Gamifying Science Communication: An Experience Report of *Jornada Galáctica* at *Canal Ciência*

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Abstract. The Canal Ciência Portal offers science communication content in various formats, including texts, biographies, informational materials, and interactive activities. These diverse offerings necessitate strategies to facilitate content exploration and promote recurring engagement. This paper describes the design, deployment, and initial evaluation of *Jornada Galáctica*, a gamification layer integrated into the portal, and introduces a goal-oriented measurement model to assess its development over multiple cycles. The research employs a seven-phase experience report methodology and a measurement plan based on the Goal-Question–Metric (GQM) approach. This plan integrates portal usage and navigation metrics with motivational-profile metrics. The initial measurement cycle established a baseline for the target audience's motivational profile and portal usage patterns. The subsequent cycle, conducted during the gamification layer's operation, provided preliminary engagement indicators reflecting initial adoption of the gamified experience. This study contributes a definition of gamification design and integrated evaluation process, both aligned with a goal-oriented measurement model. This alignment enables measurement goals to be directly linked to observable portal and gamification events, thereby supporting the continuous evolution of the gamification.

Keywords: Gamification · Motivational Profiling · Design Process · Octalysis Framework

1 Introduction

This study presents the design and initial evaluation of the *Jornada Galáctica* (Galactic Journey) gamification layer, which is integrated into the Canal Ciência Portal, a science communication initiative associated with a public research

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institution. The evaluation employs an indicator-based analysis that combines motivation metrics derived from psychometric instruments and motivational profiles with portal usage metrics from navigation logs. These metrics are organized according to measurement goals established by the Goal–Question–Metric (GQM) approach.

From a computational perspective, the primary challenge extends beyond defining game elements to operationalizing them as observable events, software requirements, progression rules, and measurable indicators. Consequently, the intervention requires a traceable link between motivational assumptions, gamification mechanics, system instrumentation, and portal logs.

The objective of this study is to describe the process for defining and deploying *Jornada Galáctica* and to evaluate its initial implementation through measurement cycles. The first measurement cycle characterizes the target audience's motivational profile and the portal's usage patterns, establishing a baseline for comparison. The second measurement cycle, conducted with *Jornada Galáctica* in operation, yields the initial gamification-related engagement indicators.

The principal contributions of this research include: (i) a seven-phase process that integrates gamification definition with indicator-driven evaluation; (ii) a measurement model structured using the Goal–Question–Metric (GQM) approach, aligning goals, questions, and metrics with the institution's objectives; and (iii) an initial application of this model across two measurement cycles, providing baseline data and the first engagement indicators to inform the ongoing development of *Jornada Galáctica*.

The rest of this paper is organized as follows: Sect. 2 presents the theoretical background; Sect. 3 describes the methodology; Sect. 4 details the seven-phase process and the measurement plan; Sect. 5 presents the discussion; and Sect. 6 presents the conclusion.

2 Background

2.1 Gamification

Gamification is defined as the use of game design elements in non-game contexts [3]. Gamification has the potential to engage individuals, motivate action, promote learning, and help address complex problems [6].

According to Honorio *et al.* [5], one of the most widely adopted structures for gamification design is the hierarchical taxonomy proposed by Werbach and Hunter [14]. This taxonomy organizes gamification into three levels of abstraction: (i) Dynamics, which sit at the top of the hierarchy and encompass conceptual aspects of how the system evolves, including constraints, emotions (such as curiosity and competitiveness), narratives, progression, and social relationships; (ii) Mechanics, which correspond to the basic processes that engage the user and determine how the dynamics are carried out, such as cooperation, reward systems, and competition; and (iii) Components, which are the practical and visible elements in the interface, such as virtual goods, missions, teams, leaderboards, collections, points, levels, and avatars.

While Werbach and Hunter's taxonomy categorizes the structural components of gamification, it lacks a mechanism to map how these elements mobilize specific human motivational forces. For this purpose, this work adopts the Octalysis framework [2] as a lens to analyze and structure motivation based on its main core drives. Octalysis is used to analyze and apply human motivation in interactive systems. In this approach, interactive systems are structured around eight Core Drivers (CD) that influence human behavior. The CDs are:

- CD1 - Epic Meaning and Calling: People are motivated by a cause or mission they believe is greater than themselves.
- CD2 - Development and Accomplishment: The drive for progress, skill development, and achieving goals.
- CD3 - Empowerment of Creativity and Feedback: Encouraging creative freedom and providing regular feedback to guide progress.
- CD4 - Ownership and Possession: Motivation that comes from owning something and wanting to improve it or acquire more.
- CD5 - Social Influence and Relatedness: Engagement with social elements such as guidance, social acceptance, social feedback, companionship, and competition.
- CD6 - Scarcity and Impatience: The need to have something because it is rare, exclusive, or not immediately available.
- CD7 - Unpredictability and Curiosity: A drive related to the pleasure of experiencing surprises and the excitement of discovering what will happen next.
- CD8 - Loss and Avoidance: Motivation to avoid negative outcomes, including fear of loss and the desire for consistency.

To complement the Octalysis framework, this work uses Self-Determination Theory (SDT) as the conceptual basis for discussing dimensions of intrinsic motivation in the target audience, as detailed in the metrics subsection [12].

2.2 Metrics in Gamification

Evaluating the outcomes of gamification requires a multidimensional approach to establish the validity and impact of a gamified system. A model for evaluating digital interventions highlights the need to incorporate several core gamification principles [4]: (1) meaningful purpose, in which the system's goals align with user interests; (2) meaningful choice, granting users agency over how they achieve goals; (3) support for player archetypes, adapting mechanics to individual characteristics; (4) continuous feedback, communicating how actions affect outcomes; and (5) visibility, making clear what progress has been achieved and what is still needed.

The metrics used to evaluate gamification can be organized according to the type of evidence they produce and the role they play in interpreting results. The evaluation of gamified interventions cannot rely on a single type of measure, since different metrics capture distinct dimensions of the phenomenon—from observable behavior in logs to self-reported subjective states and outcomes associated

with the domain objective. Consequently, behavioral metrics provide evidence of use and interaction, while psychometric instruments support the analysis of motivational states associated with the gamified experience.

Behavioral and computational interaction metrics (collected automatically) assess objective engagement through usage logs that record events and interaction patterns with the platform. These metrics include app launches, content views, achievements, and routine logs [9]. In task-execution scenarios, researchers use click counts, the volume of generated artifacts (e.g., tags), task duration, and persistence, measured by additional attempts after meeting the minimum criterion [7,11]. In gamified educational settings, direct interactions with the gamified environment are also tracked as behavioral evidence of use [8].

To interpret this behavioral evidence in terms of motivational mechanisms, this work draws on Self-Determination Theory (SDT) [12], which explains human motivation in terms of basic psychological needs. When these needs are satisfied, SDT links this state to greater intrinsic motivation; additionally, the theory characterizes extrinsic motivation as being driven by external factors, such as rewards.

The Intrinsic Motivation Inventory (IMI) is widely used in the literature as an instrument to operationalize dimensions of intrinsic motivation, enabling the description of motivational profiles and the comparison of perceptions across groups and usage conditions. It is applied to capture subjective perceptions across seven subscales [12]:

- Interest/Enjoyment (I): Measures the interest and pleasure in engaging in an activity.
- Perceived Competence (P): Assesses the sense of competence and effectiveness in engaging in an activity.
- Effort/Importance (E): Reflects the effort dedicated and the importance attributed to engaging in an activity.
- Pressure/Tension (T): Captures the pressure or tension felt during engagement in an activity.
- Value/Usefulness (V): Evaluates the perceived utility of engaging in an activity.
- Perceived Choice (C): Measures the sense of choice and autonomy in performing an activity.
- Relatedness (R): Explores interactions and connections with others while engaging in an activity.

In this work, behavior and navigation metrics extracted from logs and Google Analytics support the evaluation of the measurement goal related to *portal use*, while psychometric metrics associated with intrinsic motivation and the motivational profile based on Octalysis support the *motivational characterization of the target audience*. To ensure the selection of metrics derived from measurement goals aligned with the portal's gamification objective, the measurement process was structured according to the Goal–Question–Metric (GQM) approach [13].

3 Methodology

This work is an experience report on the creation and initial evaluation of a gamification intervention for a science communication portal. The methodology is structured as a seven-phase process, detailed in Sect. 4, which organizes decisions related to design, implementation, instrumentation, and indicator-based evaluation. These phases establish traceability between institutional needs, gamification design choices, and the empirical evidence used in the analysis. In summary, the process comprises:

- Phase 1 – Context analysis and initial decision: characterization of the portal, the institutional purpose, and the problem to be addressed through gamification.
- Phase 2 – Motivational profile definition: definition of the target audience and its motivational profile, based on intrinsic motivation (IMI) and the Octalysis framework.
- Phase 3 – Creative ideation and co-design: specification of the narrative, missions, ranks, scoring, badges, and progression rules.
- Phase 4 – Iterative prototyping: development of the gamification layer in the portal and integration with task-execution mechanisms and interaction logging.
- Phase 5 – Deployment: release of the gamification in the production environment and activation of the logging mechanisms required for evaluation.
- Phase 6 – Evaluation, metrics, and sustainment: definition and execution of the goal-oriented measurement plan (GQM), including collection and analysis of the defined metrics.
- Phase 7 – Continuous improvement: use of measurement-cycle results to guide adjustments to mission design and instrumentation.

The portal was implemented in WordPress, the content management system for *Canal Ciência*. The gamification layer was configured using two plugins: GamiPress, responsible for points, badges, ranks, and progression rules; and Forminator, used to create quizzes and forms associated with the missions. Usage and navigation data were obtained from Google Analytics and portal logs. Motivational data were collected through questionnaires based on the Intrinsic Motivation Inventory (IMI) and the User Motivational Profile.

The evidence used in the evaluation combines behavioral metrics of portal navigation and use with self-reported motivational metrics. Usage metrics were obtained via Google Analytics, while motivational metrics were obtained through psychometric instruments (IMI) and the motivational profile structured by Octalysis (UMP). The evaluation was organized into goals, questions, and metrics according to the GQM approach [13], and conducted in cycles, including an initial baseline cycle before deploying the gamification in production and the planning of subsequent cycles with the intervention in operation.

The initial measurement cycle established a baseline for *Jornada Galáctica*. This cycle offers a snapshot of the metrics defined by the Goal-Question-Metric

(GQM) approach at the onset of the gamification operation in November 2024. Subsequent measurements can be systematically compared to this baseline to identify variations, trends, and potential effects of design and implementation adjustments. The second measurement cycle analyzed data collected between November 2024 and April 2026, following the deployment of *Jornada Galáctica*. Data from July and August 2025 were excluded from the analysis due to technical issues that prevented adequate data collection during this period.

Data collection for the evaluation of the gamification was carried out using two main sources: Google Analytics (GA) and GamiPress. GA was integrated into the WordPress platform and used to automatically record metrics related to user flow within the portal, including sessions, unique users, engagement time, session duration, bounce rate, traffic sources, and most accessed pages. These data made it possible to characterize the general navigation and interaction patterns of users within the portal.

GamiPress, in turn, was used to record events directly associated with *Jornada Galáctica*, such as journey progression, badge acquisition, score assignment, mission completion, user return, and frequency of use. Thus, while Google Analytics provided evidence about overall portal usage, GamiPress enabled the monitoring of indicators specifically related to the gamified experience.

The collected data were analyzed in aggregated form and organized according to the metrics defined in the GQM model.

4 Creating *Jornada Galáctica*

4.1 Phase 1 – Context Analysis and Initial Decision

Canal Ciência is a Brazilian government initiative dedicated to science communication, maintained by the Brazilian Institute of Information in Science and Technology (IBICT), an institution linked to the Ministry of Science, Technology, and Innovation (MCTI). IBICT works to promote competencies and to develop resources and information infrastructure in science and technology, with a focus on the production, dissemination, and integration of scientific and technological knowledge. In this context, the *Canal Ciência* Portal aims to promote access to scientific knowledge for a broad and diverse audience, using different strategies to make content accessible and to foster engagement among students, educators, and the general public. After a feasibility study and an assessment of business needs, the goal of the *Canal Ciência* Portal's gamification was defined as *increasing user engagement and encouraging participation in the proposed activities*.

With respect to ethical considerations, compliance with Brazil's General Data Protection Law was ensured [1], with an emphasis on protecting personal data and minimizing the collection of identifiable information. The main risks identified relate to the diversity of user profiles served (children, adolescents, adults, researchers, educators, and students), which may require adjustments in language, accessibility, and task complexity to avoid exclusion due to inadequate

design. Another risk concerns the possibility of progressing in the gamification without effectively engaging with the scientific content, which could reduce meaningful engagement with the scientific content. The requirement for mandatory user registration may constitute an entry barrier to *Jornada Galáctica*, especially for younger users or first-time visitors.

4.2 Phase 2 – Motivational Profile

The identification of the target audience's motivational profile was carried out following a four-phase process (Fig. 1).

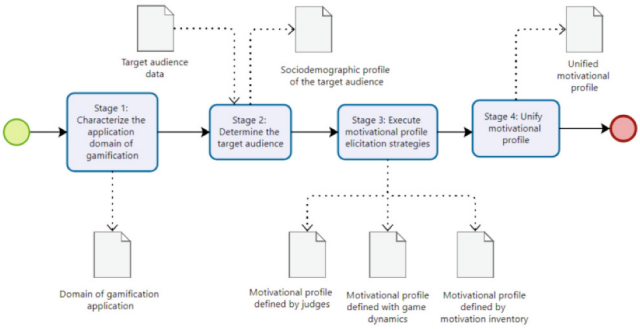

Fig. 1. Process to identify players' motivational profiles in Gamification Design [10].

In the application-domain characterization (Step 1), the domain to which the gamification would be applied was established to delimit its purpose, constraints, and target audience. In the target-audience characterization (Step 2), the primary target audience was identified, including relevant characteristics to guide the motivational-profile elicitation and, subsequently, the gamification design. The target audience comprises Brazilian students from elementary through high school who are interested in science, taking regional and socioeconomic diversity into account to ensure accessibility and adherence.

In the next phase, two strategies for eliciting the motivational profile were executed (Step 3); thus, the motivational profile was established from distinct perspectives:

– Eliciting Motivational Profile Through Judges (S1): this strategy involved selecting judges with domain knowledge, aligning gamification concepts with an emphasis on Octalysis, and then asking them to assess gamification techniques by *core drive* to estimate the target audience's profile; finally, the results from the different judges were consolidated to define the estimated profile.
  The study included 16 judges active in *Canal Ciência*, all of whom served as researchers or educators at Brazilian educational institutions ranging from

middle school through higher education. Their reported age range was 27 to 64 years; their average involvement with *Canal Ciência* was approximately 4 years (with at least two collaborators reporting more than a decade of participation), and their average educational experience was 10 years. In terms of geographic distribution, the judges represented Brazil's Central-West, North, Northeast, South, and Southeast regions. The most frequent knowledge area was Social Sciences.

– Eliciting Motivational Profile with Game Dynamics (S2): game dynamics were applied to elicit behavioral responses and preferences directly from the target audience, generating a motivational profile from this direct interaction.
Data collection involved 593 students (potential portal users) from different Brazilian states, with different levels of schooling and across age groups: children aged 5–10 years, adolescents aged 11–16 years, and young adults aged 17–24 years. A total of 581 valid responses were obtained. Data were collected with the support of teachers from different educational institutions, from elementary through high school, to obtain the greatest possible diversity of students.

Finally, the motivational profiles generated by the two strategies were unified (Step 4) into a single profile according to the procedure proposed in [10]. In S1, the judges evaluated gamification techniques associated with each Octalysis *core drive*, producing an expert-based score for each motivational dimension. In S2, the answers obtained from the game dynamics were interpreted as indicators of preference and then mapped to the corresponding *core drives*, producing a second profile based on the target audience. To combine the two profiles, the scores were organized by *core drive*, normalized to allow comparison between the expert-based and student-based results, and consolidated into a single profile. The *core drives* with the highest consolidated values were interpreted as the dominant motivational dimensions of the audience. Figure 3 was generated from this consolidated score distribution and shows the predominance of CD3, CD5, and CD6.

4.3 Phase 3 – Creative Ideation and Co-Design

The theme adopted for the portal's gamification is a space journey called *Jornada Galáctica*. It is structured as a narrative set in a future of solar-system exploration and colonization, in which players take on the role of members of multidisciplinary teams in a space race oriented toward exploration, development, and the conquest of new worlds. Narrative and mechanical progression is organized according to the Hero's Journey structure, articulating stages of player development from an initial condition to higher levels of achievement within the space-mission context.

The operationalization of the Hero's Journey in the gamification unfolds across 12 missions, in which the narrative guides the user through a set of challenges and learning experiences aligned with the central storyline. In Mission 1 (*Looking at the Earth*), the user is introduced to the problem (climate change

and pollution) and the call to action, and embarks on a space journey aboard a solar-powered spacecraft.

In Mission 1, execution is defined by an introductory letter and two initial tasks: (1) observing Earth from space and (2) identifying areas affected by pollution and deforestation, supported by an environmental monitoring panel and the solar-powered spacecraft. Completing the mission triggers rewards: the *Observador Ambiental Interplanetário* badge and the assignment of *stellar points* based on the time spent on identification (less time yields more *stellar points*), with mentorship from the ship's commander and the mascots.

Missions are defined as objectives to be fulfilled by performing actions on the portal. These actions may include, for example, accessing specific content and participating in quizzes. Records of user actions support participation and progression metrics.

Although Mission 1 is primarily structured around observation and identification tasks, CD3 is addressed through the combination of user interpretation and immediate feedback. The mission requires users to analyze visual and contextual evidence, identify areas affected by environmental degradation, and receive feedback through performance-based scoring and mission rewards. In this sense, creativity is expressed not as open-ended content production, but as situated problem interpretation and decision-making within the narrative scenario. This design choice also supports future mission expansions in which users may propose solutions, build artifacts, or personalize elements of their journey.

4.4 Phase 4 – Iterative Prototyping

In this phase, *Jornada Galáctica* was treated as a software system (a gamification layer) integrated into the portal and developed using an iterative, incremental life cycle. *Canal Ciência* is implemented in WordPress; in this work, the scope is limited to the gamification layer (*Jornada Galáctica*) integrated into the portal. First, gamification requirements and software requirements were elicited and analyzed. The gamification requirements describe the elements and rules (missions, ranks, scoring, badges, and progression). Based on these requirements, functional and non-functional requirements for *Jornada Galáctica* were derived, specifying system behavior and quality constraints. Examples of gamification requirements and software requirements are presented in Table 1 and Table 2, respectively.

In the development of gamification, *Jornada Galáctica* was implemented in WordPress using two complementary plugins. The GamiPress plugin configured and enforced progression and reward rules, including points, badges, and ranks, based on observable user actions. This configuration enabled tracking and rewarding activities such as task completion, reading portal content, and participating in quizzes, thereby updating the player's state as missions and challenges were completed. The Forminator plugin was used to create and manage forms and quizzes, facilitating the collection of user responses in knowledge-check activities across the journey's topics.

Table 1. Examples of gamification requirements

Gamification Requirements
Each mission must be configurable with respect to its rank association, while preserving the completion-bonus rule.
Jornada Galáctica must use ranks as a progression mechanism, with defined advancement criteria.
The *Looking at the Earth* mission must have an objective focused on raising awareness of the impacts of climate change and environmental preservation.
The *Looking at the Earth* mission must grant a reward composed of a specific badge and performance-based scoring.
The *Looking at the Earth* mission must use two types of scoring, with *Astropoints* tied to progression in ranks and *Energix* tied to badge-related rewards.

Table 2. Examples of functional and non-functional software requirements

Type	Software Requirements
Functional	The system must record user actions on the portal and convert them into updates to the gamification state (scoring, badges, and rank progression).
Functional	The system must provide quizzes and forms associated with missions, record responses, and link them to reward rules when applicable.
Non-functional	The system must ensure responsive behavior and navigation across different devices.

From an architectural perspective, *Jornada Galáctica* operates as a gamification layer integrated into the WordPress-based portal, following an event-driven logic. User interactions with the portal are treated as observable events that are captured, processed, and translated into updates to the gamification state. Each user action—such as accessing content, completing quizzes, submitting forms, or finishing mission tasks—generates an event recorded in the system logs. These events are interpreted by the gamification layer (configured via GamiPress), which applies predefined rules to update points, badges, ranks, and mission progression. Forminator complements this process by enabling structured data collection through quizzes and forms, which also generate events linked to gamification outcomes.

4.5 Phase 5 – Deployment

In the deployment phase, *Jornada Galáctica* was released to the portal's production environment, activating the gamification rules and the event-logging mechanisms. The gamification went live in November 2024, marking the start of operation with real users and the collection of usage data. After the release, dissemination efforts were undertaken to drive initial traffic and encourage participation, including announcements on social media and at institutional events, to increase the intervention's reach.

4.6 Phase 6 – Evaluation, Metrics, and Sustainment

To evaluate *Jornada Galáctica*, we adopted the Goal–Question–Metric (GQM) approach [13]. This approach aligns measurement goals with the organization's business needs, refines them into evaluative questions, and specifies metrics to address those questions. For *Jornada Galáctica*, two measurement goals and five questions were defined: Goal 1 (Table 3), aimed at understanding the motivational profile of portal users (questions Q1 and Q2); and Goal 2 (Table 5), aimed at understanding portal users' interests (questions Q3, Q4, and Q5). The defined metrics guide data collection to assess whether the gamification meets the established goals, identify deviations, and highlight opportunities for improvement. The relationship among goals, questions, and metrics is presented in Fig. 2, and the detailed metrics are presented in Table 4 and Table 6.

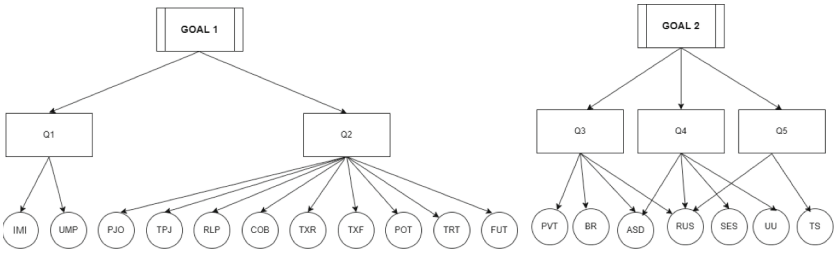

Fig. 2. Relationship between Goals, Questions and Metrics.

Table 3. Measurement Goal 1

Analyze	Gamification.
For the purpose of	Understanding.
From the viewpoint of	Gamification manager.
In the context of	Canal Ciência portal.

- Q1: What is the motivational profile of Portal users?
- Q2: How does gamification affect user engagement on the Portal?
- Q3: Which topics are of greatest interest to portal users?
- Q4: How does portal visit frequency change over time?
- Q5: Which traffic sources are most effective at attracting users interested in science to the portal?

Table 4. Measurement Goal 1 – Metrics

Code	Metric name	Description
IMI	Intrinsic Motivation Inventory	Intrinsic motivation measured through the IMI subscales.
UMP	User Motivational Profile	Intrinsic motivation is associated with Octalysis core drives.
PJO	Progression in *Jornada Galáctica*	Measures how much the user has progressed in *Jornada Galáctica*, which may indicate motivation to achieve goals.
TPJ	Time Spent in *Jornada Galáctica*	The time a user spends in *Jornada Galáctica* may indicate interest and motivation.
RLP	Long-term Retention	Measures the proportion of users who continue to use the gamified experience over a period of time, indicating sustained motivation.
COB	Achievements in *Jornada Galáctica*	Achievements earned by a user may indicate motivation to complete tasks or achieve goals.
TXR	*Jornada Galáctica* Return Rate	The proportion of users who return to *Jornada Galáctica* after a certain period of time.
TXF	Mission Completion Rate	The proportion of users who complete a mission or achieve a specified goal.
POT	Score in *Jornada Galáctica*	Measures the number of points a user accumulates.
TRT	Retention Rate	The percentage of users who return to the portal (or gamified experience) after their first visit (or over a period of time).
FUT	Frequency of Use	Measures how regularly a user returns to the portal (or *Jornada Galáctica*).

Understanding Users' Motivational Profile (Goal 1)

What is the motivational profile of Portal users? (Q1): To answer this question, GQM combines the IMI metrics (subscales) and UMP (an Octalysis *core-drive*-based profile). The most prominent *core drives* in the UMP are used as a reference to interpret which IMI subscales are most pronounced in the target

Table 5. Measurement Goal 2

Analyze	User interest.
For the purpose of	Understanding.
With respect to	Portal's usage.
From the viewpoint of	Portal manager.
In the context of	Canal Ciência portal.

Table 6. Measurement Goal 2 – Metrics

Code	Metric name	Description
PVT	Most Visited Pages by Topic	Identify the portal pages with the highest visit counts, by topic.
BR	Bounce Rate	Measure the bounce rate of science-related pages to understand whether visitors leave the portal quickly or continue browsing.
SES	Sessions	Track the total number of portal sessions over time.
UU	Unique Users (Total Users)	Monitor the number of unique users who accessed the portal during the period.
TS	Traffic Sources	Identify where visitors come from (e.g., search engines, social networks, referrals from other sites, direct traffic)
AET	Average Engagement Time per Session	Analyze how long, on average, users are actively engaged per session, which may indicate their level of interest.
RUS	Returning User Share	Measure the share of returning users out of total users, which may indicate sustained interest over time.
ASD	Average Session Duration	Evaluate the average session duration to characterize how long users spend on the portal per visit

audience (see Table 7). Thus, the motivational profile is described from two perspectives: (i) measures based on IMI subscales and (ii) motivational priorities organized by Octalysis.

Figure 3 presents the Octalysis model with the target audience's motivational profile (UMP). The results indicate that CD3 (Empowerment of Creativity & Feedback), CD5 (Social Influence & Relatedness), and CD6 (Scarcity & Impatience) are the three highest-impact *core drives*.

By relating these core drives to the IMI subscales (Table 7), we obtain a broader view of the target audience's motivation. The motivational profile points to three relevant dimensions: (i) *Interest/Enjoyment*, which reflects interest and

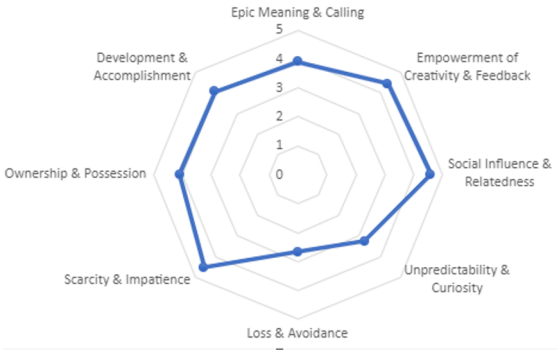

Fig. 3. Resulting motivational profile.

enjoyment in the activities; (ii) *Relatedness*, indicating that social interactions and feedback are relevant; and (iii) *Pressure/Tension*, suggesting that some level of pressure may function as a motivational factor.

Table 7. Relationship between IMI subscales and Octalysis core drives

IMI subscale	Core drives
(R) Relatedness	CD3, CD5
(C) Perceived Choice	CD2, CD4
(P) Perceived Competence	CD2, CD4
(I) Interest / Enjoyment	CD3, CD7
(T) Pressure / Tension	CD6, CD8
(V) Value / Usefulness	CD1, CD7
(E) Effort / Importance	CD2, CD8

In the second measurement cycle, the portal includes a form to collect data on the IMI and UMP instruments, which users may complete voluntarily. However, the number of responses received so far is still insufficient to generate a new motivational profile for *Jornada Galáctica* users. Therefore, the motivational profile adopted in this analysis remains as defined in the previous characterization stage, and future measurement cycles should update it as more responses become available.

How does gamification affect user engagement on the Portal? (Q2): In the first measurement cycle, the associated metrics were not collected because *Jornada Galáctica* was not yet operational. In the second measurement cycle, with gamification in operation, the metrics enabled the first indications of user engagement with the gamified experience. The PJO metric shows that most participants

(85%) remained at the first level, while 12.62% progressed to intermediate levels and 2.38% reached the final level. Engagement was therefore concentrated mainly in the initial stages of the journey.

The continuity metrics complement this interpretation: the return rate (TXR) was 21.43%, the general retention rate (TRT) was 15%, and long-term retention (RLP) was 2.38%. Among users who progressed, daily return was observed (FUT), with users remaining engaged for up to four days (TPJ). In addition, 14% of participants earned badges and received Energix (COB), while the accumulated score (POT) ranged from 50 to 5,000 stellar points, as determined by user progression. Thus, the data indicate initial adoption and signs of return, but also show that the continuity of engagement still needs improvement.

Understanding Portal Users' Interests (Goal 2)

Which topics are of greatest interest to portal users? (Q3): Analysis of the PVT metric indicates that the topics of greatest interest to users include biographies of Brazilian scientists, recent scientific output, science communication texts (*Ciência em Síntese – Science in Brief*), general information about the portal, and the history of science. This pattern indicates an interest in science content written in accessible language, as well as topics related to the history of science and scientists' contributions.

In the second measurement cycle, no significant differences were observed in the topics of greatest interest, indicating that the main patterns identified in the baseline remained stable.

How does portal visit frequency change over time? (Q4): The SES metric indicates that portal visit frequency varied throughout the first quarter of 2024, with March being the busiest period. Over the quarter, daily visits generally ranged from 200 to 600, averaging around 300, and there were nine days with more than 500 visits (peak: 601). In terms of reach, the UU metric captures the volume of unique visitors during the period, while the returning user share (RUS) was 19%, indicating that a portion of visitors returned. In addition, the bounce rate (BR) was below 1%, suggesting a low occurrence of sessions ending without further interaction. Finally, session time metrics (AET = 27 s and ASD = 1min 22 s) complement the analysis by characterizing the typical time spent per visit.

In the second measurement cycle, the SES metric recorded 21,615 sessions, while the UU metric indicated 16,689 unique users. The bounce rate remained low (BR = 0.99%), similar to the baseline, indicating that visits continued to result in some interaction with the portal. In contrast, the share of returning users was lower (RUS = 1.5%), a decrease in the relative participation of returning visitors during this cycle. The time-related metrics, however, showed a substantial increase, with an average engagement time of 2min 20 s (AET) and an average session duration of 2min 18 s (ASD). It was also observed that Monday was the weekday with the highest volume of visits.

Which traffic sources are most effective at attracting users interested in science to the portal (Q5)? In the baseline, the portal's main traffic sources (TS) were led by Google, the largest source of visits. This indicates that organic search played an important role in directing visitors to the portal. The second-largest traffic source was the organization's institutional website. Direct traffic, in third place, showed that a considerable share of visitors accessed the portal by typing the URL or using bookmarks, indicating familiarity and repeat visits.

During the second measurement cycle, the TS metric showed a change in the composition of traffic sources. Google remained the primary source of access, confirming the continued relevance of organic search; however, direct access moved from third to second place, indicating greater relative prominence for users who reached the portal directly. In addition, Linktree ranked third, while institutional pages such as gov.br ranked fourth. The set of traffic sources also became more diversified, including social networks, Wikipedia, ChatGPT, and educational platforms.

4.7 Phase 7 – Continuous Improvement

This phase is guided by the results of the second measurement cycle and by the measurement goals defined in the GQM model.

Regarding Q1, although the portal already provides a voluntary form to collect data for the IMI and UMP instruments, there are still not enough responses to update users' motivational profiles.

For Q2, the data indicate initial adoption of the gamified experience but also limited progression beyond the first level and a low mission completion rate, suggesting the need to improve instructions, feedback, progression visibility, and incentives to sustain engagement.

With respect to Q3, the stability of the topics of greatest interest and the presence of the games page among the most accessed pages suggest an opportunity to bring the journey closer to the interactive content already valued by users.

The results for Q4 show an increase in average interaction time, but a lower proportion of returning users, indicating the need for strategies that encourage return visits, such as calls to progress to the next missions and indicators of pending progress.

Finally, Q5 shows that, although Google remains the main traffic source, direct access has gained relevance, and access origins have become more diversified, reinforcing the use of channels such as social networks, institutional pages, Linktree, and educational platforms to direct users to specific missions and to strengthen the continuity of the gamified experience.

5 Discussion

The analysis of the results should consider the complementary role of the measurement cycles. The first cycle established a baseline for the motivational profile

and portal usage patterns, while the second cycle provided the first indicators of *Jornada Galáctica* in operation. User progression was concentrated mainly at the first level, with only a small proportion reaching the final level, suggesting stronger engagement in the initial stages of the journey. This limited progression may be related to the requirement to read specific portal texts in order to advance, a condition that may represent a barrier for some users.

The interpretation of these findings also depends on updating the motivational profile. The reference profile, characterized by the predominance of CD3, CD5, and CD6, has not yet been reassessed using data from actual *Jornada Galáctica* users, as the voluntary form based on the IMI and UMP has not yet received enough responses. Thus, it remains open whether the observed behavior is mainly due to limitations in implementation, differences in users' motivational profiles, or a combination of both.

Overall, the results indicate initial adoption of gamification but also difficulties sustaining engagement throughout the journey. Although return visits were less frequent, users who accessed the portal tended to spend more time interacting with its content.

Changes in traffic sources and the stability of the most accessed topics should be analyzed, taking into account dissemination actions, institutional events, content updates, seasonality, and technical limitations in data collection. These findings reinforce the need to adjust the gamified experience and to establish new measurement cycles to evaluate its evolution.

6 Conclusion

This work presented an experience report on the design, deployment, and initial evaluation of the *Jornada Galáctica* gamification layer integrated into the *Canal Ciência* portal. The GQM approach was used to structure measurement goals, questions, and metrics, combining behavioral evidence of portal use with motivational evidence obtained from psychometric instruments and the motivational profile structured by Octalysis.

The results of the first measurement cycle were used as a baseline to characterize the target audience's motivational profile and portal usage patterns before gamification data became available. The second measurement cycle provided the first indicators of user engagement with the gamified experience. Although *Jornada Galáctica* achieved initial adoption, sustaining engagement throughout the journey remains a challenge.

As future work, the study plans to refine the gamified experience and update the motivational profile with data from actual users and additional measurement cycles.

Beyond the specific case of *Canal Ciência*, this study contributes a traceable evaluation process that integrates users' motivational profiles, gamification design decisions, interaction-logging mechanisms, and observable engagement indicators.

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