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The Second-Level Digital Divide in Higher Education: Territorial and Material Disparities among Students at the University of Oran 2

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Abstract :

This study analyzes the mechanisms of the digital divide at the University of Oran 2 for the 2024-2025 academic cycle. Employs a mixed methodology, combining quantitative data from 116 questionnaires with a qualitative approach through semi-structured interviews (23 interviews). The results establish a direct correlation between residential area and the effectiveness of access to academic resources. Territorial disparities, accentuated by heterogeneous network coverage among mobile operators, penalize students from rural areas (perceived difficulty of 4.1/5 compared to 2.8/5 in urban areas). Material equipment reveals technical precarity, 89% of learners depend exclusively on their mobile phones, limiting the production of complex academic work.This diagnosis reveals insufficient campus infrastructure. The article recommends stronger collaboration with the economic sector to fund adequate technical facilities, aims to ensure a stable digital environment for the entire university community.

Keywords: digital divide, higher education, territorial inequalities, network infrastructure, university-business partnerships.

JEL Classification Codes: I23, I24, O33, L24.

Introduction:

Digital transformation has become one of the most significant phenomena affecting educational systems worldwide. The increasing integration of information and communication technologies (ICT) in higher education has profoundly reshaped teaching practices, learning methods, and access to educational resources. Universities are now called upon to integrate digital platforms, online learning, and digital educational resources in order to enhance the efficiency and accessibility of education.

However, this digital transition does not benefit all students equally. Despite the expansion of digital infrastructure and the relative generalization of Internet access, persistent inequalities remain in the way individuals use digital technologies. These inequalities are often referred to in the scientific literature as the second-level digital divide, which relates not

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only to access to technology but also to the skills, uses, and material conditions required for its effective utilization.

The concept of the digital divide was initially introduced to describe differences in access to technology between individuals or territories. However, recent research has shown that material access alone is not sufficient to ensure equitable participation in the digital economy. Indeed, even when individuals have Internet access, significant disparities remain in terms of digital skills, quality of connection, computer equipment, and socio-economic conditions (Hargittai, 2010). In the context of higher education, these inequalities can manifest themselves in several ways. Students from rural areas or less developed regions may face difficulties related to the quality of digital infrastructure, while others may be constrained by material limitations such as the absence of adequate computers or stable Internet access. These territorial and material disparities can have direct consequences on academic success, engagement in digital learning activities, and equality of opportunities among students.

The COVID-19 pandemic further increased the visibility of these inequalities. The sudden generalization of distance learning highlighted significant disparities in students' ability to access digital platforms and follow online courses under adequate conditions (UNESCO, 2021). The integration of digital technologies constitutes a lever for modernizing higher education in Algeria. Access to dematerialized educational resources remains conditioned by the quality of infrastructure and the availability of personal terminals. This study, conducted at the University of Oran 2 during the 2024-2025 academic year, examines the technical disparities that fragment the academic community. International literature extensively documents the digital divide, but the Algerian context reveals specific territorial and material issues, still little explored. In this context, studying the second-level digital divide in higher education has become a major issue for educational policies. It allows the identification of factors that limit the effective use of digital technologies and the development of strategies aimed at reducing digital inequalities within universities. Thus, this article aims to analyze the territorial and material disparities associated with the second-level digital divide among university students, in order to better understand the determinants of these inequalities and their implications for equity in higher education.

Research Question: To what extent do heterogeneous network infrastructure and precarious individual computer equipment hinder equitable learning and research conditions at the university?

Hypotheses:

- **H1:** Internet connection effectiveness depends on the residential area (urban or rural), creating a structural disadvantage for users far from urban centers.
- **H2:** Dependence on mobile phones as the primary work tool limits students' capacity to produce complex academic work, compared to laptop owners.
- **H3:** Current campus infrastructure cannot compensate for individual equipment deficiencies, making the development of partnerships with the economic sector necessary.

  Through a mixed method combining questionnaires and interviews, this article analyzes these technical barriers to identify sustainable cooperation paths between the university institution and telecommunications actors.

  This article is structured around several analytical dimensions. It begins by presenting the conceptual framework and the methodological approach adopted for conducting the survey. The analysis then focuses on the technical constraints related to network access as well as students' personal digital equipment and their level of connectivity. Particular attention is also given to potential cooperation with the economic sector in order to improve university digital infrastructures. Finally, the study highlights the main findings and proposes a set of recommendations aimed at reducing inequalities in access to digital resources within the university community.

  Justification of Methodological Choice

  The qualitative interview approach captures the lived dimension of connectivity constraints, beyond objective technical measurements. Subjective perception of connection quality influences usage practices .Collected narratives document user adaptation strategies: shifted hours, movements, equipment sharing. This approach complements quantitative data by providing access to daily action logics.

1. Conceptual framework

1.1. The Second-Level Digital Divide

The concept of the digital divide has evolved from a simple opposition between presence and absence of technology toward an analysis of usage inequalities. The second-level divide is as the gap in skills and connection quality among individuals already having basic access (Hargittai, 2002). This distinction shifts attention from physical access to effective usage conditions. In the university context, this framework allows analysis of how connection stability and terminal type (smartphone or computer) determine academic work performance. Research confirms that inequalities persist even when basic connectivity is widespread (Robinson et al, 2020)

1.2. Digital Capital and Social Environment

The technology integration depends on users' economic and social capital. Access to resources is conditioned by external factors such as residential area or household income. This approach, grounded in the sociology of usage, helps understand why rural residents suffer persistent disadvantage. Network infrastructure becomes a marker of social stratification within the institution (Selwyn, 2016). The plurality of access points and equipment diversity constitute finer indicators of digital inclusion than the mere existence of a connection (Pearce, K. E., & Rice, R. E., 2017)

1.3. Technical Adjustment Strategies

In the face of structural deficiencies in digital infrastructure, users develop various adaptive strategies to circumvent technical constraints. The subjective perception of connection quality may influence user behavior as much as objective technical measurements. In this context, the practices observed among students can be interpreted as rational responses to network instability and the limitations of available infrastructure. Movement toward areas with better network coverage, the sharing of equipment among peers, and the adjustment of connection times therefore appear as adjustment mechanisms enabling the continuation of academic activities. However, despite their creative nature, these strategies reveal the persistence of inequalities in the access to and distribution of digital resources (Alexander J. A. M. Van Deursen, 2019)

1.4. University-Business Synergy

The framework is completed by strategic partnership theory Resource contribution by the economic sector is envisaged as a solution to public budget constraints. This collaboration aims to transform material constraints into professional integration opportunities, through

specialized equipment funding, scholarship creation, or organization of training adapted to labor market needs. In the Algerian context, where public investments in higher education are constrained, this synergy appears as a credible path for infrastructure modernization.(Austin, James E.& Seitanidi, 2012)

2. Empirical study: University of Oran 2

An empirical survey was deployed at the University of Oran 2 during the 2024-2025 cycle to examine concrete modalities of access and use of digital resources. A institution's capacity to ensure a successful digital transition rests on two pillars: network infrastructure reliability and terminal availability. These technical elements interact with geographic and social parameters, potentially generating fractures within the university community.

2.1. Methodological Framework:

The study was constructed on a mixed method, combining quantitative data and qualitative approach through interviews. Questionnaires were distributed to 75 teachers and 185 students from three selected faculties. Of 260 distributed questionnaires, 145 were returned. Inclusion criteria retained were questionnaire completeness (response rate above 85%). After applying these criteria, 116 questionnaires were retained for analysis, representing a final response rate of 44.6%. Retained data includes 32 teachers and 84 students.

Collected information was supplemented by:

- semi-structured interviews conducted with a sub-sample of 15 students and 8 volunteer teachers. Quota selection was used to ensure representativeness across the three faculties and residential zones (urban and rural). These interviews, averaging 25 minutes, explored perceptions of connection quality, adaptation strategies facing technical constraints, and impact on pedagogical practices;
- a census of declared digital uses via self-administered questionnaire;
- an inventory of network infrastructure accessible on the university site (Wi-Fi hotspots, location, connection type), supplemented by direct observations and interviews with technical staff.

Table 1: Sample Distribution by Training Unit

Training Unit	Teachers	Students	Total Surveyed
ForeignLanguages (FLE)	10	28	38
Economics and Commercial Sciences (FSECSG)	12	28	40
Law and Political Sciences (FDSP)	10	28	38
Total	32	84	116

Source: Designed by the author based on survey data (2025).

The distribution of respondents is comparable across the three faculties. Teachers constitute 28% of the total, students 72%. Chi-square tests were performed to verify distribution independence between faculties; no difference was detected ($p > 0.05$), confirming sub-sample comparability.

Table 2: Characteristics of Interview Respondents

This table is presented in Appendix 1 due to its length. References to codes (E1 to E15, P1 to P8) are used in the analysis.

2.2. Inventory of Digital Infrastructure on Campus

Direct observation and interviews with technical staff reveal a contrasting situation. The University of Oran 2 has three computer rooms open to students, totaling 86 workstations. Their opening hours (8:30 AM-4:30 PM on weekdays) do not cover evening periods. Connection in these rooms is provided by a shared ADSL link, whose bandwidth becomes insufficient when multiple stations are used simultaneously.

Twelve Wi-Fi hotspots are distributed across campus, concentrated in the central library hall and administration. Amphitheaters and regular classrooms have no coverage. A technical manager states: "We have requested extension of the wireless network for three years, but budgets do not follow." (T1).

This insufficiency of collective infrastructure explains why 62% of students declare using their personal connection on campus. It indicates that the university fails to play its role as a corrector of inequalities.

2.3. Technical Constraints of Network Access

Connection reliability conditions users' daily experience. Technical difficulties center around three indicators: mobile network speed, ADSL connection quality, and 4G coverage extent. Hargittai (2002) emphasizes that connection quality determines usage inequalities. These parameters reveal quality gaps according to geographic location. A FDSP student residing in a rural area testifies: "On campus, I look for the right spot to get signal. Near the cafeteria, it works sometimes, but in the amphitheater, it's lost." (E8). A FSECSG teacher adds: "I prepare my courses at home with a fixed connection, but at the university, I can no longer access the same resources." (P3).

These variations create stratification of access to digital services.

Table 3: Summary of Uses and Access Conditions by Faculty and Residential Zone

Indicator	FLE	FSECSG	FDSP	Teachers
Total respondents	38	40	38	32
Urbanresidence	71% (27)	78% (31)	63% (24)	84% (27)
Rural residence	29% (11)	22% (9)	37% (14)	16% (5)
Main operator (urban)	Ooredoo (58%)	Djezzy (52%)	Ooredoo (47%)	Djezzy (59%)
Main operator (rural)	Mobilis (64%)	Mobilis (48%)	Ooredoo (55%)	Mobilis (70%)
Perceived difficulty[1]	3.2	2.8	4.1	2.5
Predominant usage type	Occasional consultations	Online collaborative work	Access to course documents	Research and preparation

Source: Designed by the author based on survey data (2025)

Examination of Cross-Data

1. Influence of residential location: People living in rural areas express pronounced difficulties. Spearman correlation test indicates a relationship between rural residence

and perceived difficulty level ($\rho = 0.42$; $p < 0.01$). A FLE student residing in a rural area explains: "At home, the mobile network works intermittently. I have to go upstairs to get signal. To submit work, I come to the university or to a friend in town." (E15).

2. Choice of access providers: In urban contexts, choices favorDjezzy and Ooredoo. A teacher states: "I chose Djezzy because colleagues told me it worked better in the neighborhood." (P3). In rural areas, choosing Mobilis responds to coverage necessity. A FDSP student testifies: "Mobilis is the only one that gets signal at my place. But the speed is slow." (E8). A chi-square test confirms association between residential zone and operator choice ($\chi^2 = 24.3$; $p < 0.001$).
3. Impacts on pedagogical activities: Connection disparity hinders uniformity of academic requirements. A FDSP teacher confides: "I would like to organize remote sessions, but I know several students have connection difficulties." (P7). A FSECSG student adds: "For a group project, we divided the work because we couldn't all work online simultaneously." (E3).

Working conditions quality at the University of Oran 2 is partially determined by factors external to the institution.

2.4. Personal Technical Devices and Student Connectivity

Possession of computer tools and characteristics of Internet access are determining variables in academic trajectories. Pearce and Rice (2017) show that plurality of access points and equipment diversity constitute finer indicators of digital inclusion.

Table 4: Equipment and Connectivity of Students by Faculty

Indicator	FLE	FSECSG	FDSP	Total
Laptop ownership (%)	50% (14)	57% (16)	43% (12)	50% (42)
Main use of mobile phone (%)	86% (24)	89% (25)	93% (26)	89% (75)
Fixed ADSL line at home (%)	32% (9)	39% (11)	29% (8)	33% (28)
4G use on campus (%)	61% (17)	68% (19)	57% (16)	62% (52)
Perceived difficulty[1]	3.8	3.4	4.3	3.8

Source: Designed by the author based on survey data (2025)

Interpretation of Results

1. Equipment endowment: Half of students own a laptop. Gaps between faculties range from 57% in FSECSG to 43% in FDSP ($\chi^2 = 6.8$; $p < 0.05$). A FDSP student explains:

"I have a computer at home, but it's old. For everything else, it's the phone." (E11). Rural students are under-equipped by 18 points compared to urban students (38% vs. 56%), a notable difference ($\chi^2 = 8.2$; $p < 0.01$). Main phone use concerns 89% of respondents. AFaculty of Economics, Business and Management Sciences(FSECSG) student testifies: "Doing research on the phone is complicated. PDFs are small, you can't take notes." (E4). Students spend more time on work using a phone.

2. Residential Internet access: One-third of students (33%) benefit from a fixed ADSL line. FSECSG has the highest rate (39%), FDSP the lowest (29%). A FDSP student residing in a rural area explains: "At my parents' place, no fixed Internet. Too expensive. I make do with 4G." (E7). Facing this deficit, the majority of students turn to 4G. A FSECSG student testifies: "In the evening, when everyone connects, it's slow. I have to waitlate." (E10).
3. Mobile connection use at university: 62% of students use their personal connection on campus, a practice more widespread in FSECSG (68%). FDSP students encounter difficulties. A student confides: "At university, I can't connect in the library. I go out to the hall to get signal." (E6). The university fails to offer an alternative to individual connections. A teacher observes: "I see my students leaving the amphitheater to get network signal." (P1).
4. Obstacles expressed during interviews: A rural FLE student confides: "When the network doesn't work, I feel excluded. I miss information." (E15). A FSECSG student using his phone explains: "For projects, we use WhatsApp. But for a real document together, it's complicated without a computer." (E3). A FDSP student residing in a rural area adds: "Sometimes I spend hours downloading a judgment. In the end, I ask a friend to send it via Bluetooth." (E7). A teacher summarizes: "There are those who have everything at home, and those who manage with a phone and a connection that cuts out." (P6).

Synthesis of Inequalities

The analysis reveals a three-level configuration:

- Shortage of adapted equipment: Lack of personal computers (50% ownership) hinders work completion. The phone allows consultation but limits production. Students using exclusively a smartphone develop navigation skills but fewer competencies in word processing, document management, or multimedia creation.

- Constrained residential access: Low proportion of households equipped with fixed lines (33%) makes the majority dependent on erratic mobile connection.
- Insufficient collective infrastructure: Campus network does not compensate for these deficiencies. Existing computer rooms do not meet needs (restrictive hours, limited number of stations, deficient connection).

These observations confirm analyses by Robinson et al. (2020) on the persistence of digital inequalities in higher education.

2.5. Cooperation with the Economic Sector

Intensifying exchanges between university and economic actors represents a path to resolve certain material difficulties. Interviews reveal expectations from teachers and students. A FSECSG teacher emphasizes: "The university alone cannot finance everything. Businesses need to help us." (P5). A student adds: "If companies gave scholarships or equipment, it would help those without means." (E2).

This collaboration cantakeseveralforms:

- Infrastructure support: Participation in acquiring equipment for practical work rooms, renewal of computer parks, creation of equipped workspaces. The experience of the University of Science and Technology HouariBoumediène with Sonelgaz (2022) enabled equipping three multimedia rooms.
- Targeted research funding: Directing funds toward projects responding to business needs. CIFRE agreementscould serve as a model.
- Aid and professional integration devices: Scholarship creation, specialized training funding, organization of extended internships.
- Dedicated mixed structures: Shared laboratories, on-campus incubators allowing regular interaction between researchers, students, and professionals.

This relationship benefits from being part of a sustainable exchange framework. For the university, it provides access to funding and knowledge of professions. For businesses, it enables talent detection and access to scientific expertise.

3. Discussion

3.1. Hypothesis Testing

Results validate the three hypotheses:

- H1 confirmed: Connection effectiveness depends on residential zone. Rural students declare higher difficulties (4.1/5 vs. 2.8/5). Spearman test confirms the relationship ($\rho = 0.42$; $p < 0.01$).
- H2 confirmed: Mobile phone dependence (89%) limits complex work production. Verbatims testify to difficulties in document research, writing, or collaborative work. The equipment gap in computers between rural and urban students (18 points) aggravates this situation. Students equipped with smartphones develop consultation skills but struggle to acquire production competencies.
- H3 confirmed: Campus infrastructure does not compensate for individual deficiencies. 62% of students use their personal 4G on site. Existing computer rooms suffer from restrictive hours and limited connection. The twelve Wi-Fi hotspots do not cover amphitheaters or classrooms.

3.2. Contributions to Literature

This study contributes to digital divide literature in several ways:

1. Contextualization: Application of the second-level divide concept (Hargittai, 2002) to a little-documented Maghreb context.
2. Mixed methodology: Combination of quantitative data and qualitative interviews to capture disparity extent and subjective experience.
3. Territorial dimension: Highlighting the structuring role of geographic variable (urban/rural).
4. Links between equipment and skills: Suggestion that terminal nature (smartphone vs. computer) differentially influences digital skill development.
5. Practical paths: Proposals for partnerships with the economic sector.

3.3. Implications for University Policies

Results suggest several orientations:

- Investment in campus infrastructure: Installation of Wi-Fi hotspots in collective spaces, amphitheaters, and classrooms. Extension of computer room hours.
- Partnerships with operators: Negotiation of specific offers for the university community.
- Equipment aid: Assistance devices for computer acquisition for scholarship or rural students. Long-termloan programs.

- Usage training: Workshops on using tools adapted to bandwidth constraints. Integration of advanced digital skilldevelopment modules.

4. Limitations and perspectives

4.1. MethodologicalLimitations

- Sample size: N=116, adequate for an exploratory study, does not permit statistical generalization to the entire university.
- Non-probability sampling: Use of a reasoned sample limiting representativeness.
- Declarative data: Information on uses and perceived difficulties not cross-referenced with objective speed measurements.
- Temporal snapshot: Survey over a single academic year, without analysis of evolutions.
- Absence of direct digital skills measurement**:** Focus on material and territorial aspects without direct skill measurement.

4.2. Research Perspectives

- Quantitative extension**:** Larger-scalesurveyincludingother Algerian universities.
- Objective measurements: Systematic speed tests in different campus zones and at homes.
- Longitudinal dimension: Follow-up over time to analyze inequality evolution.
- International comparisons: Confrontation with data from other Maghreb or African countries.
- Skills analysis: Integration of standardized digital skills tests

5. Conclusion

Observation at the University of Oran 2 shows that obstacles in teaching activities originate in structural deficits. Interviews capture the concrete dimension of these difficulties.

The first deficit concerns individual computer equipment: 89% of students use a phone as main tool, which does not fully meet university training needs. A student summarizes: "With the phone, we survive, we don't really work." (E11). This situation questions students' capacity to develop expected advanced digital skills.

The second concerns Internet connection: perceived network quality, variable according to location and operator, disadvantages rural residents. A student confides: "Sometimes I spend more time looking for network than working." (E15).

The third point relates to campus infrastructure, whose capacity does not suffice to compensate for these inequalities. A teacher observes: "The university should be a place where inequalities fade. For digital, it's the opposite." (P5).

These imbalances reproduce and amplify social and territorial inequalities. To remedy them, the university institution cannot intervene in isolation. Establishing structured relationships with economic actors constitutes an option to transform these constraints.

The academic trajectory should not be conditioned by material factors. By ensuring all students a digital environment with guaranteed minimum performance, the university will allow personal qualities and invested work to become the sole criteria for success.

In sum, the findings highlight the structural nature of the second-level digital divide in higher education, driven by both territorial and material disparities. Addressing these inequalities requires a comprehensive and coordinated approach involving infrastructure development, targeted student support, and inclusive digital policies. These findings also underline the need for further research to better understand the long-term impact of digital inequalities on students' academic performance.

Recommendations

Strengthening Digital Infrastructure

Reducing Territorial Disparities

ProvidingMaterial Support to Students

Enhancing Digital Skills

Improving Digital Learning Platforms

Implementing Inclusive Public Policies

Strengthening Monitoring and Evaluation

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Appendices

Appendix 1: Table 2 - Characteristics of Interview Respondents

Code	Status	Faculty	Zone	Operator	Declared Usage Profile
E1	Master 1 Student	FLE	Urban	Ooredoo	Occasional consultations
E2	Master 2 Student	FLE	Rural	Mobilis	Document access, messaging
E3	Master 1 Student	FSECSG	Urban	Djezzy	Collaborative work
E4	Master 2 Student	FSECSG	Urban	Ooredoo	Resource downloading
E5	Master 1 Student	FSECSG	Rural	Mobilis	Library use
E6	Master 2 Student	FDSP	Urban	Djezzy	Legal code consultation
E7	Master 1 Student	FDSP	Rural	Ooredoo	Document access
E8	Master 2 Student	FDSP	Rural	Mobilis	Unstable connection

Code	Status	Faculty	Zone	Operator	Declared Usage Profile
E9	Master 1 Student	FLE	Urban	Ooredoo	Document research
E10	Master 2 Student	FSECSG	Rural	Djezzy	Circumvention strategies
E11	Master 1 Student	FDSP	Urban	Ooredoo	Phone use
E12	Master 2 Student	FLE	Urban	Djezzy	Collaborative platforms
E13	Master 1 Student	FSECSG	Rural	Mobilis	Shared connection
E14	Master 2 Student	FDSP	Urban	Ooredoo	Jurisprudential research
E15	Master 1 Student	FLE	Rural	Mobilis	Travels to connect
P1	Teacher	FLE	Urban	Djezzy	Course deposit
P2	Teacher	FLE	Urban	Ooredoo	Research, publication
P3	Teacher	FSECSG	Urban	Djezzy	Pedagogical platforms
P4	Teacher	FSECSG	Rural	Mobilis	File deposit constraints
P5	Teacher	FSECSG	Urban	Ooredoo	Collaborative work
P6	Teacher	FDSP	Urban	Djezzy	Legal resources
P7	Teacher	FDSP	Rural	Mobilis	Videoconference difficulties
P8	Teacher	FDSP	Urban	Ooredoo	Thesis supervision
T1	Technician	-	-	-	Network maintenance