

Understanding how Digital Intelligence contributes to Digital Creativity and Digital Transformation: A Systematic Literature Review

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Abstract

Despite the rising potential of the Digital Intelligence (DI) emerging concept for practitioners, only a few research studies have considered its contribution to the enterprise digital transformation.

Due to its novelty, the scope, application domains, and main research themes of DI are still unclear to date.

Through a Systematic Literature Review (SLR), we analyzed relevant academic literature and tentatively identified major research areas to facilitate the understanding and study of DI in the digital transformation era.

The results have shown that DI is at an early stage of research and investigation. To fill the gap between theory and practice, we have proposed a research agenda of DI with several perspectives.

1. Introduction

Digital transformation also known as digitalization refers to a business model driven by “the changes associated with the application of digital technology in all aspects of human society” [35, P.689]. It is usually implemented through digitization, i.e. the “ability to turn existing products or services into digital variants, and thus offer advantages over tangible product e.g., easier and faster distribution.” [36, P.6]

In an environment of digitization, where the pace with which advancement in technology takes place, a mounting pressure on organizations to adapt, change and innovate is increasing continually in order to remain competitive [37]. There is no doubt that technological advances require new competencies; thus, the concept of digital intelligence (DI) has emerged [13, 14, 38].

Overall, DI is the ability to acquire and apply new knowledge and skills related to digital technologies: social, mobile, analytics, cloud, and, more recently,

cyber security [39]. More than just the ability to use digital technologies, it addresses the what, why, where, when, who, how, and how much of digital technology to improve operational efficiency and outcomes. DI is fundamentally about our relationship with technology, just as emotional intelligence is about our relationship with others [41].

Due to the lack of a globally shared understanding of DI, the DQ framework [14] was introduced by the DQ institute. This framework was identified as a best practice to be used as global industry standards for digital skills by the IEEE Digital Literacy Industry Connections Program. It aggregates 25 leading frameworks on digital skills from around the world. In this regard, we have based our SLR reference on this framework as a basis. The DQ Framework is structured around two categories: “areas” and “levels” of digital intelligence. Eight broad areas of one’s digital life have been identified: Digital Identity, Digital Use, Digital Safety, Digital Security, Digital Intelligence, Digital Communication, Digital Literacy and Digital Rights.

The competencies within these within these eight areas can be further differentiated by three different “levels” of maturity—Digital Citizenship, Digital Creativity, and Digital Competitiveness. In total, this creates an eight-by- three matrix of 24 competencies. Cf. figure 1.

Despite the rising potential of the Digital Intelligence (DI) concept in the managerial literature, a few academic studies have addressed its contribution to the enterprise digital transformation.

Thereby, the main objective of this research is to give a comprehensive understanding of DI through the academic literature and to underline its potential role in the digital transformation era. We have run a Systematic Literature Review (SLR) in order to bring answers to the following research questions:

- What are the definitions of DI in the extant literature?

- How does DI contribute to digital creativity and digital transformation?



Figure 1. DI framework proposed by DQ Institute

The rest of this paper is organized as follows. Section 2 presents the research methodology used for this research. Section 3 reports and discusses the results. Section 4 presents the identified future research directions and Section 5 concludes the paper.

2. Methodology

The main goal of this paper was to explore the DI concept drawing on a literature review. In order to analyze and systematize knowledge on the subject of DI, we conducted a systematic literature review (SLR) following the proposed agenda by [21] and [2]. An SLR is aimed to systematically identifying and selecting relevant papers to be reviewed on a particular topic and rigorously analyzing the extracted data to answer a set of research questions in order to explore, classify, and analyze the extant literature through quality assessment criteria [21, 2]. This method comprises six steps that are presented in the following subsections.

2.1 Research identification

The goal of this paper was to understanding and mapping definitions on DI intelligence as well as analyzing its potential contribution to digital creativity and digital transformation.

2.2 Research strategy

Our search strategy mainly comprises the major terms related the research questions. Moreover, we

employ alternative spelling and synonyms through Boolean operator (AND; OR) to connect different studied words and terms. The research articles were screened from “Business Source Complete” (EBSCO) database that covers all disciplines of business and management. In addition, we limited the publication year from 2014 to 2019. The articles identified from this database were downloaded into a references management tool called ZOTERO. As the main keyword for our research we primary screened the database by use of the following keywords: “digital intelligence”, “digital” AND “intelligence”, “intelligence quotient” AND “digital”, “Digital intelligence quotient” OR “digital IQ”, “Digital quotient” OR “IQ”.

2.3 Study selection

We determined specific criteria to select articles for synthesis and analysis. To be included, an article has to be written in English, accessible, published in a scientific journal. Therefore, Master and Doctoral dissertations, proceeding or conference articles, working papers, press articles and textbooks were excluded for this review. We separately performed title and abstract screening, according to included and excluded criteria, and the screening results were compared. In case of differences, the article was jointly investigated to reach a consensus. The final list of this phase was sent for the quality assessment.

2.4 Quality assessment

In this stage, the quality criteria were defined to evaluate the selected list from section 2.3. The main goal of this section is to select articles based on their rigorousness, credibility and relevance to our research concepts [7, 28, 4, 19]. The authors completely reviewed articles and removed low quality research. Research objective, adequate information about a context, methodology, analysis, the research outcome and validity are the main quality criteria. The selected articles addressed the following questions [28, 4, 19]:

- Is there an adequate description of the context in which the research was carried out?
- Is there a clear statement of research aims?
- Does the paper describe an explicit research question?
- Is the research design appropriate to address the research aims?
- Is the literature review adequate?
- Is the collected data in a way of addressed research issue?

- Is the data analysis sufficiently rigorous?
- Is there a clear statement of findings?
- Is the study valuable for research or practice?
- Does the paper discuss limitations or validity?

We assessed the articles based on four possible options [28, p.282], which address four points Likert scale for evaluation and finalization a selected list: an issue is not mentioned at all (score 0), little mentioned (score 1), adequately addressed (score 2) and completely addressed (score 3). To ensure the reliability of the selected list, we have removed the articles with the average score lower than 1 point.

From 93 articles identified, only 7 of them included the research criteria. Through the quality assessment, none of the articles could reach 1 point to select to analyze. In other words, DI and its related synonyms that were mentioned in section 2.2 were not discussed in this database, which highlights an important gap in the extant literature.

Drawing on the DI framework [14], we have conducted another article’s screening based on the 8 competencies areas of this framework, namely “digital right”, “digital literacy”, “digital communication”, “digital emotional intelligence”, “digital security”, “digital safety” and “digital use” (cf. figure 1). We have used Taylor & Francis Online database to enrich the results.

Considering our research strategy, we have used the same process by the Boolean operator for these competencies areas and their related terms. Then articles were listed based on excluded and included criteria. Following the process of quality assessment (cf. section 2.4), the qualified list comprises 20 items from 394 explored researches at the beginning, about the considered DI competencies areas.

2.5 Data extraction

In this step, data was extracted from the qualified list and comprises title, authors, journal, methodology, DI competencies areas, application area, DI definition and its contribution to digital creativity and digital transformation.

2.6 Data synthesis and analysis

The selected articles through the SLR process were analyzed and synthesized at this stage. The outcome of this section represents a descriptive analysis of the included articles and provides a detailed research agenda for future studies. The final qualified list includes 20 articles. Figure 2 depicts the process of SLR to reach the final selected list from the EBSCO and Taylor & Francis Online databases.

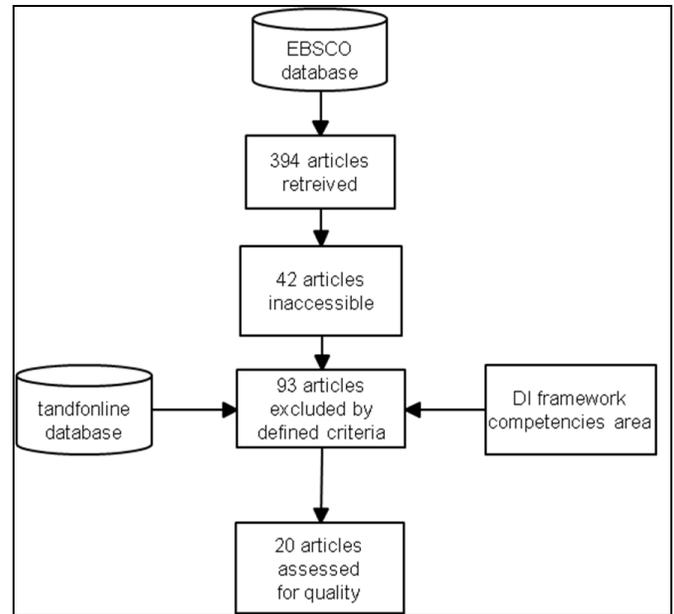


Figure 2. Systematic literature review method

3. Results

This section presents an overview of articles selected for their quality from our SLR. We present the distribution of articles by journal, methodology and application area. In addition, DI definitions and the distribution of article according to the eight DI framework competencies are analyzed. Some articles are counted more than once because they cover more than one competency.

3.1 Distribution of articles by journal

Table 1 presents the distribution of articles by journal.

Table 1. Distribution of articles by journal

Journal	Number of articles (%)	References
Journal of AIS	1 (5%)	[10]
Information Services & Use	1 (5%)	[22]
Journal of Interactive Marketing	1 (5%)	[18]
Behaviour & Information Technology	1 (5%)	[5]

Informatica Economică	1 (5%)	[27]
International Journal of Consumer Studies	1 (5%)	[6]
Information Processing and Management	1 (5%)	[9]
Journal for Business, Economics & Ethics	1 (5%)	[12]
The European Journal of Social Science Research	1 (5%)	[8]
European Journal of Information Systems	2 (10%)	[43][44]
Nordic Journal of Digital Literacy,	1 (5%)	[45]
Computers in the Schools	1 (5%)	[46]
Information, Communication & Society	1 (5%)	[47]
Australasian Journal of Educational Technology	1 (5%)	[48]
ALT-J Research in Learning Technology	1 (5%)	[49][50]
Learning, Media and Technology,	1 (5%)	[51]
Enhancing Learning in the Social Sciences	1 (5%)	[52]
Information Polity	1 (5%)	[20]

3.2 Distribution of articles by methodology

Table 2 shows the distribution of articles regarding research methodology [26]. The Survey and the case study were the preferred method within these articles. [44] Is an epilogue, it wasn't mentioned in the table 2.

Table 2. Distribution of articles by methodology

Methodology	Number of articles (%)	References
Survey	5	[5],[10], [27], [8][46][47]
Case study	5	[22] [43][45][48][49]
Interview	2	[20][50]

(Mixed) quasi-experimental design	1	[18]
Lab-based quasi-experiment	1	[9]
Practical syllogism	3	[12] [51][52]
Generalized linear modeling (GLM)	1	[6]

3.3 Distribution of articles by application area

Table 3 provides an overview of the application areas that have addressed the DI concept. In this line, the education sector possesses a high rank. Following, the general management studies, the healthcare system and society/ socio-economy are at the third place, while government is the least application area.

Table 3. Distribution of articles by application area

Application area	Number of articles	References
Education	4	[5], [18], [9], [27][45][46][47][48][49][50][51]
Healthcare	2	[10], [22]
Socio-economic and Society	2	[6], [8],
Government	1	[20]
General	1	[12] [43][44]

3.4 Distribution of articles by DI competencies areas

Whilst DI and its related terms have not been sufficiently studied in EBSCO, we employed DI competencies areas [14] as the main research terms in the SLR process and we have expanded the research using Taylor & Francis Online database. Only 4 (out of 8) DI framework competencies areas were considered in the literature. The majority of articles focused on 'Digital Literacy' followed by 'Digital Security', 'Digital Communication' and 'Digital Emotional Intelligence'. 4 competencies areas considered by the DI framework were not addressed in the literature namely: 'Digital Rights', 'Digital Identity', 'Digital Use' and 'Digital Safety'.

This result confirms that DI is at an early stage of research and investigation, which underlines the gap in the extant literature. Table 4 demonstrates the distribution of DI competencies areas within our qualified list.

Table 4. Distribution of articles by DI competencies areas

DI competencies area	Number of articles	References
Digital Literacy	12	[9], [6],[8], [20], [22] [45][46][47][48][49][50][51]
Digital Security	2	[5], [27]
Digital Communication	4	[10], [12][43][44]
Digital Emotional Intelligence	2	[18][16]

3.5 Distribution of articles by DI's level of analysis

The synthesis of the qualified list shows that the articles focus mainly on the individual level rather than team/organizational level, in exploring the contributions of DI competency areas. Table 5 presents this distribution of references.

Table 5. Distribution of articles by DI's level of analysis

Level of analysis	Number of articles	References
Individual	6	[5], [9], [10],[18], [22], [27]
Organizational	1	[12]
Society	3	[6],[8], [20]

3.6 Core DI definitions in the analyzed articles

In order to answer to our first research question and to clarify the scope of DI, we have examined the main DI definitions in the analyzed articles cf. table 6.

In light of these definitions, we can argue that DI is not about the use of digital technologies at the exclusion of human ability; rather, it is about the relative strengths of both people and technology and

how we can capitalize on those strengths. It is the ability to mobilize digital technologies wisely.

Table 6. Core DI definition in the literature

DI Definitions	References
<i>"is a comprehensive set of technical, cognitive, meta-cognitive, and socio-emotional competencies that are grounded in universal moral values and that enable individuals to face the challenges and harness the opportunities of digital life."</i>	[14]
<i>"A combination of 8 proposed intelligence: intrapersonal, interpersonal, musical, logico-mathematical, linguistic, spatial, bodily-kinesthetic and naturalist."</i>	[39]
<i>"Is an individual's ability to decode and manipulate information and knowledge by use of digital technology and transfer them into the digital environment"</i>	[13]

With regards to cognitive science field [29] and in the stream of the definition of [14], we consider in this paper the DI as a competence with three dimensions:

- Cognitive dimension: as it allows designing strategies for learning digital technologies,
- Behavioral dimension: to act appropriately towards and with technology and,
- Affective dimension: to be agile and believe in one's own efficiency.

3.7 Distribution of articles by DI competency areas and their contribution to digital transformation

In order to explore how DI competency areas contribute to digital transformation, the articles were categorized based on studied DI competency areas and their contributions in table 7.

Table 7. Distribution of articles by DI dimensions and their contribute to the research context

DI dimension	DI contributions to digital creativity and digital transformation	References
Digital Literacy	<p>Digital literacy impacts on</p> <ol style="list-style-type: none"> 1) students creativity and ability to use digital ressources 2) Users adaptation with digital health, 3) digital divide, 4) Ability to use digital technologies for their needs 5) Use of e-government facilities. 	[6], [8], [9],[22], [20]
Digital security	<ol style="list-style-type: none"> 1) Reducing cyber-attacks like phishing, unauthorized access and Malware 2) behave safely in use of Wi-Fi and Bluetooth security 3) Develops users' ability against social engineering attack. 	[5], [27]
Digital emotional intelligence	Impacts on purchase decision: product attitudes (consumers and utilitarian attitudes) and product choices.	[18]
Digital Communication	<p>Impacts on</p> <ol style="list-style-type: none"> 1) Moral discernment through shaping new regulation of digital communication 2) Sharing private health information (PHI) in virtual health communities (VHC), 3) Privacy concern and virtual community outcomes. 	[12], [10]

The analysis of the qualified list shows that the majority of articles emphasize digital literacy as a critical competency for the digital transformation.

For instance, the educational sector was investigated by [9], in order to explore children's (ages 11–13) digital skills and creativity in a Google search activity. The findings reveal that digital literacy enhances children's competency to discover task requirements and complex research operations versus simple fact finding. It consequently improves children's interaction with the digital environment and performance in schools.

[22] Have studied the impact of digital health literacy on public health system. Accessibility of a broad range of digital health systems like e-Health, m-Health, interactive electronic records in various languages, health decision support programs, and online communities, offers adaptable digital information. The efficient use of these technologies depends on individuals' digital health literacy.

However, digital health services are not readily understandable for users with low digital health literacy, it subsequently increase the digital divide gap. The authors stresses on the role of training programs to improve digital literacy to make use of public health care systems.

Digital security and more specifically the ability to behave safely in the cyber environment is the second DI competency area found through SLR findings.

In [5] two hundred and fifty smart mobile device owners from the University of South Australia were surveyed. It was found that smart mobile device users in the survey generally underestimated the value that their collective identities have to criminals and how these can be sold. This underlines the user' low digital security knowledge and skills. Thus, regular training programs for enhancing digital security culture and for improving users' digital skills to identify ongoing cyber risks and learn security protective behavior.

The second article related to digital security [27] determines the notable role of individuals' awareness and skills to protect their information against social engineering. Through social engineering users' passwords, usernames, credit card data or other types of ID are attacked. The findings of this survey underline that social engineering targets individual, not system security, thus, learning security principals and the protective manner in the cyber era are as crucial as technological security.

Digital emotional intelligence as a competency to adjust and identify emotions within the digital environment is studied by [18]. The authors indicate

how consumers' product attitude, product choices and purchase decisions are influenced by online reviews' emotional contents. Through self-construal approach the article explains how consumers with independent self-construal are influenced by emotional reviews more than consumers with interdependent self-construal. Furthermore, customers' product attitudes are enhanced by positive emotional content/review, while negative or mixed online emotional content declines customer's utilitarian. The regulation of online emotion as the main variable of this study highlights the role of digital emotional intelligence.

Digital communication is argued by [10] and [12] in two different approaches and implications. [12] contends that digital communication conceptualizes new social norms and control forces through changing the value and goals. However, these new norms and controls raise the question of "what is the right thing to do?" (p. 348) and lead to new challenges for moral discernment, because corporate members cannot understand a possible process of digital communication. [12] Implements practical syllogism method and analyzes the results by social control theory within a business. The research proposes establishing new regulations for digital communities that are directed by a digital leader.

[10] Conducts a survey to explore which factors affect on sharing personal health information (PHI) in a virtual health community (VHC). Drawing on the privacy calculus model and the concept of affective commitment, [10] concludes that privacy concern provided by system security management influences willingness to share PHI, regardless of user's affective commitment to VHC.

4. Future research directions

The findings from SLR indicate DI, as the key competence to adapt to the digital era, is not fully considered in the academic literature. Regarding to our first research question, we could not gain yet a unified definition from the literature. Thus we have considered 3 DI components as a way to synthesize a common understanding for future DI research. We expand our research based on the DQ framework competencies [14] to run the SLR process.

To address our second research question, the resulting qualified article list only considers four out of eight DI competency areas namely: Digital Literacy, Digital Security, Digital Communication

and Digital Emotional Intelligence. Thus, the contribution of DI to the digital creativity and digital transformation cover only these competency areas.

This finding underlines that the academic literature and top tier journals doesn't address the same theme as the professional literature, and need to be further explored in order to gain a common understanding. However, the eight DI competency areas were much more investigated by practitioner research [24], [13], [31] [33].

Furthermore, the major screened articles investigated DI at the individual level, while team and organizational levels were not really addressed. These levels of analysis are mainly argued in a variety of sources like books, or book chapter, website, reports and white papers published by international non-profit organizations [1]. Hence, the contribution of DI to digital creativity wasn't addressed and needs to be further explored in future research.

In the digital transformation era, knowledge sharing, as well as, the ability to acquire and apply new knowledge and skills are dramatically enhanced thanks to digital technologies i.e. the main technologies that have deeply revolutionized our society: Social, Mobile, Analytics, Cloud (SMAC). Organizational ability to mobilize these technologies wisely leads to digital creativity.

The current research by MIT Sloan Management Review asserts improving DI in an organization fosters the digital transformation and enhances a chance of embracing digital opportunities to "reestablish profitable growth". Integrating organizational DI with business strategy is proposed as the main lever of digital competition. In this line four competencies areas is proposed by [24] for organizational DI: "strategy, culture, organization, and capabilities.

DI is a critical business ability to sustain Business Intelligence [32]. An organizational ability to "synchronize business and IT strategies, govern IT, and execute IT projects and enterprise systems", as a business DI, is determined by [32] in their book. [31] Asserts that DI continuously "optimizes business decision and customer experiences across the customer life cycle" through offering competitive advantage. [3] Introduces DI as one of the seven enablers in financial service providers that advances "customer loyalty, sales and marketing return on investment" [3].

Table 8. Future research directions

1	Exploring how DI fosters digital agility and digital creativity to develop competitive advantage of a business
2	Defining DI with its related competencies areas at 3 levels: individual, group, organization
3	Defining determined measurement to assess DI and its competencies areas at 3 levels: individual, team, and organization.
4	Measuring effects of different variables like gender, age, job and etc. on DI
5	Studying the impact of competencies on firm performance : marketing, operation, financial performance etc.
6	Studying the impact of DI on social interaction.
7	Investigating impacts of DI on digital innovation and responsibility
8	Exploring an impact of DI on digital creativity.
9	Identifying the implications of DI dimensions on different digital technologies use like IoT and cloud based system.
10	Identifying to what extent DI can extend the robots.
11	Conducting interdisciplinary research to identify how neuroscience can influence DI

This research offers some implications for practitioners, as well. DI is the part of the globalization of markets, the digitization of work and organizations, and the continued development of the Fourth Industrial Revolution. It follows other such phenomena as the Internet of Things (IoT), Big Data, Artificial Intelligence, Blockchain, and, soon, Quantum Computing, that are becoming infused in our daily lives. In this light, our study reveals that companies must develop a mindset that allows them to integrate the various workplace needs of speed, mobility, multitasking, and efficiency, by working ubiquitously- anywhere, anytime, and through one device- and without falling into addiction, digital intoxication, misinformation, and techno-stress, which can lead to burnout. On the one hand, companies must face new disruptive players who have profoundly overwhelmed traditional sectors through the use of digital technologies, and, on the other hand, be able to adapt faster and personalize their products and services to customers who have become more informed about market offers and more

demanding by imposing their rules of an increasingly competitive game [41].

Finally, in order to fill current knowledge gaps in DI and team creativity research, we envision extending the Team Creativity Model (TCM) [40] by reconsidering it in the digital creativity and the digital transformation era. The TCM advanced an explanation to understand the antecedents of team creativity. It posits that both individual creativity and shared mental models contribute to team creativity. As organizations increasingly rely on teams to solve problems creatively or design new products and Services, team creativity in the digital era are a promising future research direction. Thereby, we could analyze how effectively using digital technologies could enhance the Team Creativity Model (TCM).cf. figure 3: extended TCM model.

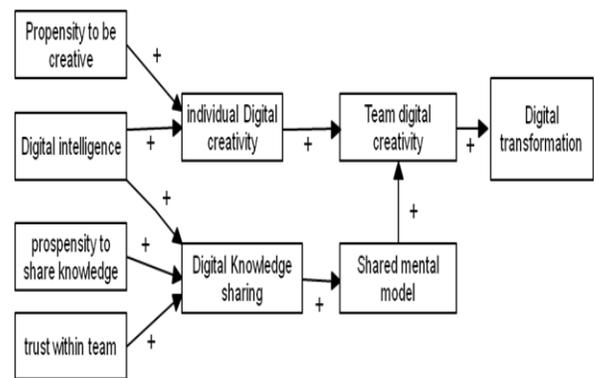


Figure 3: Proposal for extending TCM [40] in the digital transformation era

We envision exploring the TCM more fully through qualitative studies with different creative problem solving or designing teams with digital technologies, as well as some initial confirmatory quantitative studies Using Structural Equation Modeling [42] to investigate the relationships between TCM constructs.

5. Conclusion

Motivated by the growing significance of digital intelligence and digital creativity in the digital transformation era, we decided to systematically gather and rigorously analyze and synthesize the literature, in order to explore how the literature. Our primary goal was to explore what is DI regarding digital creativity and digital transformation. It also intends to analyze the competencies areas of DI and

their contribution to individual and organizational level, regarding the challenges faced by organizations and opportunities for new disruptive business. This SLR promises several potential benefits both for researchers and practitioners. The demographic findings are potential value for researchers to shape their future research directions. This research indicates despite the imperative role of DI for digital transformation and creativity, it is not comprehensively investigated by academic literature. However, practical research such as [31], [24], discuss the important of DI through white papers, books, websites, etc.

6. References

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