manage materials, deliverable during the dynamics).

The dynamics was conducted with the voluntary participation of students / researchers who work in the Laboratory of the SPIDER project. Table III contains descriptions of the participants' profile, as well as the code that was used to designate each one of them during the presentation of the results.

TABLE III. DESCRIPTION OF THE PARTICIPANTS' PROFILE

Participant Code	Formation	Professional Activity	Time of experience in Software Engineering
H1	Master (attending)	Technician	2 years
H2	Doctorate (attending)	Technician	4 years
H3	Master (attending)	Researcher	1,5 year
H4	Doctorate (attending)	Professor	10 years
H5	Doctorate (attending)	Researcher	4 years
H6	Doctorate (attending)	Systems Analyst	4 years
H7	Master (attending)	Researcher	5 years

There was also one participant, in addition to the seven who accepted to participate, with the attribution of a Judge, who observed the dynamics, checking if the others involved were carrying out the activities. The Judge also filled in the score table according to the evaluative items of the missions. The score information was made available to the participants in the performance worksheet (Google Worksheet, a tool used to make available to those involved the scores obtained in the actions carried out in the missions). A detailed description of the dynamics application is reported in [12].

#### IV. EVALUATION OF THE PARTICIPANTS' PERCEPTION

The evaluation in the applied dynamics performed in two moments, which happened when Missions 5 and 6 were executed. The results obtained in Mission 5 are described in [12]. The results obtained in Mission 6 will be described in this paper, the participants' perceptions for each problem are exposed below.

##### A. Culture Change in the Organization.

For the problem of culture change in the organization, the participants highlighted the relevance of inserting in the SPI the game elements present in the gamification. As reported below:

**H3:** *"I believe that the dynamics used in an organization can bring many benefits to mitigate the impacts that may occur in the organization's culture. The gamification elements encourage people to participate."*

**H2:** *"In an organizational environment, instant feedback, recognition and rewards stimulate those who participate, so the use of game elements in gamification in implementation helps a lot with the changes that will be necessary, very beneficial for the team."*

##### B. Lack of Knowledge in Software Engineering

For the problem of lack of knowledge in software engineering, the participants pointed out the importance of the strategies present in the dynamics in relation to the orientations, training and assistance provided:

**H1:** *"Training was essential to obtain more knowledge in the context of the model that was adopted, in our case the MOSE, as it contributed to the understanding of what needs to be done to fulfill the expected goal. Therefore, I found the training to be very effective, as it helped to develop activities more clearly and objectively."*

**H7:** *"The guidance and training made it very clear how to proceed in the context of the improvement model used."*

##### C. Lack of Understanding of the Responsibilities of those Involved

For the problem of lack of understanding of the responsibilities of those involved, the participants reported that the way the dynamic was conducted favored the understanding of the responsibility that each one had to play to help achieve the expected results in the implementation of SPI:

**H5:** *"The way in which the information was passed on in the dynamics made clear the responsibilities of each one, that is, the defined structure met and promoted the development of the demands."*

**H3:** *"As for the distribution of activities in the dynamics, I found it very interesting that there was no imposition to*

*develop the activities, giving people the possibility to take the activities that had more affinity or even knowledge, according to our skills, This ends up generating in those involved a sense of responsibility.”*

#### **D. Lack of Support Software Tools**

For the problem of lack of support software tools, the participants reported the proposed strategies as necessary, aimed at moments of guidance, aids and suggestions regarding the software tools that were considered and used in the improvement implementation, as reported below:

**H3:** *“The guidance received facilitated the understanding and use of the tools by the team.”*

**H4:** *“With moments of suggestions, the proposed tools could be evaluated by our team, this favored adherence to the needs of the laboratory, referring to the use and experience of the team itself.”*

**H7:** *“The possibility of helping and being able to receive help regarding the use of the tools, makes the environment for the development of activities more constructive and collaborative.”*

#### **E. Lack of / Little Commitment of Top Management**

For the problem of lack of little commitment from the top management, it was noticed by the participants that the presence and effective participation of the Manager contributed and encouraged the team to develop the necessary activities in the improvement, as reported below:

**H3:** *“I found the participation of top management to be very interesting and extremely important, as we see in the literature that recommendations in the improvements implementation must perform from the top to the bottom, so the change has to have the support of top management, this was noticeable at times suggestion from the team, where he was always supporting and directing the team, it helps to motivate the team as it shows that everyone is working together for improvement.”*

**H2:** *“The participation of top management in the dynamic was very important as a whole, as it generated motivation for the group, as it was possible to perceive that it was something really important for the organization, since the top management representative is working with the team.”*

#### **F. Little Support from Employees**

For the problem of little support from employees, participants reported moments of awareness and guidance related to addressing the importance and benefits of adopting an improvement model as essential, as well as moments of recognition and rewards provided in the dynamics, which also encouraged achievement of their activities, as reported below:

**H7:** *“The mechanisms used in the dynamics to guide and raise awareness favored the involvement and participation of the team, helping each participant to remain present and acting in a committed way at all stages of the dynamics.”*

**H4:** *“The moments proposed in the dynamics for recognition of the work to those involved generate motivation for the team to maintain commitment to the steps and deliveries necessary in the improvement.”*

#### **G. Turnover of the Personnel Involved**

For the problem of turnover of the personnel involved, the participants highlighted the importance of offering moments of improvement, present in the actions of tutoring and guidance, as well as they found the recognition and reward strategies used as a way to recognize the work that was developed relevant, as reported below:

**H4:** *“The dynamics aimed at maintaining the participation of those involved were of great importance, as they managed to engage and promote the development of the necessary tasks, there was also no dropout during the application of the dynamics, which shows that the team was able to see that it was not about something individual, but something that will benefit the whole team.”*

**H1:** *“Recognition strategies for the work performed are means that encourage participation and contribute to the continuity of action of those involved throughout the implementation of the improvement.”*

#### **H. Lack of / Little Qualified Human Resources**

For the problem of lack of / little qualified human resources, the participants highlighted the relevance of adopting the proposed moments in the dynamics that made possible scenarios of guidance and assistance from people from the team itself, when there were difficulties in developing some demands, as reported below:

**H2:** *“The guidelines and assistance provided were effective to supply the necessary knowledge to carry out the activities.”*

**H5:** *“Many organizations on a daily basis demand the skills and competences of their employees, with only the requirement of professional knowledge, but means are not always provided to minimize the difficulties experienced by their employees, the strategies present in the dynamics aimed at guidance and aid are positive strategies to be adopted.”*

#### **I. Focus on Certification instead of Focusing on Improvement**

For the problem of focus on certification instead of focusing on improvement, the participants reported that the dissemination of information related to the purpose, requirements and objectives necessary to achieve the results favored in the dynamics, promoted the awareness, understanding and contributions of those involved in implementing in a adequate and in its completeness the desired improvement, as reported below:

**H6:** *“The way in which the dynamics was structured contributed to removing the vision of only being evaluated or only seeking certification, as the dynamics was developed in a very collective context in the laboratory, providing a feeling of being part of the whole, that is, each collaborator was fundamental to achieve the expected result to improve our laboratory.”*

#### **J. Lack of Government Incentive**

For the problem of lack of governmental incentive, the participants reported as a positive factor the incentive promoted in the dynamics to structure mechanisms to publicize the work that is developed by the group in the laboratory, since it allows the visualization and recognition of external people, as reported below:



**H1:** *"The strategies developed will greatly contribute to the visibility and understanding of the work developed by the group in the laboratory, and consequently attract partnerships and recognition from external people."*

**H3:** *"As for the dissemination factor, I found a positive strategy for the laboratory to promote visibility to the public, as it does not restrict the work carried out to the group alone."*

**K. Lack of Knowledge the Importance of Models by the Market**

Thus, as in the problem exposed in Subsection J, in the problem of lack of knowledge the importance of models by the market, there were incentives to establish means of publicizing the work developed by the team, which were seen by employees as necessary and important to the context of the laboratory, as reported below:

**H5:** *"The data collection itself contributed to obtaining information that the team itself did not know, because with this knowledge it was easier to propose and follow up with dissemination actions, after understanding the laboratory context considering what was expected in the improvement."*

**H6:** *"The solutions established, according to the expected result in the dynamics, will contribute to give more visibility to the work performed by the Laboratory."*

**L. Reduction in Consulting Hours as a Way to Reduce Costs**

For the problem of reduction in consulting hours as a way to reduce costs, it was argued that the information passed on in relation to the model, regarding the necessary requirements for implementation, was of great importance to justify and encourage the development of the necessary actions to achieve the improvement, as reported below:

**H7:** *"The structure provided was fundamental for understanding the demands, and the real needs in the context of the group in view of the improvement model adopted, as everyone worked together in the development of the necessary tasks to structure and improve the Laboratory scenario."*

**M. Lack of / few Projects to validate an Improvement Program**

For the problem of lack of / few projects to validate an improvement program, the participants justified the moments of guidance to the team regarding the need to develop consistent projects that contribute to achieving the desired improvement as relevant, as reported below:

**H1:** *"The guidelines contributed to the understanding of the team in establishing consistent projects, capable of providing the expected result in the context of improvement."*

**H4:** *"The strategies to guide the team favored the knowledge and understanding necessary to structure effective means to achieve the results in the implementation."*

**N. Bureaucracy in Improvement Programs**

For the problem of bureaucracy in improvement programs, the participants indicated as positive the strategies aimed at clarification regarding the perceptions of excessive formalities that the improvement would bring to the work

environment, and reported as necessary the moments of contribution based on the suggestions proposed by the team to structure the process collaboratively, as reported below:

**H1:** *"The guidelines on the adopted model helped a lot in understanding and favored the development of the necessary demands, that is, it became easier to understand what was expected."*

**H3:** *"The collaborative construction of the team, in terms of defining the activities necessary to meet what was expected in the improvement model, made the development of demands favorable and efficient, demystifying the vision of only obligations to employees."*

**O. Continuity of Team Engagement in the Defined Process**

For the problem of continuity of team engagement in the defined process, the participants highlighted as relevant the guidance actions related to the transfer of information necessary for improvement, as well as the provision of performance in the demands made. These actions contribute to maintaining engagement in the process as it helps to achieve goals in activities and provides constant learning, as reported below:

**H2:** *"If the dynamics remained for the other dimensions, I would be able to remain engaged to develop the necessary demands."*

**H4:** *"Considering the same dynamics, to develop the other points of improvement and maintain those that have already been carried out, it would be very feasible that I would have the motivation and commitment to participate."*

**H7:** *"I would be able to maintain my engagement to continue if the strategies proposed in the dynamics were maintained."*

**P. Lack of / little Knowledge of Models by Employees**

For the problem of lack of / little knowledge of the models by the employees, the participants pointed out as important and necessary the moments of guidance related to clarifying doubts about the model adopted, as well as the moments of assistance provided, in order not to interrupt the improvement process, as reported below:

**H1:** *"I did not know the model used, so the moments of guidance focused on the context of the model were of great relevance for the understanding and use of the knowledge acquired in the development of demands."*

**H6:** *"The help of another participant in difficult situations was essential to carry out the demands, without interrupting and affecting the performance of the activities necessary for improvement."*

**Q. Different Interpretations regarding the Models**

As in the problem exposed in Subsection P, in the problem of different interpretations in relation to the models, the participants reported the importance of clarifying in the dynamics the purpose and procedures referring to the improvement model to be implemented, as reported below:

**H4:** *"The clarifications directed to the SPI scenario, and the information related to the desired model of improvement, notably helped the team to perform what was necessary to obtain the results adhering to the model used, which contributed to minimize the different*

*perceptions that the employees had in the context of improvement.”*

#### R. Lack of Consistent Project Portfolio planning

For the problem of lack of consistent project portfolio planning, it was pointed out as relevant to establish an adequate planning for their projects, which can contribute to obtaining the expected results with the implementation of the program, as reported below:

**H1:** *“The dynamics favored the awareness of the team to establish a set of works and strategies in the organization, capable of providing the expected result in the context of improvement.”*

#### S. Lack of Consistent Planning by the Organization's Top Management

For the problem of lack of consistent planning by the top management of the organization, the importance of establishing adequate planning by all involved was perceived, where everyone could contribute to obtaining the expected results, as reported below:

**H4:** *“The suggestions and opinions collected to structure and align the process with those involved were a moment of collaboration and of great relevance to those involved in the implementation.”*

**H5:** *“This was a strategy aimed at those involved to establish a structure that would meet the strategic objectives of the organization and the needs to adhere to the expected improvement, with the adoption of the model.”*

#### T. Lack of Model Flexibility

For the problem of lack of models flexibility, the importance of disseminating information related to the model was perceived, in order to clarify and structure, with those involved, the procedures to be performed, as reported below:

**H4:** *“The information passed on to the improvement model helped to understand the needs of the organization and contributed to structuring the procedures that would help to achieve the expected results in the context of the improvement, showing those involved that there may be an adequate and simplified structure to meet organization's needs.”*

**H6:** *“The possibility of proposing suggestions to structure the activities according to the needs of the Laboratory, and that consequently contribute to the achievement of the improvement results, is a necessary strategy as it clarifies the procedures seen as bureaucratic and rigorous in the implementation of having only impositions.”*

### V. DISCUSSION

In Mission 6, participants' perceptions were collected considering the dynamics applied with gamification elements to the treatment of each problem.

According to the reports presented, in Section IV, the participants provided positive feedback regarding the strategies applied to the treatment of each problem, where they evidenced at many times the importance of moments aimed at guidelines, clarifications and assistance, necessary to obtain the necessary knowledge. to develop the demands, and even for the understanding and awareness of the benefits

that the implementation would bring to the team's work environment.

The participants considered the proposed moments to be relevant to obtain suggestions and opinions from the team to structure and establish actions, together with the representative of the top management, in the Laboratory to achieve the expected results in the improvement implementation, stating that this made the environment more collaborative, where everyone could contribute and have ownership of what was being built.

Strategies of recognition and rewards in the work performed were declared necessary to maintain the engagement and interaction of the team throughout the dynamic, as they generated the motivation and commitment to develop activities related to improvement more efficiently.

Therefore, it was noticeable that the strategies applied to the problems promoted the learning, motivation and engagement necessary for those involved to develop the necessary activities to achieve the improvement results.

### VI. CONCLUSION

This study presented an evaluation of the participants' perception who acted in a dynamic with gamification elements suitable for the treatment of SPI problems or difficulties. This evaluation aimed to obtain feedback regarding the strategies applied to the problems, whether they promoted the learning and engagement necessary to develop the activities necessary to achieve the improvement results.

According to the analysis of the reports obtained, it was noticeable that the strategies applied to the problems promoted the learning, motivation and engagement necessary for those involved to develop the activities necessary for the improvement.

A limitation of this work is related to the scope of application of the dynamics, as it was used in only one competence dimension of the MOSE improvement model. This delimitation may have contributed to the positive results, as it is a smaller context. Therefore, the results could be different if they were applied in their entirety, considering the other dimensions of competence that make up the model.

As future work, we intend to replicate the dynamics considering all the competence dimensions that make up the model, in order to compare the results obtained in the applications.

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