Integrating Gamification and Usability: A Framework for Usability Recommendations for Gamified Systems

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Abstract: Gamified systems incorporate gamification elements to influence user behaviour and engagement. Although gamification frameworks and usability standards exist, their integration remains insufficiently formalised. Gamification elements are often classified inconsistently across abstraction levels, while usability guidelines are typically applied at the system level without linkage to specific gamification elements. This paper proposes a framework for constructing and applying usability recommendations for gamified systems. The approach integrates a taxonomy of gamification elements organised according to the MDA model, a recommendation metamodel, and a tool for determining usability recommendations for gamified systems. The framework generates usability recommendation sets based on parameters such as age group, application domain, gamification goals and usability goals. Its application to three systems from different domains demonstrates that the framework produces different recommendation sets depending on user and system parameters. The proposed framework provides a formal approach for linking gamification elements with usability recommendations.

1 INTRODUCTION

Modern information systems increasingly incorporate gamification elements to influence user behaviour and promote engagement (Khaldi, Bouzidi, & Nader, 2023). Gamification refers to the use of game design elements in non-game contexts (Deterding, Dixon, Khaled, & Nacke, 2011), including points, badges, levels, leaderboards, challenges, rewards, avatars and others (Schöbel, Janson, & Söllner, 2020).

Although established frameworks such as Mechanics-Dynamics-Aesthetics (MDA) distinguish abstraction levels, classifications of gamification elements remain inconsistent across sources (Schöbel, Janson, & Söllner, 2020). Identical elements may be positioned at different levels depending on the framework, described using varying terminology or treated as separate despite functional similarity. In some cases, elements that operate at the level of mechanics are presented alongside higher-level dynamics (Schöbel, Janson, & Söllner, 2020). This inconsistency complicates comparison across studies and makes it difficult to classify gamification elements within a unified structure.

While usability recommendations and gamification design frameworks exist, mappings between gamification elements and usability recommendations are rarely formalised. As a result, the relationship between motivational design decisions and their usability implications often remains implicit (Schöbel, Janson, & Söllner, 2020). This can lead to gamification elements increasing cognitive load, reducing clarity or introducing interaction barriers when usability constraints are not incorporated into design (Skulmowski & Xu, 2022). Furthermore, usability recommendations in gamified systems depend on the context. While general usability principles remain applicable, gamified systems require consideration of additional parameters such as age group and application domain (Koivisto & Hamari, 2014). Different user groups respond differently to gamification elements, and the same elements may require different usability adaptations. (Klock, Gasparini, Pimenta, & Hamari,

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2020). For example, competitive gamification elements may be appropriate in sports applications but may be used with constraints (Dereli & Kahraman, 2024). Therefore, usability recommendations for gamified systems should be linked to gamification elements and aligned with specific system characteristics.

Despite the growing literature, there is no structured framework that formalises gamification elements across abstraction levels, links these elements to usability recommendations and operationalises recommendation suggestions based on system parameters such as age group and application domain. To address this gap, this paper contributes a unified framework that links gamification elements with usability recommendations, supported by an MDA-based taxonomy, and enables recommendation generation based on user and system characteristics through a formalised rule-based decision model implemented in a web tool, thereby providing a practical approach for selecting usability recommendations in gamified system development.

The remainder of the paper is organised as follows. Section 2 reviews related work on gamification design frameworks, usability guidelines, and gamification elements. Section 3 presents the proposed framework, including the taxonomy of gamification elements and the recommendation knowledge base. Section 4 describes the implementation of the web tool and demonstrates its application for selected systems. Finally, Section 5 discusses conclusions.

2 RELATED WORK

Research on usability recommendations for gamification systems can be grouped into three main directions: (1) motivation-oriented gamification frameworks, (2) adaptations of usability heuristics to games and gamified systems and (3) studies addressing gamification elements in relation to system context and target audience.

Several studies focus on aligning gamification design with motivational theories. Morschheuser et al. (Morschheuser, Hamari, Werder, & Abe, 2017) synthesised 17 gamification frameworks and proposed a set of gamification design process guidelines emphasising user motivation, goal definition and iterative development. Moreover, Tondello et al. (Tondello, Kappen, Ganaba, & Nacke, 2019)introduced 28 heuristics derived from motivational affordances and user-type models such as Octalysis and HEXAD. Van Roy et al. (Van Roy & Zaman, 2017) proposed nine heuristics grounded in Self-Determination Theory. Raviya (Raviya, 2025) combined motivational and behavioural theories with frameworks such as MDA and Octalysis to derive eight design principles applicable across domains. Krath et al. (Krath & Von Korflesch, 2012) identified more than 60 gamification design principles across education, healthcare, sustainability and fitness. These works primarily focus on motivational and behavioural outcomes rather than addressing concrete usability or interaction design considerations, leaving a gap in understanding how gamification elements influence the usability of interactive systems.

Another line of research adapts established usability principles to games and gamified systems. Akthar et al. (Akthar, Islam, Islam, Sadia, & Hasan, 2023) adapted Nielsen's heuristics to game development contexts. Desurvire et al. (Desurvire & Wiberg, 2009) introduced the Principles of Playability (PLAY) and observed that usability principles differentiate highly rated and poorly rated games. Coelho et al. (Coelho & Abreu, 2025) proposed heuristics based on Systemic Gamification Theory. Carvajal-Jimenez et al. (Carvajal-Jimenez, Vergara-Laurens, & Rivera-Gonzalez, 2024) demonstrated, through a case study of a gamified learning application, that established usability principles support system adoption. These studies confirm the relevance of usability in gamified systems. However, they provide general heuristic guidance rather than structured recommendations for gamification elements and therefore provide limited ability for selecting suitable gamification elements based on user and system characteristics.

Gamification research frequently refers to elements such as points, badges, levels and leaderboards. Frameworks such as MDA distinguish between abstraction levels. However, classifications differ across sources. Consequently, the same gamification element may be positioned at different abstraction levels or described using different terminology. This limitation complicates gamification element selection. Some studies relate gamification elements to user experience factors. Alsaleh and Alnanih (Alsaleh & Alnanih, 2019) identified seven UX factors and aligned them with gamification elements. Koivisto and Hamari (Koivisto & Hamari, 2014) showed that gamification effects vary across demographic and contextual aspects, including age. Tondello et al. (Tondello, et al., 2016) validated the HEXAD user type model and observed correlations between user types and preferences for different elements. These studies

address motivational fit and user preferences. However, they do not provide a formal structure for linking gamification elements with usability recommendations based on user and system characteristics.

The reviewed studies address gamification design, usability heuristics and contextual adaptation as largely separate topics. Gamification frameworks and approaches focus on psychological alignment, usability-oriented approaches adapt general heuristics to gamification contexts and contextual studies analyse demographic and application domain differences. However, these research directions remain insufficiently integrated and provide limited support for translating motivational and contextual findings into concrete usability guidance for specific gamification elements. Current literature does not provide an integrated structure that (i) organises gamification elements across abstraction levels, (ii) links those elements to concrete usability recommendations and (iii) supports selection of usability recommendations based on system and user characteristics. As a result, designers lack a unified method for systematically deriving usability guidance when specific gamification elements are implemented under defined contextual conditions.

3 FRAMEWORK

The proposed framework for constructing and applying usability recommendations for gamified systems is structured into two interconnected layers: the Methodology layer and the Implementation layer, as illustrated in Figure 1.

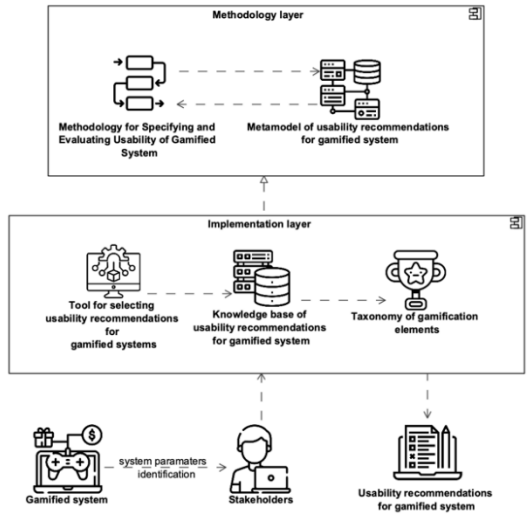

Figure 1: Framework for usability recommendation construction and selection.

The Methodology layer specifies how usability recommendations are structured and selected for a gamified system. It consists of (1) a methodology that constructs recommendation sets from user and system characteristics (e.g. age group, application domain, gamification goals, usability goals) and (2) a metamodel that distinguishes between general usability recommendations and usability recommendations for gamification elements, enabling guidance at the appropriate abstraction level while remaining adaptable to user and system characteristics.

The Implementation layer operationalizes the methodological principles through a software tool for selecting usability recommendations for gamified systems, supported by a knowledge base of usability recommendations for gamified systems and taxonomy of gamification elements. The knowledge base is constructed according to the metamodel defined in the Methodology layer, ensuring that all stored recommendations follow a consistent structure. The knowledge base contains 1070 recommendations in total, including general usability recommendations (203), recommendations for gamification element selection (197) and usability recommendations for gamification elements (670). Based on specified user and system characteristics, the tool applies selection rules to generate recommendation sets. The tool is intended for stakeholders such as gamified system developers, product owners and evaluators.

3.1 Gamification Elements Taxonomy

Numerous lists of gamification elements have been proposed, but they frequently mix heterogeneous concepts from different abstraction levels. Concrete interface components, behavioural patterns and experiential outcomes are presented together (e.g., points / badges, competition / collaboration, fantasy / discovery), which hinders systematic element selection. To provide a structured basis for recommendations, a MDA-based taxonomy was developed, informed by concepts derived from established gamification literature (Hunicke, LeBlanc, & Zubek, 2004; Zichermann & Cunningham, 2011; Werbach & Hunter, 2012; Upshall, 2020).

The taxonomy is not intended as a universal classification scheme. Instead, it provides a structured basis for linking gamification elements to usability recommendations. Elements were extracted from prior gamification frameworks and consolidated to reduce redundancy (e.g. medals/trophies/badges ->

badges; score/XP/health -> points). The grouping of similar elements was based on two criteria: (1) functional equivalence in terms of their role in user interaction, and (2) similarity in their effect on user behaviour and their contribution to dynamics (e.g. progression, competition). Elements that differed only in terminology or visual representation but served the same purpose and contributed to the same dynamics were merged into a single category. This approach ensures that the taxonomy reflects conceptual distinctions rather than superficial naming differences, while preserving the behavioural meaning of gamification elements. The resulting taxonomy is summarized in Tables 1–3 and structurally represented in Figure 2 and Figure 3.

3.1.1 Taxonomy Structure

The taxonomy distinguishes three levels: Mechanics (M) – concrete system components implemented in the interface; Dynamics (D) – behavioural patterns emerging from users' interaction with mechanics; Aesthetics (A) – experiential outcomes perceived by users.

Mechanics correspond to interface-level design elements directly implemented in the system. Table 1 summarises key mechanics including points, badges, challenges, leaderboards, levels, avatars, penalties, performance feedback, unlockable content, virtual currency. These are actionable components under designer control.

Table 1: Mechanic components in the gamification elements taxonomy.

Mechanic	Description
Achievements	Custom defined objectives
Assistance	Support provided to help complete tasks
Avatars	Visual projections of a user character
Badges	Visual representations of achievements
Chance	Randomized outcomes affecting results or rewards
Challenges	Tasks requiring effort
Choices	Options allowing selection between different actions or paths
Collections	Sets of items to accumulate
Cooperative challenges	Tasks that require multiple participants to complete together
Dialogues	Structured exchanges of messages
Full game	A complete game embedded within the system
Gift	Selfless transfer of items or resources between game participants
Hints	Contextual clues guiding task completion
Leaderboards	Visual displays of player progression
Levels	Defined steps in player progression
Penalties	Negative consequences applied for certain gameplay actions
Performance feedback	Information about how the player is doing
Performance stats	Quantitative data about player's performance over time
Points	Numerical accumulable values assigned for actions or achievements
Reminders	Notifications prompting action or return to the system
Retries	Opportunities to attempt a task again after failure
Rewards	Benefits granted after successfully completing actions
Rules	Defined constraints that regulate actions and behaviour
Skill trees	Structured paths representing development of abilities
Status	Indicator of position, rank, or standing within the system
Status bars	Visual indicators of progress or resource levels
Story, storyline	Structured sequence of events providing narrative context
Teams	Defined groups of users working together for a common goal
Unlockable content	Content that becomes accessible after meeting conditions
Virtual currency	Digital units used for exchange within the system
Virtual pets	Interactive digital characters that require care or interaction
Virtual Treasure	Valuable virtual items obtained through activity
Warnings	Messages alerting about risks, errors, or negative consequences

Dynamics describe behavioural patterns that emerge from users' interaction with mechanics. Table 2 summarises key dynamics such as competition, collaboration, progression, time pressure, exploration, personalization, and affective engagement. For example, leaderboards and points may be associated with competitive behaviours, whereas teams and cooperative challenges may support collaborative interaction patterns..

Table 2: Dynamics components in the gamification elements taxonomy.

Dynamic	Description
Relationships	Interaction and ongoing social links between participants.
Collaboration	Working together to achieve a shared goal.
Altruism	Helping others without expecting a direct reward.
Knowledge-sharing	Exchange of information or experience.
Competition	Form of action during which player attempts to perform better than others
Progressive difficulty	Dynamic of tasks becoming harder over time.
Time pressure	Subjective feeling of limited time available to perform tasks
Emotions	Feelings arising during interaction: curiosity, competitiveness, frustration, happiness.
Surprise	Occurrence of unexpected outcomes.
Progression	User's growth and development
Guidance	Provision of help or direction during use.
Exploration	Discovery of new parts of the system.
Item acquisition	Obtaining or collecting items or resources.
Personalization, Customization	Changing system elements according to individual preference.

Aesthetics describe higher-level user experiences and emotional responses resulting from interaction with gamified systems. Table 3 summarises the aesthetics included in the taxonomy.

Table 3: Aesthetic components in the gamification elements taxonomy.

Aesthetic	Description
Fellowship	Experience of social connection within a shared interactive environment.
Challenge	Experience of overcoming obstacles through effort, skill, and increasing difficulty.
Sensation	Experience of sensory stimulation and immediate perceptual enjoyment during interaction.
Narrative	Experience of engaging in unfolding in sequential fashion events that create meaning and tension.
Discovery	Experience of exploring unknown content and uncovering new possibilities.
Submission	Experience of engagement through structured and repetitive activity
Expression	Experience of self-actualization and identity through personalization and choice.
Fantasy	Experience of immersion in an imagined or fictional context.

3.1.2 Relationship between Elements

Figure 2 maps dynamics to intended aesthetic outcomes within the conceptual layer of the taxonomy. For example, collaboration, relationships, altruism aligns with fellowship and progressive difficulty, time pressure relate to the aesthetic of challenge. Aesthetics are not implemented directly but rather are manifested through behavioural dynamics triggered by mechanics.

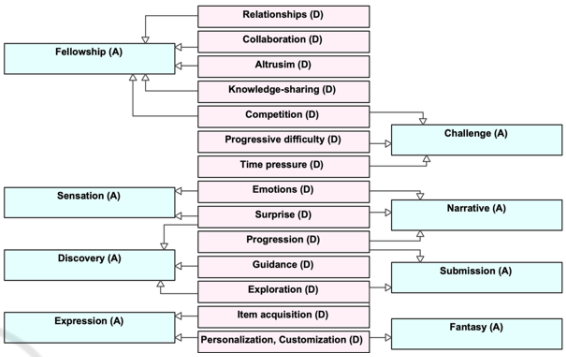

Figure 2: Relationships between aesthetics and dynamics in the gamification taxonomy.

Figure 3 links dynamics to implementable mechanics. For example, leaderboards and points can trigger competitive dynamics, whereas team-based mechanics and cooperative challenges can support collaboration. Together, Figures 2 and 3 form a complete hierarchical model in which mechanics enable dynamics that shape aesthetic experiences.

The proposed taxonomy separates experiential goals (e.g., fantasy, discovery) from implementable components (e.g., avatars, unlockable content), allowing usability recommendations to be linked to specific elements while still considering their intended user experience.

3.2 Recommendation Construction Method and Rule-Based Recommendation Selection

A structured methodology was developed to define (1) how general usability recommendations are identified, (2) how suitable gamification elements are selected and (3) how usability recommendations for gamification elements are formulated. The process consists of twelve steps (Figure 4).

S1. Identify user and system characteristics, including age group, application domain, potential disorder, gamification and usability goals and usability principles.

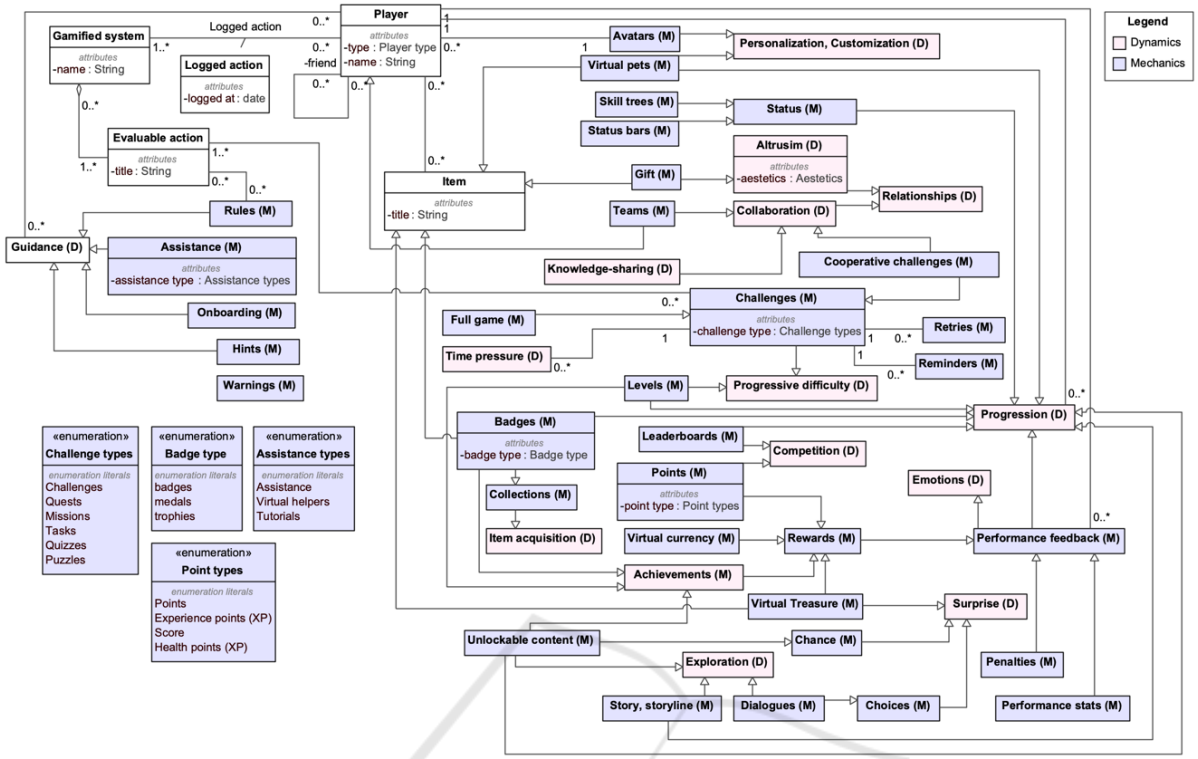

Figure 3: Relationships between dynamics and mechanics in the gamification taxonomy.

S2. Determine general usability recommendations for gamified systems based on the criteria defined in Step 1.

If gamification elements need to be selected and evaluated, the following steps are applied:

S3. Initiate the process of selecting gamification elements.

S4. Determine recommended gamification elements based on selected user and system characteristics.

S5. Determine not recommended gamification elements based on the same characteristics and exclude them from the candidate set.

S6. Select gamification elements that are implemented or planned for implementation in the system. The selection may include both recommended and non-recommended elements.

S7. Determine usability recommendations for the selected gamification elements, based on ISO 9241-110 and ISO 9241-112 principles.

S8. Determine usability recommendations for the selected gamification elements, based on the WCAG 2.2. (Web Content Accessibility Guidelines).

S9. Determine usability recommendations for the selected gamification elements, derived from academic sources.

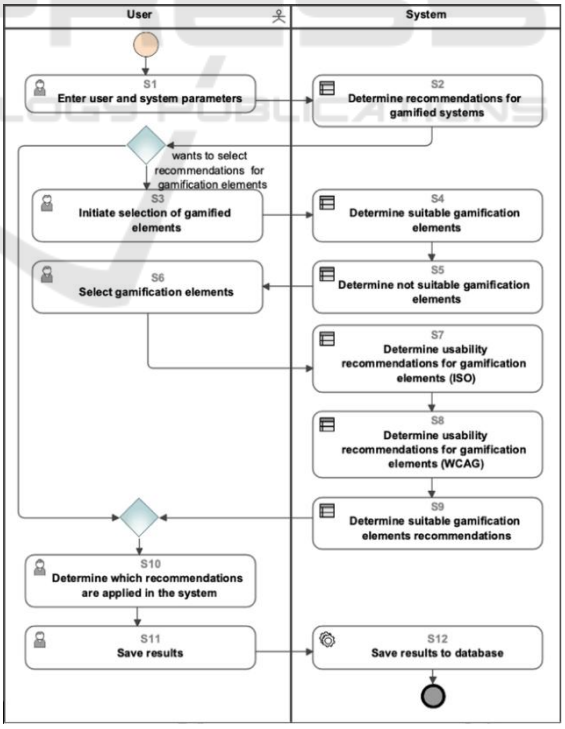

Figure 4: The process of creating a set of recommendations for the usability of a gamified system.

S10. Determine which of the proposed recommendations have already been implemented in the system. The possible implementation statuses are: implemented, partially implemented, not implemented.

S11–S12. Save the selected recommendations and their implementation status for future use.

3.2.1 Decision Modelling with DMN

To formalise the recommendation logic and ensure consistency, decision modelling was implemented using the DMN (Decision Model and Notation). In this study, DMN decision tables were used to:

1. to determine general usability recommendations for gamified systems;
2. to identify suitable and unsuitable gamification elements;
3. to assign specific usability recommendations to each selected gamification element based on WCAG and ISO standards.

In S2, the decision table titled "Generalised Recommendations" is used to select general usability recommendations tailored to the specific user and application context (Figure 5). The decision outcome is based on six parameters identified through a systematic literature review (Magylaitė, Kapočius, Butleris, & Čeponienė, 2022):

1) Age Group (e.g. children, teenagers, adults, elderly) - each age group has distinct usability needs and preferences.
2) Application Domain (e.g. education, medicine, habits formation) - different domain implies different usability expectations and constraints.
3) Disorders (e.g. anxiety, stroke, Alzheimer's disease) - Various physical or cognitive impairments may affect perception and interaction ability.
4) Gamification Goals (e.g. improve focus, reduce stress) – different goal influences what types of recommendations are most appropriate.
5) Usability Goals (e.g. reduce memory load, improve recognition) – define the intended usability characteristics.
6) Usability Principles, based on the ISO 9241-110 human-system interaction principles and Nielsen's usability heuristics.

Based on these criteria, the decision table returns a tailored set of general recommendations applicable across the system.

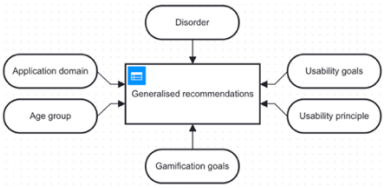

Figure 5: DMN model for general usability recommendation selection.

In S4, the "Suitable Gamification Elements" DMN table is used to identify candidate elements aligned with specified user and system characteristics, while in S5, the "Not Suitable Gamification Elements" table is applied to identify inappropriate elements and exclude them from the candidate set.

In S7-8, usability recommendations for gamification elements are derived using the decision tables "Usability recommendations for gamification elements (ISO)" and "Usability recommendations for gamification elements (WCAG 2.2)". In S9, additional recommendations for gamification elements are identified from literature review and assigned to the previously selected gamification elements (Figure 6).

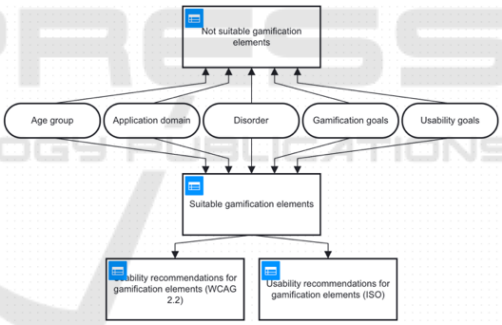

Figure 6: DMN model for gamification element selection and assigning usability recommendations to gamification elements.

The same input parameters used in S2 were also applied in these steps. However, the usability principle parameter is excluded because the element-level decision tables operationalise the relevant ISO and WCAG guidance directly and the selection of recommendations for gamification elements is driven primarily by user and system characteristics.

3.2.2 Adaptation of ISO and WCAG Standards to Gamification Elements

To ensure alignment with recognised usability and accessibility principles, three standards were analysed: ISO 9241-110:2020 (interaction

principles), ISO 9241-112:2017 (information presentation principles) and WCAG 2.2. (Web Content Accessibility Guidelines for accessibility).

Each recommendation from these standards was reviewed individually to assess its applicability to specific gamification elements from the taxonomy. Although the standards are formulated at system level, their principles were adapted to individual gamification elements, considering the functional characteristics of each element and its influence on user interaction.

For each applicable element–standard combination, a tailored usability recommendation was formulated and supplemented with a practical example. From ISO 9241-110, 46 of 65 recommendations were mapped to at least one gamification element. From ISO 9241-112, 72 of 83 recommendations were adapted. From WCAG 2.2, 7 of 16 guidelines were found applicable to at least one gamification element. The remaining recommendations were classified as system-level guidelines.

In Steps 7 and 8, the decision tables use the selected *gamificationElement* as the primary input. For ISO-based recommendations (S7), the output includes the adapted recommendation, an illustrative example, and the corresponding ISO reference. For WCAG-based recommendations (S8), an additional *disorder* parameter is included to address accessibility requirements

3.2.3 Rule Structure and Recommendation Formulation

Recommendation logic in the framework is formalised using conditional rules expressed in an if-then structure. Each rule links input parameters to one or more recommendations stored in the knowledge base. In its general form, a rule can be expressed as follows:

if (*ageGroup* ∧ *applicationDomain* ∧ *disorder* ∧ *gamificationGoal* ∧ *usabilityGoal* ∧ *gamificationElement*)
then {set of recommendations}

Not all parameters are required in every rule; the set of conditions included in a rule depends on the specific user and system characteristics. General usability recommendations may depend on a broader combination of user and system characteristics. Recommendations for gamification elements are primarily conditioned by the selected gamification element and are supplemented by input parameters only when necessary.

The following rule types are implemented within the framework:

- Rules for selecting general usability recommendations
- Rules for identifying suitable gamification elements and associating them with corresponding usability recommendations
- Rules for identifying not recommended gamification elements
- Rules for assigning ISO-based usability recommendations to gamification elements
- Rules for assigning WCAG-based accessibility recommendations to gamification elements

To illustrate how decision rules are formulated within the framework, an example of a rule for selecting a suitable gamification element is presented below.

if *(ageGroup = adults)* AND *(applicationDomain = healthy eating)* AND *(gamificationGoal* contains *increase engagement and motivation* OR *to foster competition)*
then leaderboard

In this example, the combination of demographic characteristics and motivational goals triggers the recommendation of the leaderboard element within the decision model. Depending on the rule type, the decision outcome may consist of a single gamification element, gamification elements set, or one or more associated usability recommendations for gamification elements.

3.3 Introducing Usability Recommendations in Web Tool

To operationalise the proposed methodology, a web tool was developed for selecting usability recommendations for gamified systems. The tool implements all methodological steps described in Figure 4 and generates three types of recommendations based on selected user and system characteristics: (1) a list of general usability recommendations, (2) a list of recommended gamification elements and (3) a list of usability recommendations tailored to the selected gamification elements.

The prototype's user interface was developed using the Next.js framework, enabling dynamic parameter selection and interactive result presentation. The decision logic was initially modelled using the Decision Model and Notation (DMN) standard within the Camunda platform. The DMN decision tables formalised the selection rules defined in the methodology layer. For integration into

the web environment, the DMN tables were transformed into database tables and implemented as SQL-driven rule sets, preserving the input parameters and recommendation outputs. The system uses PostgreSQL as a relational database management system to store the recommendation knowledge base and generated recommendation sets for each gamified system individually.

Figure 7 illustrates the parameter selection interface. Users can specify gamification goals, usability goals, age group, application domain, potential disorders, relevant Nielsen or ISO usability principles. Each parameter field allows selecting one or multiple parameters as well as the ability to indicate that the field does not apply. This ensures adaptability of recommendations to different input parameters.

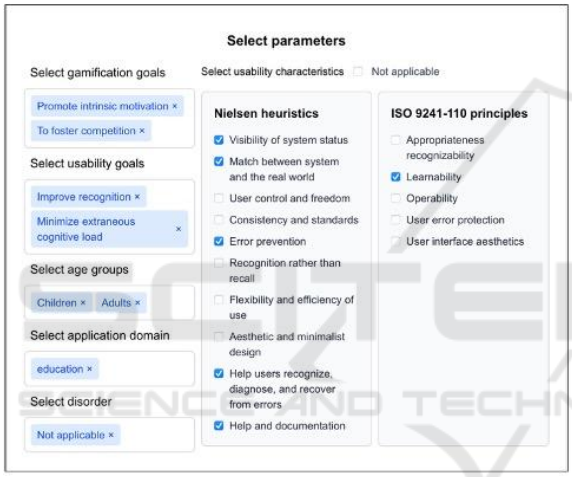

Figure 7: Parameter selection interface of the web tool.

Figure 8 presents the interface displaying generated recommendations. Each recommendation includes input parameters such as applicability by age group and domain, associated usability characteristics and implementation status indicators (, implemented, partially implemented, not implemented). The web tool implements the proposed framework by linking the conceptual metamodel and taxonomy with decision logic, enabling the generation of usability recommendation sets.

4 APPLICATION OF THE RECOMMENDATION SET

To demonstrate the practical application of the proposed framework, the web tool was applied to three gamified systems representing different application domains and user groups: Duolingo ABC (children's education), Fabulous (mental health and well-being), and Safe Roads Challenge (driving). This section illustrates how the framework generates recommendation sets based on changes in user and system parameters. The following parameter configurations were used for recommendation selection:

Application: Duolingo ABC
Domain: Education
Age group: Children
Gamification goal: Increase engagement and motivation
Usability goals: Encourage through positive messaging; Reduce memory load

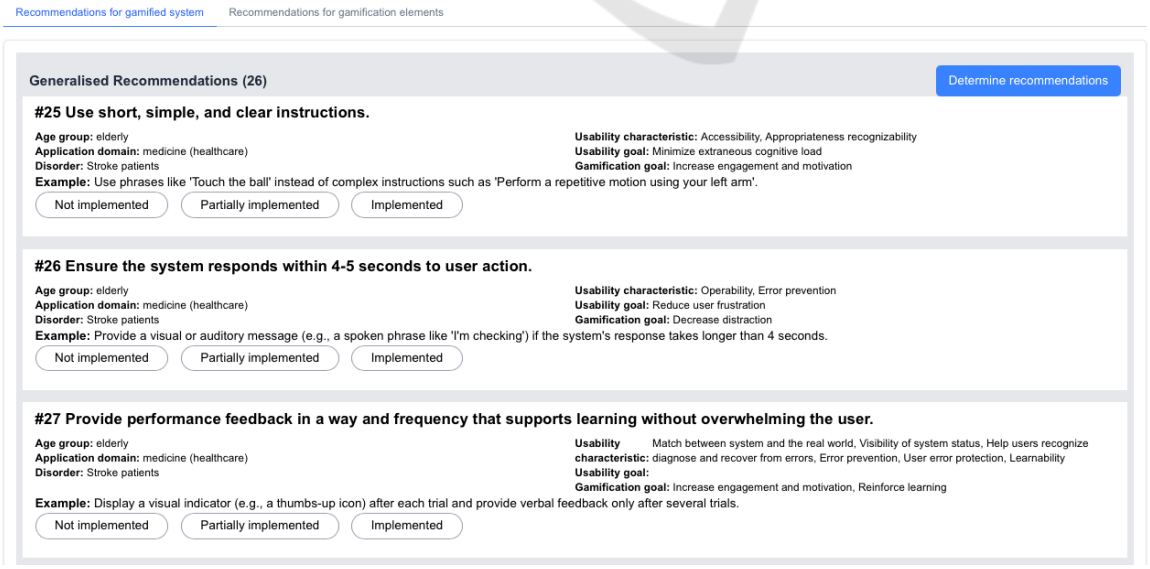

Figure 8: Interface displaying generated usability recommendations.

Application: Fabulous
Domain: Mental health
Age group: Teenagers, Adults, Elderly
Gamification goals: Promote intrinsic motivation; Reduce stress
Usability goals: Encourage through positive messaging; Minimize extraneous cognitive load; Improve recognition

Application: Safe Roads Challenge
Domain: Driving
Age group: Adults
Gamification goals: Improve focus; Reduce stress
Usability goals: Minimize extraneous cognitive load; Focus attention on key elements; Improve recognition; Reduce user frustration

4.1 General Usability Recommendations

For each configuration of user and system input parameters, the framework generated a different set of general usability recommendations from the same knowledge base, based on different rule combinations. The selected examples illustrate how the framework produces differentiated recommendation sets based on these parameters.

For Duolingo ABC, the framework generated 2 general recommendations, which emphasised clarity of instruction and multimodal information presentation. The system triggered rules encouraging the use of friendly language, visually supported guidance and clearly defined goals appropriate for children in an educational context. Additionally, the system prioritised combining visual and verbal cues within a structured narrative format to support recognition and reduce memory load for children. For example, the framework generated the recommendation *"Use friendly language, relevant visuals and clear goals."* with the example *"Use cartoon characters with icons and encouraging phrases to guide learning."*

For Fabulous, the framework generated 4 general recommendations, which focused on information reduction and terminology adaptation. The framework prioritised progressive disclosure - limiting the amount of information presented per screen and revealing secondary details only when necessary - consistent with stress reduction and minimising extraneous cognitive load as a goal. Furthermore, terminology simplification was emphasised by suggesting replacing technical or clinical labels with familiar, real-world language. This supports recognition and reduces interpretative effort, which is particularly relevant in emotionally sensitive domains. For instance, the framework generated the recommendation *"Reduce the amount of information presented in the user interface. Present only the essential information per screen. Use progressive disclosure to reveal additional details only when needed."* accompanied by the example *"The breathing exercise screen initially shows only one large 'Start' button and a simple phrase like 'Need a moment to relax?'. Once started, the animation guides the breathing visually."*

For Safe Roads Challenge, the framework generated 4 general recommendations, which focused on perceptual consistency and attention management. The framework generated rules related to consistent colour coding and gradual visual transitions. Smooth colour transitions were recommended instead of abrupt changes to communicate system state changes. The consistent use of colour semantics supports intuitive recognition and reduces the need for interpretation during driving. These recommendations reflect application domain constraints, where maintaining visibility and avoiding sudden visual disruption are critical for safe interaction. As an illustration, the framework produced the recommendation *"Apply consistent colour codes to system feedback to support intuitive recognition and reduce the need for interpretation."* with the example *"Use green to indicate safe driving, yellow for caution, and red for speeding across all screens, maintaining colour meaning consistency regardless of context."*

Overall, the results demonstrate that general usability recommendations are selected based on user and system characteristics.

4.2 Selection of Recommended Gamification Elements

The tool generates a subset of gamification elements that are considered appropriate based on user and system characteristics.

For Duolingo ABC, the tool recommended rewards, onboarding, narrative, virtual helpers, tasks, cooperation, levels, avatar and performance feedback. This profile supports guided learning for children, combining narrative and avatars for engagement with cooperation and feedback for social and achievement motivation.

For Fabulous, the tool recommended rewards, progress, points, badges, narrative, performance feedback, challenges and full game. Compared to Duolingo ABC, the selection emphasizes self-

regulation and habit formation via progress tracking and moderated challenges, supporting sustained engagement in a behaviour-change context.

For Safe Roads Challenge, the tool recommended a more controlled set - challenges, levels and assistance - to limit distraction in a safety-critical domain. The selected elements provide clear goals, structured progression and guidance, whereas competitive or visually intensive elements are avoided to minimise cognitive load and protect attention.

4.3 Usability Recommendations for Recommended Gamification Element

The final step produces a set of usability recommendations for gamification elements, as each selected gamification element maps to multiple ISO, WCAG and literature-derived recommendations. For Duolingo ABC, the framework generated 499 recommendations, 259 for Fabulous and 161 for Safe Roads Challenge. This variation is determined by the number of selected gamification elements and the input parameters activating rule combinations. Duolingo ABC produced the largest recommendation set because it involved a broader range of gamification elements. Fabulous produced a mid-sized set due to mental-health constraints and stress-reduction goals limiting competitive and visually intensive elements. Safe Road Challenge produced the smallest set because safety constraints reduced the recommended element, concentrating recommendations on visibility, attention management and cognitive load control.

These findings indicate that recommendation sets are generated based on defined rules and user and system characteristics, resulting in different recommendation outputs for different parameter configurations rather than fixed recommendation sets across systems. The observed results highlight the differences between the proposed framework and existing gamification and usability recommendations approaches. While prior studies typically provide general guidelines, they do not support the generation of usability recommendation sets for gamification elements based on user and system characteristics. In contrast, the proposed framework enables the selection of usability recommendations for specific gamification elements based on user and system characteristics, supporting the integration of gamification and usability.

5 CONCLUSIONS

This paper presented a structured framework for linking gamification elements with usability recommendations. Although gamification design frameworks and usability standards exist, their integration is rarely formalised into a decision structure. The proposed approach combines a taxonomy of gamification elements, a methodology for recommendation selection and knowledge base of usability recommendations.

Application to three systems demonstrated that recommendation sets vary according to input parameters such as age group, application domain and defined goals. Differences in the content and number of recommendations indicate that the framework generates recommendations dynamically rather than providing a static set of guidelines.

By mapping gamification elements to ISO 9241-110, ISO 9241-112 and WCAG 2.2 principles, the framework provides standards-based support for gamification element usability design. Its structure, covering general recommendations, element selection and usability recommendations for gamification elements, supports a progression from contextual analysis to implementation guidance.

Although the proposed framework demonstrates its ability to generate recommendation sets based on user and system characteristics, further validation through empirical studies is required. Future work will examine its application in real-world gamified systems to assess the impact of the generated recommendations on usability outcomes.

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