

## Digital Bias in Social and Educational Research

التحيز الرقمي في البحوث الاجتماعية والتربوية

**Prof. Ibtissem GHANEM<sup>1</sup>**

Higher Normal School of Technological Education Teachers Of Skikda  
(ENSET), LARES Laboratory- University of Skikda, Algeria  
i.ghanem@enset-skikda.dz

**Dr. Ibrahim BEZAZ**

University 20 August 1955 Skikda, LARES Laboratory-  
University of Skikda, Algeria  
i.bezaz@univ-skikda.dz

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### Abstract:

This article examines the phenomenon of digital bias as a complex methodological problem confronting researchers in the social and educational sciences. It distinguishes five principal forms of digital bias: selection and representation bias, algorithmic bias, digital divide bias, digital measurement bias, and confirmation bias. The article analyzes the mechanisms that generate these biases and their implications for the validity of research findings, while proposing systematic strategies for mitigating their effects. The study draws on a critical review of the literature on digital research methodology and applied social science.

**Keywords:** digital bias, social research, algorithms, digital divide, research methodology, big data.

### ملخص:

يُعالج هذا المقال ظاهرة التحيز الرقمي بوصفها إشكاليةً منهجية مُركّبة تواجه الباحثين في العلوم الاجتماعية والتربوية. ويُميز المقال بين خمسة أشكال رئيسية للتحيز الرقمي هي: تحيز الاختيار والتمثيل، والتحيز الخوارزمي، وتحيز الهوية الرقمية، وتحيز القياس الرقمي، وتحيز التأكيد، ويُحلّل المقال الآليات المُنتجة لهذه التحيزات وتداعياتها على صحة النتائج البحثية، مع تقديم استراتيجيات منهجية للتخفيف من أثرها. وتستند الدراسة إلى مراجعة نقدية لأدبيات منهجية البحث الرقمي والعلوم الاجتماعية التطبيقية.

**الكلمات المفتاحية:** التحيز الرقمي، البحث الاجتماعي، الخوارزميات، الهوية الرقمية، منهجية البحث، البيانات الضخمة.

## I. Introduction

Over the past two decades, social and educational research has witnessed an unprecedented expansion in the use of digital tools for data collection and analysis. Yet this transformation has given rise to deep methodological problems, foremost among them what has come to be known as digital bias. Salganik (2019) drew attention to the fact that digital data are "always large, but rarely representative" — a characterization that encapsulates the very essence of the problem at hand.

Digital bias may be defined as the systematic distortion that affects data, analyses, or research findings as a result of the use of digital tools and platforms. Boyd and Crawford (2012) classified these concerns among the "critical questions" that ought to accompany the development of big data in the social sciences, cautioning against the risk of technological dazzlement at the expense of methodological rigor.

This article pursues four objectives: (a) to conceptualize digital bias; (b) to map its forms and patterns; (c) to analyze the mechanisms underlying its emergence; and (d) to propose strategies for reducing its impact in social and educational research.

## II. The Conceptual Framework of Digital Bias

### 1. Defining Digital Bias

Digital bias is an umbrella term encompassing the various forms of methodological deviation that arise from the use of digital technologies in scientific inquiry. Salganik (2019)

distinguished four fundamental characteristics of digital data — scale, permanence, breadth of reach, and incompleteness — with this last characteristic constituting the primary gateway through which bias enters.

At the conceptual level, Boyd and Crawford (2012) identified three intertwined layers of bias: bias at the point of data generation, bias introduced through algorithmic processing, and bias at the point of interpretation. In actual research practice, these three layers are so thoroughly entangled that disentangling any one of them from the others proves exceedingly difficult.

## **2. Digital Bias and the Problem of Spurious Comprehensiveness**

O'Neil (2016) warned that the sheer scale of digital data frequently creates the illusion of comprehensiveness in researchers' minds, even as the complete absence of entire population groups from the digital sphere renders that apparent comprehensiveness a methodological fiction. This concern has led a number of theorists to call for dedicated standards for evaluating digital research — standards that differ fundamentally from those applied to traditional survey-based studies.

## **III. Forms of Digital Bias in Social and Educational Research**

### **1. Selection and Representation Bias**

Selection bias is among the most prevalent forms of digital bias, manifesting in the failure of digital samples to faithfully represent the broader population. In an extensive study, Hargittai (2020) found that digital communities tend to over-represent

younger, urban, and more educated groups while implicitly excluding older, rural, and lower-income populations — a pattern some researchers have termed "selective access bias."

In the educational context specifically, the experience of e-learning during the COVID-19 pandemic laid this limitation bare with unusual clarity. Studies relying exclusively on digital data proved unable to construct an accurate picture of the educational reality facing millions of students who lacked any digital access — a state of affairs that led Eubanks (2018) to argue that such methodologies perpetuate "digital discrimination" rather than addressing it.

## 2. Algorithmic Bias

Algorithms are designed on the basis of training data that reflect pre-existing assumptions and the social structures prevalent in particular cultural contexts. Noble (2018) documented how the algorithms powering Google's search engine reproduce racial and gender stereotypes — not through deliberate design, but because they function as a mirror of the data on which they were trained.

In social science research, Benjamin (2019) observed that this bias takes on a structural character when such algorithms are deployed in decisions with significant social consequences — employment, education, and criminal justice — at which point technical bias transforms into actual discrimination, cloaked in the language of digital objectivity.

### 3. Digital Divide Bias

Hargittai (2020) noted that the digital divide extends beyond mere access to technology to encompass disparities in digital competency and patterns of use — what she termed "the second-level digital divide." This deeper divide gives rise to systematic biases even within internet-connected segments of the population.

In the Algerian and broader Arab context, the geographic gaps between northern and southern regions, and between rural and urban areas, constitute a structural source of bias in any digital study. As O'Neil (2016) has argued, the absence of network connectivity in particular regions leads to the systematic exclusion of entire population groups from the scope of inquiry — a problem that poses a serious threat to the validity of findings in regional social and educational research.

### 4. Digital Measurement Bias

This form of bias addresses questions of validity and reliability when conventional measurement instruments are transposed to a digital environment without adequate testing. Tourangeau and Ye (2009) demonstrated that respondents react differently to electronic questionnaires compared to their paper-based counterparts, particularly on sensitive questions concerning social attitudes and private behavior — a phenomenon that has come to be known as the "medium effect."

### 5. Digital Confirmation Bias

The algorithms powering social media platforms operate according to a logic of personalization and recommendation,

thereby feeding the phenomenon of "echo chambers." When researchers draw on the content of these platforms as a data source, they risk — as Boyd and Crawford (2012) caution — being drawn toward the most active and vocal users, while neglecting the silent and disengaged segments that often constitute the largest portion of a given society.

## **IV. The Mechanisms Generating Digital Bias**

### **1. Corporate Control over Data Flows**

The digital landscape is dominated by large corporations that exercise tight control over the generation, storage, and use of data in ways that serve their commercial interests. Noble (2018) has argued that this dominance leads to the production of data shaped by the logic of profit and virality rather than by the requirements of scientific objectivity, making big data derived from these platforms a matter of serious methodological concern.

### **2. Bias in the Design Phase**

Developers, like all human beings, carry their cultural backgrounds and unconscious assumptions, which seep imperceptibly into the architecture of tools and algorithms. Benjamin (2019) has called this phenomenon the "New Jim Code" — a reference to the way digital design reproduces the structures of social discrimination in the apparently neutral language of technology.

### 3. Digital Behavioral Dynamics and Performed Identity

Behavior on social media platforms frequently embodies a carefully managed and imagined identity rather than a person's authentic self. Salganik (2019) warned that researchers who extract data from these platforms are, in effect, engaging with "presented selves" rather than the actual behavior of their subjects — a situation that threatens the construct validity of their conclusions.

## V. Implications for Social and Educational Research

### 1. Threats to Internal and External Validity

Digital bias poses a twofold threat to research validity: it undermines internal validity by contaminating causal relationships with bias introduced through digital instruments, and it erodes external validity when digital samples fail to represent adequately the population under study. O'Neil (2016) argues that predictive models built on biased digital data become "weapons of math destruction" — perpetuating social inequalities under the guise of objectivity.

### 2. The Reproduction of Social Inequalities

When educational policies or social interventions are grounded in findings from digitally biased research, they risk deepening existing structural inequalities. In her detailed study, Eubanks (2018) documented how digital decision-making systems in social welfare, education, and justice have historically harmed the most vulnerable populations rather than helping them.

## VI. Strategies for Mitigating Digital Bias

### 1. Methodological Triangulation

Salganik (2019) recommends combining digital approaches with traditional methods — interviews, field observation, and administrative records — within a framework of methodological triangulation, regarding this as the most robust safeguard for verifying the soundness of digital findings and enhancing their external validity.

### 2. Transparency and Methodological Disclosure

**Boyd and Crawford (2012) urge researchers to adopt a standard of "full methodological transparency," encompassing detailed documentation of how digital data were collected and processed, an account of the limitations of the instruments employed, and critical scrutiny of the algorithms used before any conclusions are drawn from them.**

### 3. Intentional Diversity in Sample Design

Hargittai (2020) advocates for what she calls "inclusive sampling design" — an approach that deliberately incorporates digitally marginalized groups into the study framework, using alternative channels to reach them (such as telephone interviews and community intermediary networks) rather than relying solely on the populations that digital platforms spontaneously attract.

#### 4. Algorithmic Auditing

Both Noble (2018) and Benjamin (2019) have called for mandatory independent audits of algorithms used in social and educational research, designed to expose their potential biases. To this should be added the systematic testing of digital measurement instruments with each population subgroup separately, in order to verify differential validity before any large-scale deployment.

#### VII. Conclusion

This article has argued that digital bias is not an incidental technical malfunction but a complex, structural phenomenon rooted in the design of digital tools and in the social and cultural dynamics that surround them. The review of the literature — particularly the works of Boyd and Crawford (2012), Salganik (2019), and Noble (2018) — reveals that digital bias operates across multiple, interlocking levels, extending from the design of the instrument to the interpretation of findings.

The central challenge remains one of achieving a productive critical synthesis between the immense possibilities offered by digital tools and the rigorous methodological vigilance demanded by their limitations. This article recommends the integration of digital bias as a substantive topic in research methodology curricula at Arab universities, the development of locally grounded methodological guidelines that account for the specific social and technological context of Arab societies, and investment in the construction of algorithmic analysis tools tailored to the characteristics of the Arabic language and the diversity of its cultural contexts.

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