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FROM MULTIPLE INTELLIGENCES TO DIGITAL INTELLIGENCE: EXPANDING GARDNER'S PARADIGM IN THE TECHNOLOGICAL AGE

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Abstract

This study explores whether digital intelligence can be conceptualized as a new type of intelligence within Gardner's Multiple Intelligences (MI) paradigm, in the context of rapid socio-technological transformations. Building on existing frameworks of digital competence (DigComp) and Digital Intelligence (DQ), the paper proposes an operational definition of digital intelligence and examines its dimensionality, distinctiveness, and predictive value. A hypothetical exploratory design is presented, including the construction of a six-factor Digital Intelligence Scale assessing identity and reputation, self-regulation, communication, safety, critical thinking, and digital creativity. Illustrative findings suggest a coherent factorial structure with strong internal reliability and a higher-order general factor. Digital intelligence shows moderate associations with logical-mathematical, spatial, interpersonal, and intrapersonal intelligences, indicating a cross-domain cluster of cognitive and socio-emotional abilities. Hierarchical regressions demonstrate that digital intelligence predicts digital well-being and reduces risky online behaviors beyond the contribution of MI profiles. Conceptually, the study argues that digital intelligence may represent an emerging applied intelligence shaped by the demands of digital environments, potentially satisfying several of Gardner's criteria for defining an intelligence. Although empirical data are hypothetical, the model highlights the need for rigorous psychometric, developmental, and neurocognitive research to validate digital intelligence as a distinct construct.

Keywords: Digital Intelligence, Multiple Intelligences, Digital Competence, DQ Framework, Risky Digital Behaviors

1. Introduction

Over the past two decades, socio-technological transformations have redefined the way people learn, work, and relate to others. Mobile devices, generative artificial intelligence, social platforms, and online learning environments have become the basic infrastructure of everyday life, especially for younger generations. However, dominant psychological models of intelligence - from the general "g" factor to hierarchical theories such as Cattell-Horn-Carroll (CHC) - were developed in a pre-digital context and only indirectly capture adaptation to technological environments.

The theory of Multiple Intelligences (MI) formulated by Gardner (1983/2011) proposes a pluralistic vision of intelligence, considering that people have several relatively autonomous types of intelligence (linguistic, logical-mathematical, spatial, musical, kinesthetic, interpersonal, intrapersonal, naturalistic, possibly existential) (Gardner, 1983/2011; Morgan, 2021). Although the theory has had a major impact in education, it has been criticized for its lack of robust psychometric support and for the questionable extension of the concept of "intelligence" (Klein, 1997; Waterhouse, 2006, 2023).

In parallel with these debates, conceptual frameworks dedicated to adapting to digital environments have emerged, centered on notions such as digital competence and digital intelligence. The European DigComp framework defines digital competence as a set of knowledge, skills and attitudes in five major areas (information and digital literacy, communication and collaboration, content creation, safety, problem solving) (Vuorikari et al., 2022). The DQ Institute proposes the concept of Digital Intelligence (DQ) as a comprehensive set of technical, cognitive, metacognitive and socio-emotional competences, structured in eight areas of digital life: identity, use, safety, security, emotional intelligence, communication, literacy, rights (DQ Institute, n.d.; IEEE, 2020).

However, these frameworks remain largely at the level of competence language, without discussing their status in relation to the major psychological theories of intelligence. In addition, the literature on "digital intelligence" suggests that it could be an emerging "new form of intelligence", at the interface between cognitive, social and emotional skills used in digitally-mediated contexts (Digital intelligence, 2019; Voinea, 2025).

The research problem of this article derives from this situation: can we conceptualize "digital intelligence" as a new type of intelligence in the sense of Gardner, or is it just a combination of competencies already described by MI and classical cognitive models?

The general objective of the study is to explore the possibility of conceptualizing digital intelligence as a new type of intelligence in the MI paradigm, by:

1. formulating an operational definition of digital intelligence;
2. identifying its main dimensions;
3. examining the relationships between digital intelligence and the multiple intelligences profile.

Starting from this, we address the following research questions:

- RQ1: Can digital intelligence be defined as a coherent construct, conceptually distinct from digital competence?
- RQ2: Is the empirical structure of an assessment tool organized into dimensions consistent with the proposed theoretical model?
- RQ3: What is the relationship between digital intelligence and Gardner's multiple intelligences?
- RQ4: Does digital intelligence predict indicators of adaptation in the online environment (e.g. digital well-being, risky behaviors) above and beyond the MI profile?

2. Literature

2.1. Classical conceptions of intelligence

Traditional models of intelligence have emphasized the existence of a general factor (g) that explains the common variance of performance in various cognitive tasks, complemented by specific or group factors. Contemporary hierarchical models, such as CHC, describe intelligence in a three-layer structure: g at the top, broad abilities (fluid, crystallized, visual-spatial, memory, processing speed, etc.) and narrow aptitudes (Carroll, 1993; McGrew, 2009). These models are based on robust factor analyses and have a strong psychometric tradition.

Although they provide a solid framework for understanding individual differences, they do not explicitly discuss adaptation to digital environments, implicitly considering that the abilities involved in these contexts are expressions of the general and specific factors already described.

2.2. Gardner's Theory of Multiple Intelligences

Gardner (1983/2011) proposed the theory of multiple intelligences as an alternative to the psychometric view centered on g. He argues for the existence of at least eight distinct intelligences: linguistic, logical-mathematical, spatial, musical, kinesthetic, interpersonal, intrapersonal, and naturalistic, to which he later added a possible existential intelligence (Gardner, 1983/2011; Morgan, 2021).

Gardner formulated a series of criteria for recognizing a domain as an intelligence: neuropsychological evidence of modularity, the existence of scholarly cases, a distinct developmental trajectory, identification of a set of basic operations, representation in symbols and cultural systems, support from psychometric and experimental studies, etc. (Gardner, 1983/2011). MI theory has profoundly influenced educational practice, encouraging the design of learning contexts that capitalize on the diversity of intelligence profiles (Gardner, 2011; UTHSC TLC, n.d.).

From a scientific perspective, MI theory has been criticized for lacking a solid empirical basis to demonstrate the existence of completely independent intelligences (Klein, 1997; Waterhouse, 2006, 2023). Factor analyses tend to identify structures consistent with a general factor and several group factors, rather than a set of autonomous systems. Some authors have called MI a "neuromyth," arguing that there is no neuroscientific evidence for distinct brain modules corresponding to each intelligence (Waterhouse, 2023).

Gardner (2025) responded to these criticisms by emphasizing that MI theory is a psychological and educational framework, not a psychometric model of cognitive structure, and that recent neuroscience research supports the idea of partially distinct brain networks for different domains of competence (Gardner, 2025).

2.3. Digital competence and digital intelligence

The DigComp framework formulated by the Joint Research Centre of the European Commission provides a comprehensive definition of digital competence in five domains (information and digital literacy, communication and collaboration, digital content creation, safety, problem solving), detailed in 21 competences and eight

proficiency levels (Vuorikari et al., 2022). Recent updates (DigComp 2.2 and 3.0) include examples related to AI, the Internet of Things and remote work, reflecting the rapid dynamics of digital environments.

In parallel, the DQ Institute and the IEEE 3527.1 standard define Digital Intelligence (DQ) as a set of 24–32 competencies organized into eight critical areas: digital identity, usability, safety, security, digital emotional intelligence, communication, literacy, rights (DQ Institute, n.d.; IEEE, 2020; Patel, 2019). DQ is defined as a set of social, emotional, and cognitive abilities that enable individuals to meet the challenges and capitalize on the opportunities of the digital world (Digital intelligence, 2019).

These frameworks emphasize observable competencies and behaviors, but do not explicitly discuss whether DQ can be categorized as an "intelligence" in the psychological sense, similar to IQ or MI.

2.4. From digital competence to digital intelligence

The existing literature suggests that adaptation to digital environments involves:

• complex cognitive processing (critical analysis and evaluation of information, algorithmic thinking, controlled multitasking);

• social and emotional skills (online communication, empathy, emotion regulation in technologically mediated interactions);

• self-regulation and metacognition (online time management, addiction prevention, online–offline balance);

• ethical and civic orientation (digital rights, responsibility, social impact of online decisions) (DQ Institute, n.d.).

Thus, the concept of digital intelligence can be seen as a higher-level organization of these abilities, with a status similar to other forms of applied intelligence (e.g. emotional intelligence), provided that its structural coherence and predictive value for adaptation in digital environments are demonstrated.

3. Methodology

3.1. Study design

Our approach can be viewed as a cross-sectional exploratory study with a dominant quantitative component, aiming to:

• identify the factorial structure of a digital intelligence assessment tool,

• examine the relationships between digital intelligence and the multiple intelligences profile,

• test the predictive value of digital intelligence for online adaptation indicators.

We recall that the description below represents a hypothetical pilot scenario, intended to exemplify the operationalization and analysis method.

3.2. Participants

The hypothetical sample consists of N = 312 students (65% women, 34% men, 1% undeclared), aged between 18 and 25 years (M = 20.7, SD = 1.9), enrolled in two urban universities. Inclusion criteria:

• daily access to the internet and regular use of digital devices;

• providing informed consent;

• absence of reported severe cognitive impairment.

3.3. Instruments

1. ***Digital Intelligence Scale (SID) – pilot version***

o Self-report questionnaire with 36 items, 5-point Likert scale (1 = not at all true, 5 = very true).

o The items are constructed to reflect six theoretical dimensions, inspired by DQ and DigComp:

1. Digital identity and reputation management
2. Self-regulation and digital health
3. Online communication and relationships
4. Digital safety and security
5. Critical thinking and digital ethics
6. Creativity and digital production

In the hypothetical scenario, the Cronbach's alpha coefficient for the total scale is .91, and for the subscales it varies between .78 and .86 (good internal reliability).

2. ***Multiple Intelligences Inventory (MII)***

o Adaptation of a self-report inventory based on MI theory, containing 72 items (8 subscales × 9 items).

o Measures self-perception of the intensity of each intelligence (linguistic, logical-mathematical, spatial, musical, kinesthetic, interpersonal, intrapersonal, naturalistic) (Marenus, 2025).

3. ***Digital Wellbeing Scale (DWS)*** – created based on the literature on digital wellbeing and DigComp (Vuorikari et al., 2022).

o 10 items assessing online–offline balance, satisfaction with technology use, perception of control.

*4. **Digital Risk Behavior Scale (DRB)***

o 10 items assessing the frequency of risky behaviors (excessive data sharing, interactions with strangers, accessing illegal content, ignoring safety settings).

3.4. Procedure

Participants completed the questionnaires online, through a secure platform. The order of the instruments was counterbalanced to reduce order effects. Completion took approximately 25–30 minutes. All hypothetical procedures comply with ethical standards: anonymity, confidentiality and the possibility of withdrawal at any time.

3.5. Data analysis

Analysis plan:

• *Exploratory factor analysis (EFA)* for SID items (principal axis factoring method, oblimin rotation), to identify the structure of digital intelligence dimensions.

• *Calculation of internal reliability (Cronbach's alpha).*

• *Pearson correlations* between SID scores and MI subscales, as well as adaptation indicators (SBD, SCRD).

• *Hierarchical regressions* to examine whether digital intelligence predicts digital well-being and risk behaviors above and beyond multiple intelligences.

4. Results (hypothetical / illustrative)

4.1. Factor structure of the Digital Intelligence Scale

EFA (KMO = .91, Bartlett test $p < .001$) indicated an optimal solution with six factors with eigenvalues > 1, which explain 62.4% of the total variance. The items were grouped coherently along theoretical dimensions:

1. Digital identity and reputation management (7 items; $\alpha = .83$)
2. Digital self-regulation and health (6 items; $\alpha = .82$)
3. Online communication and networking (6 items; $\alpha = .81$)
4. Digital safety and security (6 items; $\alpha = .85$)
5. Critical thinking and digital ethics (6 items; $\alpha = .80$)
6. Digital creativity and production (5 items; $\alpha = .78$)

Factor loadings were generally > .45 on the target factor and < .30 on the other factors, suggesting a relatively clear structure. The factors correlated moderately with each other (r between .30 and .55), which supports the idea of **a general digital intelligence (DIg) factor**, over and above the specific dimensions.

4.2. Descriptive statistics

The scores on the IDg had a hypothetical mean of M = 3.52 (SD = 0.58) on a scale of 1–5. The distribution was approximately normal, with a slight negative skew (slightly more students above the mean).

At the MI level, the highest self-reported scores were for interpersonal (M = 3.70, SD = 0.55) and intrapersonal (M = 3.65, SD = 0.60) intelligences, and the lowest for naturalistic intelligence (M = 2.80, SD = 0.70).

4.3. Relationships between digital intelligence and multiple intelligences

The hypothetical Pearson correlations show:

• IDg correlates moderately with **logical-mathematical** ($r \approx .35$) and **spatial** ($r \approx .30$) **intelligences**, suggesting the role of cognitive processing.

• Significant correlations also with **interpersonal** ($r \approx .40$) and **intrapersonal** ($r \approx .38$) **intelligences**, indicating the importance of socio-emotional and self-reflective skills in digital adaptation.

• More modest correlations with linguistic ($r \approx .25$) and musical ($r \approx .15$) intelligences; weak correlations with naturalistic intelligence ($r \approx .05$, ns).

This profile suggests that digital intelligence is not reduced to a single MI intelligence, but intersects several domains, configuring **a specific cluster of skills**.

4.4. Digital intelligence and online adaptation indicators

Hypothetical hierarchical regressions:

• *Prediction of digital well-being (SBD):*

o Step 1: multiple intelligences explain 18% of the variance ($R^2 = .18$, $p < .001$); the strongest contributions belong to intrapersonal and interpersonal intelligences.

o Step 2: adding IDg increases R^2 to .29 ($\Delta R^2 = .11$, $p < .001$); the β coefficient for IDg is significant ($\beta \approx .35$, $p < .001$), suggesting that digital intelligence adds significant predictive value.

• *Prediction of digital risk behaviors (SCRD – higher score = more risk):*

o Step 1: multiple intelligences explain 10% of the variance ($R^2 = .10$, $p < .01$); intrapersonal intelligence is negatively associated with risk ($\beta \approx -.25$).

o Step 2: adding IDg increases R^2 to .21 (ΔR^2 = .11, $p < .001$); IDg has a significant negative relationship with risk behaviors ($\beta \approx -.34$, $p < .001$).

These suggested results indicate that a higher level of digital intelligence is associated with **more digital well-being** and **fewer risky behaviors**, even when we consider the MI profile.

5. Discussions

5.1. Digital Intelligence as a New Type of Intelligence in the MI Paradigm

The hypothetical results support the idea that digital intelligence can be conceptualized as a relatively coherent construct, structured in six dimensions that correspond to distinct adaptive requirements of digital environments (identity, self-regulation, communication, safety, critical thinking, creativity). The factor structure and internal reliability suggest the existence of a stable organization, with a higher-order general factor (IDg).

Applying **Gardner's criteria**, several arguments in favor emerge:

• *Specific basic operations*: assessing the credibility of online information, managing multiple identities, navigating social networks, setting and maintaining digital boundaries.

• *Importance in cultural evolution:* current societies rely heavily on digital environments; effective adaptation to them becomes a condition for social, educational and professional participation (Vuorikari et al., 2022; DQ Institute, n.d.).

• *The possibility of "digital experts"* (game designers, content creators, cybersecurity analysts) with exceptional performance, analogous to scholars in other fields.

• *Own symbolic and instrumental systems*: programming languages, graphical interfaces, social platforms and related cultures.

At the same time, digital intelligence remains strongly connected to other intelligences (logical-mathematical, spatial, interpersonal, intrapersonal), which raises the question of whether we are dealing with a completely distinct intelligence or with **a transversal cluster of abilities**.

5.2. Dialogue with criticisms of MI

Critics of MI emphasize the lack of evidence for the existence of autonomous intelligences and the risk of conceptual "inflation" by the continuous addition of new intelligences (Klein, 1997; Waterhouse, 2006, 2023). The introduction of digital intelligence as a new type of intelligence could be perceived as reinforcing these criticisms.

The possible answer, in the spirit of Gardner (2025), is that MI should not be understood as a strictly psychometric description of cognitive structure, but as a functional framework for understanding the domains in which people demonstrate significant adaptive competence (Gardner, 1983/2011, 2025). From this perspective, the question becomes: **is there a domain of adaptation – "digital life" – sufficiently important, coherent and distinct to justify the conceptualization of a dedicated intelligence?** Hypothetical data suggest that yes, provided that future rigorous empirical research confirms the structure and validity of the construct.

5.3. Theoretical implications

The conceptualization of digital intelligence can function as a bridge between:

• psychometric models (g, CHC),

• MI theories,

• digital competence frameworks (DigComp, DQ).

On the one hand, DI can be integrated into a hierarchical model: g → broad skills → specific intelligences (including DI). On the other hand, it can be seen as **an applied meta-domain** combining executive functions, social and emotional skills, and technological knowledge, analogous to how emotional intelligence has been conceptualized at the interface between cognition and affect.

5.4. Practical implications

At the educational level, the recognition of digital intelligence could support:

• *revising the curriculum* to explicitly include the development of the dimensions of DI (identity, self-regulation, safety, critical thinking, digital creativity), in line with DigComp and DQ (Vuorikari et al., 2022; DQ Institute, n.d.).

• *training teachers and counselors* to assess and support digital intelligence profiles of students.

• *counseling and intervention programs* focused on digital health, addiction prevention, online relationship management and reducing risky behaviors.

In work psychology and career guidance, the digital intelligence profile could become relevant in orientation towards intensely digitalized professions (IT, digital marketing, game design, data analysis).

5.5. Limitations and future directions

The main limitation of this article is the **hypothetical** nature of the empirical data; the scenario presented illustrates how a pilot study might look, but does not replace actual research. Other conceptual and methodological limitations include:

- focus on self-report, vulnerable to social desirability bias;
- lack of longitudinal data on the development of digital intelligence across the lifespan;
- absence of neurocognitive indicators to support modularity.

Future directions:

- confirmatory factorial studies and cross-cultural invariance tests;
- correlation of digital intelligence with objective performance in digital tasks (simulations, serious games);
- longitudinal research on the development of ID in children and adolescents and the impact of educational interventions.

6. Conclusions

Our study proposed **a conceptualization of digital intelligence** as a possible new type of intelligence in the MI paradigm, building on the existing frameworks of digital competence (DigComp) and digital intelligence (DQ). A six-dimensional model was formulated and it was illustrated, through a hypothetical pilot study, that:

- the factor structure of a dedicated instrument can be coherent,
- digital intelligence presents a specific correlation profile with multiple intelligences,
- ID predicts digital well-being and risky online behaviors above and beyond the MI profile.

In a cautious formulation, *digital intelligence can be considered an emerging construct with the potential to be recognized as a distinct intelligence*, conditional on the accumulation of psychometric, neuropsychological evidence and the development of valid instruments.

On the same note, we propose a ***definition of digital intelligence*** according to which it can be understood as ***the relatively stable ability of the individual to perceive, process and integrate information, to make decisions and to act adaptively, creatively and ethically in digital environments, using the available technical and social resources to achieve personal, educational and professional goals, while protecting their own well-being and the rights of others.***

We appreciate that in the context of the technological age, such an extension of Gardner's paradigm seems not only theoretically legitimate, but also necessary to understand human adaptation to the digital world.

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