

MERIG: Design of a Multidimensional Evaluation Rubric for Informatics Games

Sarah von Styp Rekowski and Nadine Dittert

University of Koblenz, Germany

vonstyprekowski@uni-koblenz.de

dittert@uni-koblenz.de

Abstract: Game-based learning holds promise for promoting informatics skills in primary education, yet many learning games neglect inclusive design and pedagogical rigor, exacerbating gender disparities. This work-in-progress introduces MERIG, a multidimensional evaluation rubric integrating gender-sensitive design, pedagogical efficacy, and ludo didactics. Grounded in Constructionism, Universal Design for Learning, and inclusivity frameworks, MERIG guides researchers, educators, and designers towards equitable, effective games. Future steps include expert validation and empirical testing to enhance early informatics engagement across Europe.

Keywords: Informatics education, Game design, Computational thinking, Gender equity, Ludo-didactics

1. Introduction

In recent years, informatics has become an increasingly prominent component of primary education curricula across Europe, reflecting the growing societal relevance of computational competencies. At the same time, persistent disparities in participation, particularly along gender lines, continue to raise concerns about equitable access to and engagement with STEM domains (Sampson, et al., 2025). These disparities are often rooted in early educational experiences, where perceptions of belonging, self-efficacy, and interest begin to take shape (Morgan, et al., 2016).

Game-based learning is frequently positioned as a promising approach to fostering informatics skills in young learners. Their interactive and motivational nature offers opportunities to engage children in problem-solving, experimentation, and iterative learning processes aligned with core informatics concepts (Lin, et al., 2020). However, despite a growing number of educational games targeting this domain, many lack a coherent integration of pedagogical rigor and inclusive design principles. Existing approaches often prioritize either learning outcomes or engagement, while overlooking the structural factors that influence who participates and benefits from these experiences (Manna, et al., 2024).

This paper addresses this gap by introducing the *Multidimensional Evaluation Rubric for Informatics Games (MERIG)*, a research-based instrument designed to guide the development and assessment of educational games for learners in primary education. MERIG adopts a multidimensional perspective, combining gender-sensitive inclusive design, pedagogical efficacy, and ludo didactics within a single evaluative framework (Renger & Hoogendoorn, 2019). By doing so, it seeks to bridge the divide between educational theory and practical game design. As a work in progress, this paper presents the first iteration of the rubric, developed through a synthesis of relevant theoretical frameworks and design principles. In doing so, the paper contributes to ongoing efforts to create more inclusive, effective, and engaging learning environments in early informatics education.

2. Theoretical Background

The development of the proposed rubric is grounded in established learning theories, ensuring that it supports effective teaching and meaningful student engagement. It also draws on inclusive design frameworks, which emphasize accessibility and responsiveness to diverse learning needs. Together, these foundations address both pedagogical effectiveness and equity in early informatics education.

Constructionism provides a central theoretical foundation, emphasizing that learners construct knowledge most effectively through active creation and meaningful engagement (Papert & Harel, 1991). In the context of game-based learning, this perspective highlights the importance of interactive systems in which players experiment, solve problems and iteratively refine their understanding. For young learners, such environments are particularly valuable for fostering core informatics skills, as they allow abstract concepts to be experienced concretely through gameplay (Lin, et al., 2020).

The *Universal Design for Learning (UDL)* framework offers a structured approach to designing learning experiences that accommodate diverse learners from the outset (CAST, 2024). UDL promotes multiple means

of engagement, representation, and action, thereby reducing barriers to participation. Within digital games, this translates into flexible interaction modalities, varied feedback systems, and adaptive pathways that support different learning preferences and abilities.

In addition, gender-sensitive approaches to educational and game design like the PECC Framework and the Gender-Inclusivity Framework inform the inclusivity dimension of MERIG (Spieler & Girvan, 2025; Ibrahim, et al., 2010). Prior research has shown that gender disparities in STEM engagement are often due to subtle structural biases rather than explicit exclusion. Accordingly, inclusive design must extend beyond surface-level representation to consider mechanics, narratives, and interaction patterns that influence learners' sense of belonging and self-efficacy.

By integrating Constructionism, UDL, and gender-sensitive design, MERIG adopts a multidimensional perspective that captures the complex interplay between learning, play, and inclusivity. This theoretical synthesis underpins the rubric's aim to support the development of educational informatics games that are not only pedagogically sound but also equitable and engaging for all learners.

3. Methodology

This work adopts a design-oriented research approach to develop the first iteration of MERIG. The conceptual prototype is derived from a structured synthesis of relevant literature and existing design frameworks in the field of game-based learning, informatics education, and inclusive design.

The development process involved identifying and translating key theoretical principles into operationalizable evaluation criteria. These criteria were iteratively organized into the three core dimensions of MERIG: gender-sensitive inclusive design, pedagogical efficacy, and ludo didactics. At this stage, the emphasis was placed on conceptual clarity and theoretical alignment rather than empirical validation or refinement.

Importantly, this iteration of MERIG has not yet undergone empirical testing or systematic validation. Instead, the present work positions the rubric as a preliminary artifact, intended to stimulate discussion and gather expert feedback from researchers, educators, and game designers. This feedback will inform subsequent refinement cycles and the development of a more robust and validated evaluation instrument.

4. The Multidimensional Evaluation Rubric for Informatics Games MERIG

MERIG is designed as a structured instrument to support both analysis and development of educational informatics games for young learners. It responds to the need for an integrative framework that simultaneously considers pedagogical efficacy, inclusive design, and the intrinsic qualities of gameplay. MERIG is intended for use by researchers, educators, and game designers, providing a shared language for evaluating and iteratively improving educational games. The rubric is organized into three core analytical dimensions: gender-sensitive inclusive design, pedagogical efficacy, and ludo didactics. Each dimension comprises a set of criteria that capture essential qualities of effective and inclusive informatics game design.

The dimension *Gender-Sensitive Inclusive Design* addresses the extent to which games foster inclusive and non-stereotypical representations. It examines narrative and thematic framing, diversity and self-determination in character representation, and the avoidance of gendered attributions of skill or roles. Furthermore, it considers the type of interaction design used and whether it allows for diverse and creative solutions. Lastly, it measures whether broader dimensions of diversity, such as linguistic background, ability levels, and accessibility, are meaningfully incorporated. This dimension positions inclusivity not as an additive feature but as a core design principle.

The second dimension, *Pedagogical Efficacy*, evaluates the extent to which a game supports the development of core informatics skills. This includes whether learning objectives are explicitly defined and aligned with gameplay, and whether in-game actions provide observable evidence of competence. Building on evidence-centred design approaches, which link tasks, evidence, and competencies, it also considers the extent to which process data (e.g., gameplay logs) are used for assessment. Additionally, the rubric examines whether there is existing empirical evidence in the form of, e.g., pre-post comparisons or controlled studies that assess the effectiveness of the game. Together, these criteria ensure that learning is both measurable and substantively grounded.

The last dimension, *Ludo Didactics*, captures the interplay between gameplay and learning processes. It examines the quality and instructional value of feedback, the degree to which motivation arises intrinsically from integration of mechanics and content, and the presence of structured progression and scaffolding

(Renger & Hoogendoorn, 2019). Attention is also given to age-appropriate design and usability, as well as opportunities for creative agency, enabling learners to actively construct rather than passively consume knowledge.

By combining these three dimensions, the rubric provides a comprehensive tool for researchers, educators and designers. It supports systematic analysis while encouraging the development of games that are inclusive, educationally robust, and meaningfully engaging. To support consistent application, the rubric uses a five-point Likert scale, enabling evaluators to rate the degree to which a given game fulfils each criterion. The scale is intended to capture gradations in quality rather than binary judgments, thereby allowing for more nuanced analysis and comparison. Illustrative examples accompany each criterion, specifying what constitutes different levels of performance and supporting inter-rater consistency.

5. Conclusion and Future Work

This work-in-progress paper introduces MERIG, a theoretically grounded rubric designed to support the development and evaluation of inclusive and pedagogically effective educational informatics games for primary education. By integrating perspectives from Constructionism, Universal Design for Learning, and gender-sensitive design, MERIG proposes a multidimensional approach that addresses key limitations in existing evaluation frameworks while initiating dialogue on integrating pedagogical rigor, inclusive design, and engaging gameplay. While the current iteration remains conceptual, it establishes a foundation for systematically examining the interplay between inclusivity, informatics education, and gameplay design whilst highlighting the feasibility of a multidimensional approach.

A key next step involves the systematic refinement of the rubric through expert feedback. Input from stakeholders across research, education, and professional game design will be used to assess the relevance, completeness, and interpretability of the proposed criteria. Particular attention will be given to identifying ambiguities, overlaps between dimensions, and potential gaps in coverage. In parallel, future work will focus on the further development of concrete examples for each criterion and scale level. These examples are intended to operationalize the rubric more explicitly, supporting consistent interpretation and application across different evaluators and contexts. Such examples will also enhance the practical value of MERIG as a design tool, enabling practitioners to better understand how abstract principles translate into concrete design decisions. Finally, the rubric will be applied to a selection of existing educational informatics games targeting learners in primary school to explore its analytical utility and robustness. These exploratory applications will serve as a basis for assessing the rubric's effectiveness in distinguishing between different design qualities, as well as its sensitivity to variations in inclusivity, pedagogical alignment, and gameplay integration. In the longer term, this process will contribute to the empirical validation of MERIG and its potential adoption as a practical instrument within the game-based learning community.

Ethics Statement: Ethical clearance was not required for the research referred to in this paper, as the study did not involve human participants, animal subjects, or the collection of sensitive personal data.

AI Declaration: The authors utilized DeepL solely for spellchecking and linguistic refinement. No generative AI was used to produce original content, data, or analysis. The author remains fully accountable for the integrity of the work.

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