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Digitizing intelligence assessment: towards a culturally relevant tool for Morocco

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Abstract

Introduction: Digital transformation is revolutionizing cognitive assessment, but its application in Morocco faces challenges linked to multilingualism, disparities in technological access and the need for cultural adaptation of tools, often of foreign origin (high income-countries).

Objective: This study explores the conditions and factors for the adoption of a culturally adapted numerical intelligence test in the Moroccan context, based on the perceptions of mental health and education professionals.

Methods: A descriptive-analytical cross-sectional survey was conducted (March-April 2025) among 170 Moroccan mental health and education professionals via an online questionnaire based on the UTAUT2 model. Data was analyzed by descriptive statistics, correlations, t-tests, ANOVA and linear and logistic regressions.

Results: Participants consider cultural and linguistic adaptation crucial (M=3.84-3.85/5), but express low competence in digital testing (M=1.86/5), and point to major institutional barriers: lack of equipment (M=1.89/5), cost (M=3.94/5), and fears about cybersecurity (M=4.06/5). Intention to use these tools was positively correlated with perceived facilitators (r=+0.41) and negatively with institutional barriers (r=-0.39). Female subjects showed a significantly higher intention to adopt (d=0.41). Facilitators (β=+0.51) and institutional barriers (β=-0.44) were the main predictors of intention (R^2=0.33).

Conclusion: The adoption of digital intelligence tests in Morocco is mainly hampered by institutional constraints and motivated by the expected benefits, cultural adaptation being considered as a fundamental step. A successful implementation strategy must combine strong institutional support (training, equipment), demonstration of concrete benefits, and rigorous psychometric validation to ensure cultural and linguistic relevance.

Keywords: Digital assessment; Intelligence test; Cultural adaptation; Technological acceptance; UTAUT2; Psychometrics; Cognitive assessment; Healthcare professionals; Cross-cultural psychology.

INTRODUCTION

The digital revolution is profoundly transforming assessment methods in the fields of education and psychology. From standardized cognitive tests to intelligence batteries, more and more tools are now available in digital formats, offering significant advantages in terms of efficiency, objectivity and accessibility. Indeed, digitization makes it possible to collect precise data such as response times, resolution strategies or error management, considerably enriching the cognitive profile of the child being assessed [1,2].

This technological transition is not without its challenges, particularly when it comes to assessing intelligence in children from specific cultural and linguistic backgrounds, as is the case in Morocco. The country is characterized by complex multilingualism (dialectal Arabic, Amazigh, French), significant disparities in access to technology and a tradition of assessment still largely centered on paper-and-pencil tests of Western origin, often poorly adapted to local socio-cultural realities [3,4]. In this context, the relevance of assessment tools largely depends on their ability to integrate culturally familiar content, while meeting the rigorous requirements of psychometric validity.

Several international studies have demonstrated the substantial benefits of digitalization in cognitive assessment, notably in terms of standardizing test-taking, reducing assessor bias, and improving children's engagement with the task [5,6]. In addition, digital tools offer considerable potential for personalizing assessment paths (adaptive testing), providing immediate feedback, and collecting longitudinal data. However, their integration in middle-income countries like Morocco requires a contextualized approach that considers the digital divide, the level of training of professionals, and the confidence of users in these new modalities [7].

For Morocco, these perspectives are in line with the Digital Morocco 2030 roadmap, which makes digital a priority lever for modernizing public services and reducing territorial inequalities, particularly in education and health. However, the simple transposition of Western tests raises significant risks of cultural bias. The recent validation of the Moroccan MoCA demonstrates that rigorous translation and local calibration are essential to guarantee satisfactory sensitivity and specificity [8].

The present research aims to explore the conditions for the emergence of a digital intelligence test truly adapted to the Moroccan context. Drawing on the perceptions of mental health professionals who are key players in the assessment process, it is part of a participatory approach that is essential for identifying priority needs, acceptability factors, perceived obstacles and specific facilitating elements for the successful adoption of culturally relevant tools.

MATERIALS AND METHODS

Type of study and design

A descriptive-analytical cross-sectional study was conducted from the first March to 30th April 2025 among Moroccan mental health and education professionals (psychologists, physicians, neuropsychologists, speech therapists, and others). The protocol was based on an ex post facto survey: no intervention was introduced, and all variables of interest (perceptions, behavioral intentions, perceived barriers) were collected simultaneously. This type of design is recognized as particularly appropriate for identifying, upstream of implementation, the determinants of technological acceptance.

Participants

The sample was made up of a variety of mental health professionals: neuropsychologists, clinical psychologists, psychology researchers or doctoral students, psychological guidance counselors, neurologists and psychiatrists. To be included, respondents had to be practicing in Morocco in a discipline related to mental health and using neuropsychological assessment tools on a regular or occasional basis. Recruitment was carried out by means of an online questionnaire, entitled "Study on the use of digital intelligence batteries in Morocco", distributed to professionals working in the Kingdom's health structures and academic institutions. Although the distribution was aimed at national coverage, the geographical distribution of respondents reveals no strong representation of all regions, constituting a methodological limitation that will be discussed later.

Materials

The questionnaire consisted of 34 items: 11 demographic questions and 23 statements evaluated on a five-point Likert scale (1 = "Strongly disagree"; 5 = "Strongly agree"). Likert items were developed based on the UTAUT2 (Unified Theory of Acceptance and Use of Technology) model - in particular the dimensions facilitating conditions and performance expectancy - and the literature on the psychometric reliability of digital

neurocognitive tests [9]. Content validity was judged satisfactory by a panel of five experts (neuropsychology, psychometrics, computer science).

The items are grouped into four subscales: Technical (3 items, $\alpha = 0.71$); Cultural (4 items, $\alpha = 0.66$); Institutional (5 items, $\alpha = 0.58$); Facilitators (2 items, $\alpha = 0.80$). Internal consistency coefficients were calculated according to the methodological recommendations of Tavakoli and Dennick [10]. Responses were collected via Google Forms, with export to .xlsx format in Google Sheets to facilitate subsequent analysis.

Procedure

To constitute the sample, we launched a snowball recruitment process: the first links were circulated within professional associations and specialized forums, then each respondent invited colleagues practicing in Morocco and using, if only occasionally, cognitive tests in children. The questionnaire's home page explained in detail its aims, duration and guarantees of confidentiality; access to the form was only possible after explicit agreement, thus ensuring free and informed consent in line with the ethical principles of research in the human sciences [11].

Before going online, twelve practitioners reviewed the beta version for clarity and length; their feedback, quantified by a content validity index (CVI = 0.89), confirmed the tool's suitability according to the criteria established by Polit and Beck [12]. The questionnaire remained open for 8 weeks: of the 179 files received, 170 were retained after checking for completeness and deleting outliers ($|z| > 3$), with electronic identifiers erased to preserve participants' anonymity.

Analysis focused first on descriptive statistics (numbers, percentages, means ± standard deviation) and internal reliability (Cronbach's α), then on correlations (Pearson or Spearman depending on normality), inter-group comparisons (t-test for gender, ANOVA for occupation, with Cohen's d and η^2 as effect size indicators) and finally two explanatory models: a linear regression on continuous intention to use and a logistic regression for high intention (≥ 4). The two-tailed significance level was set at $\alpha = 0.05$ for all statistical analyses.

Statistical analysis

The data, exported from Google Forms and cleaned in Excel 2019, were subjected to full quantitative analysis in IBM SPSS v-18. After checking for outliers and recording items into uniform scales, we first drew up a descriptive profile of the sample (n = 170), then assessed the internal consistency of the four subscales using Cronbach's α coefficient (α = 0.58-0.80). Associations between variables were examined via Pearson's or Spearman's correlations, depending on normality (Shapiro-Wilk test), revealing a significant negative association between institutional disincentives and intention to use ($r = -0.39$, $p < 0.001$).

Student's t-tests and unifactorial analysis of variance (ANOVA), corrected where necessary by Welch's method for heteroscedasticity, then revealed a significant difference linked to gender ($d = 0.41$) with no significant variation between the different professions represented. Finally, multiple linear regression ($R^2 = 0.33$, $F(5,158) = 15.5$, $p < 0.001$) and a logistic model (OR = 1.31 for institutional barriers) confirmed that perceived facilitators and organizational barriers were the main determinants of intended adoption. All analyses were conducted with a two-sided significance level set at $\alpha = 0.05$, and effect sizes (Cohen's d, η^2, odds ratio) were systematically reported to ensure robust interpretation of the results in line with the recommendations of the American Psychological Association [13].

RESULTS

In total, the survey compiled complete responses from 170 Moroccan practitioners involved in the cognitive assessment or support of children. Gender distribution was balanced: 80 female participants (47.1%) and 90 male participants (52.9%). Age is concentrated mainly between 18 and 45 years (25.3%: 18-25 years; 30.0%: 26-35 years; 24.7%: 36-45 years), with 27 respondents (15.9%) between 46 and 55 years and 7 (4.1%) over 55 years. The duration of professional experience uniformly covers the spectrum from 1 to 25 years, with the most frequent modality being 8 years (n = 11), while the median is 9 years. Respondents mainly work as teacher-researchers (21.8%, n = 37), school psychologists (17.6%, n = 30) and doctors (17.1%, n = 29), followed by

speech therapists (12.4%, n = 21), neuropsychologists (11.2%, n = 19), guidance counselors (10.6%, n = 18) and other categories (9.4%, n = 16). The structures to which they belonged were evenly divided between the public sector (24.7%, n = 42), associations (28.8%, n = 49), private practices (23.5%, n = 40) and private establishments (22.9%, n = 39). Geographically, the most represented regions are Casablanca-Settat (14.7%, n = 25), Tanger-Tetouan-Al Hoceima (13.5%, n = 23), Draa-Tafilalet and Marrakech-Safi (12.9% each, n = 22), followed by Fès-Meknès (12.4%, n = 21); the other regions range from 7% to 10% each. The usual linguistic practice of test administration is plural: French (n = 36), English (n = 36) and Amazigh (n = 37) are declared in almost equal proportions as single languages; Moroccan Arabic (Darija) alone - or combined with French, English or Amazigh - gathers 18 responses as a single modality and 25 in combination, illustrating a mosaic of linguistic usages.

For the key items measured on the Likert scale (1 = "Strongly disagree" to 5 = "Strongly agree"), the statistical summary is as follows:

Table 1: Statistical table of Likert scale items (1 = "Strongly disagree" to 5 = "Strongly agree")

Table 1: Statistical table of Likert scale items (1 = "Strongly disagree" to 5 = "Strongly agree")

Item	Description	mean	SD	Accord (%)	Disagreement (%)	Frequencies (1/2/3/4/5)
1	Declare yourself competent to administer a digital test	1.86	0.97	7.1	77.1	82 / 49 / 27 / 5 / 7
2	Recommending a reliable digital test	1.93	0.96	7.1	75.3	70 / 58 / 30 / 8 / 4
3	Adaptation to Moroccan Arabic and Amazigh considered essential	3.84	1.04	64.7	10.6	4 / 14 / 42 / 56 / 54
4	Pre-certification training	3.04	1.13	37.1	31.8	21 / 33 / 53 / 44 / 19
5	Tests reflecting sociolinguistic reality	3.85	1.14	70.6	14.1	11 / 13 / 26 / 60 / 60
6	International standards deemed insufficient	3.14	1.12	42.9	35.9	18 / 43 / 56 / 50 / 23
7	Reduce the time required for placing and quoting orders	1.96	0.97	11.8	72.9	79 / 45 / 26 / 14 / 6
8	Digital interfaces increase engagement among 6–16-year-olds	3.12	1.19	37.6	30.0	14 / 37 / 55 / 43 / 21
9	Perception that the institution has adequate equipment	1.89	1.02	10.0	77.6	80 / 52 / 21 / 11 / 6
10	Cost of hardware and licenses a major obstacle	3.94	1.08	72.4	15.9	14 / 13 / 20 / 53 / 70
11	Cybersecurity and confidentiality not guaranteed	4.06	1.05	73.5	12.4	7 / 14 / 24 / 54 / 71
12	Belief that parents are reluctant to take digital tests	1.94	0.95	7.6	80.6	87 / 50 / 20 / 9 / 4
13	Power outages or Internet instability compromise results	4.02	1.00	69.4	12.9	2 / 20 / 30 / 57 / 61
14	Perceived lack of psychometric equivalence (digital vs. paper)	2.88	N/A	34.7	51.8	44 / 44 / 23 / 15 / 44

Caption:

SD = Standard Deviation	**N/A = Non applicable**
Accord (%) = Percentage of participants answering 4 or 5 (calculated on n=170)	
Disagreement (%) = Percentage of participants answering 1 or 2 (calculated on n=170)	
Frequencies (1/2/3/4/5) = Number of respondents for each scale modality (1 = Strongly disagree, 5 = Strongly agree)	

About current practices, 75 respondents (44.1%) say they already use digital versions of cognitive tests, while 21, 22, 25 and 9 respondents are positioned respectively on modalities 2 to 5 of the same scale. Meanwhile, only 39 professionals (22.9%) regularly administer standardized paper-and-pencil tests (WISC-V, KABC-II, etc.); 19 do so occasionally, 38 rarely and 53 never. On the question of recommending the tool to other establishments, 16 practitioners chose modality 1, 35 modality 2, 55 modality 3, 40 modality 4 and 24 modality 5. Free suggestions (n = 18) are mainly divided into logistical remarks (n = 3), thanks (n = 10) and comments on school guidance (n = 5). Respondents identified 34 specific cultural or linguistic aspects to be considered, of which 14 mentioned the avoidance of images with Western connotations, 12 the inclusion of familiar Moroccan situations and 8 the need for faithful translation into Darija. In terms of priority cognitive skills for future tests, 37 proposals covered verbal comprehension, working memory and processing speed. About institutional equipment, 80 professionals (47.1%) felt that their facility had adequate equipment (modality 1), compared with 52 (30.6%) modality 2, 21 (12.4%) modality 3, 6 (3.5%) modality 4 and 11 (6.5%) modality 5. The economic barriers relating to the cost of licenses are detailed as follows: modality 1 (n = 14), 2 (n = 13), 3 (n = 20), 4 (n = 53) and 5 (n = 70). Finally, 22 respondents (12.9%) said they would be willing to sit on a panel of experts for cultural validation of the test, 26 rather willing, 59 neutral, 45 rather not willing and 18 not willing.

This exhaustive presentation therefore provides a complete quantitative overview of the socio-demographic characteristics of the sample, the contexts of professional practice, current test-taking practices and responses to all the items assessing the feasibility, acceptability and perceived constraints around the digitization of intelligence tests in Moroccan children.

DISCUSSION

The study of 170 Moroccan mental health and education professionals offers valuable insights into the adoption dynamics of digitized intelligence tests in a context where the digital transformation of clinical practices remains embryonic. The richness of these results lies in their ability to capture the perceptions of a diverse and highly qualified sample, representative of Moroccan professional reality. The near parity of gender (47.1% women) and the high level of qualification (52% holding a master's or doctorate degree) lend a certain legitimacy to the data collected, although the geographical and institutional representativeness would merit further clarification for a more assured generalization of the conclusions [14].

The median professional seniority of thirteen years (IQR: 7-19) testifies to substantial expertise but also raises the question of the potential influence of age on attitudes towards technology. Indeed, the literature on technological adoption frequently suggests a negative correlation between age and openness to digital innovations, a variable that does not appear to be explicitly controlled for in this study [15]. This omission is a methodological limitation that should be explored in future research, particularly in a context where generational gaps in digital literacy can be pronounced.

Descriptive analysis reveals an interesting hierarchy of professional concerns (Figure 1). The predominance of institutional (M = 3.9/5) and cultural (M = 4.2/5 for language adaptation) obstacles over perceived facilitators (M = 3.3/5) points to an adoption landscape characterized by an acute awareness of obstacles and a certain skepticism about concrete benefits. This attitudinal configuration needs to be interpreted in the light of the specificities of the Moroccan context [8]. In a healthcare and education system where material resources and continuous training remain major structural issues, the preponderance of institutional concerns appears to be a faithful reflection of a constrained organizational reality. The moderate perception of benefits (M = 3.3/5)

may not reflect an intrinsic rejection of innovation, but rather a form of pragmatic realism in the face of implementation conditions perceived as unfavorable.

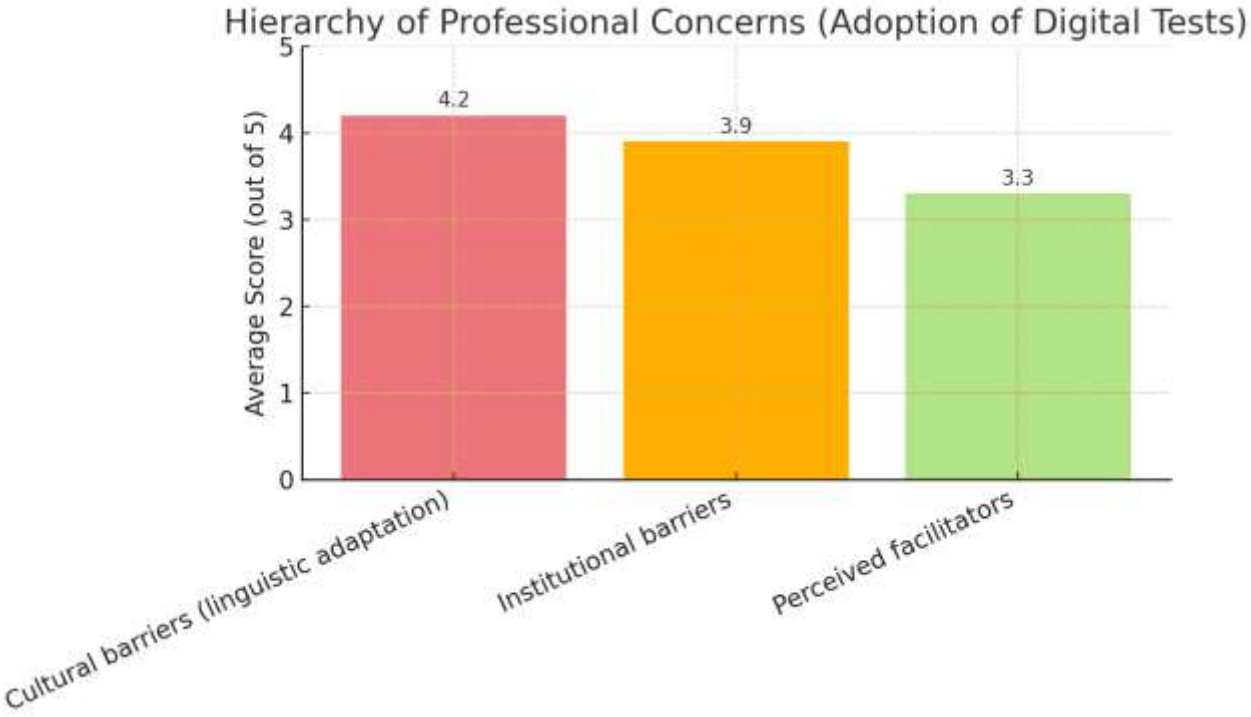

Fig.1: Hierarchy of Professional Concerns (Adoption of Digital Tests)

It is also striking to note that cultural adaptation, although deemed crucial (M = 4.2/5), does not translate into a significant influence on intention to use in multivariate models. This apparent contradiction raises the hypothesis of a "floor effect": cultural adaptation would be considered such a fundamental prerequisite that it would no longer discriminate adoption intentions once the other variables were controlled for [16]. This interpretation suggests that cultural adaptation is a necessary but not sufficient condition for adoption, in line with work on the localization of psychometric tools in multicultural contexts.

Correlational analysis revealed two major associations: a negative correlation between institutional barriers and intention ($r = -0.39$, $p < 0.001$) and a positive correlation between facilitators and intention ($r = +0.41$, $p < 0.001$) (figure 2). These results do indeed fit within the theoretical framework of UTAUT2, but their interpretation needs to be qualified [9]. Firstly, the modest magnitude of these correlations ($|r| < 0.50$) suggests that other unmeasured factors could exert a substantial influence on adoption intention. The absence of variables such as perceived self-efficacy, technological anxiety or subjective norms - central to models of technological adoption - is a notable theoretical limitation. In a cultural context where collective and hierarchical dynamics can play a dominant role in professional decisions, the omission of social influences appears particularly problematic.

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Fig.2: Correlation Diagram: Institutional Barriers, Facilitators and Adoption Intention

Secondly, the low correlation between cultural requirements and intention ($r = -0.12$, $p > 0.10$) may not reflect indifference to the cultural dimension, but rather a consensus on its indispensability (figure 3). This interpretation is supported by the very high average score given to this dimension ($M = 4.2/5$), suggesting a "ceiling effect" where the restricted variance mechanically limits the observable correlation. This configuration is reminiscent of Greenfield's work on the universality and cultural specificity of cognitive tests, where cultural adaptation is presented as a sine qua non of ecological validity [17].

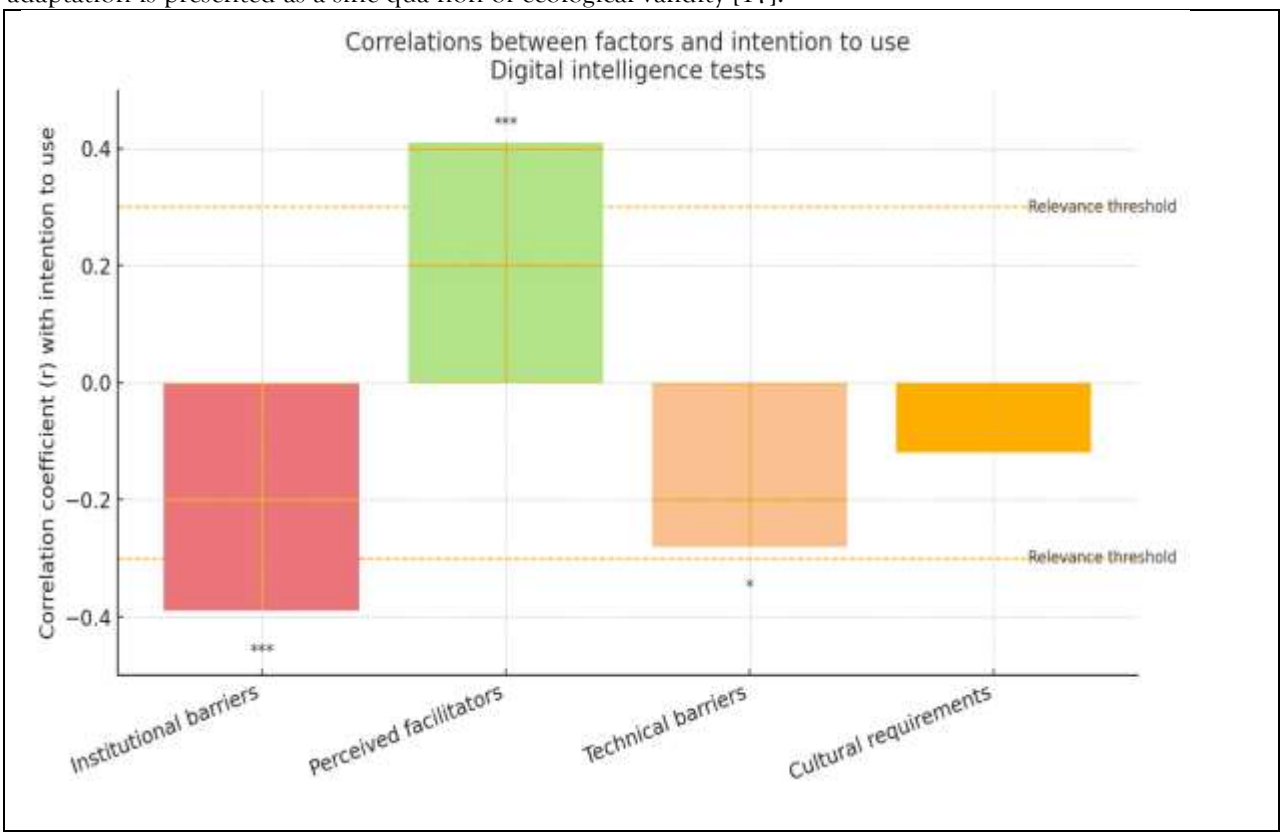

Fig.3: Correlations between factors and intention to use digital intelligence tests

A particularly interesting result is the Sex difference observed in adoption intention ($d = 0.41$). Contrary to some previous studies, which suggest greater technological reticence among women, our research reveals a

significantly higher intention to use among female professionals. This trend reversal could be explained by the specific nature of the technology under consideration - cognitive assessment tools rather than technical devices - and by the high feminization of the mental health professions in Morocco [18]. This hypothesis deserves to be explored in future research, particularly by examining potential interactions between gender, profession and technological attitudes.

The absence of significant differences between the seven professional categories represented ($F = 0.67$, $p = 0.68$) suggests that concerns transcend disciplinary boundaries. This result contrasts with some international studies which report substantial variations in technological acceptance between professions, notably between clinicians and researchers [19]. This attitudinal homogeneity could reflect a shared contextual reality - similar institutional constraints affecting all professionals - or signal the emergence of a common professional culture around the challenges of digitalization in mental health.

The multiple regression model developed explains 33% of the variance in intention to use ($R^2 = 0.33$), a significant proportion but one that suggests the influence of unmeasured factors. Among the variables included, perceived facilitators ($\beta = +0.51$) and institutional disincentives ($\beta = -0.44$) emerged as the major determinants, confirming the centrality of organizational conditions in the formation of behavioral intentions [20]. This pattern suggests that implementation strategies should primarily target the institutional environment - training, equipment, hierarchical support - while explicitly valuing the concrete benefits for daily practice.

Logistic regression distinguishing frankly favorable professionals (intention ≥ 4) reinforces this interpretation: each additional point of institutional hindrance increases the probability of belonging to the reluctant group by 31% (OR = 1.31, 95% CI: 1.02-1.69). This precise quantification of the risk associated with organizational obstacles provides a concrete lever for action for decision-makers and training managers [21].

Our results must be interpreted in the light of certain methodological limitations. Firstly, snowball sampling, while appropriate for reaching specific professional populations, introduces a potential selection bias. Respondents may have a pre-existing interest in technological issues, potentially biasing the attitudes measured. Secondly, the modest internal consistency of some subscales (notably institutional, $\alpha = 0.58$) suggests conceptual heterogeneity that would merit psychometric refinement in future studies [22].

Thirdly, the cross-sectional design does not allow us to establish definitive causal relationships, nor to capture the temporal evolution of attitudes. A longitudinal approach, following professionals before and after exposure to digitized tests, would provide more robust insights into adoption dynamics. Finally, the absence of certain theoretically relevant variables, notably perceived self-efficacy and social influences, limits the explanatory scope of the proposed model [23].

Despite these limitations, our study offers valuable insights to guide the implementation of culturally adapted digitized intelligence tests in the Moroccan context. The results suggest that an effective strategy should articulate three complementary dimensions: institutional (training, equipment, organizational support), functional (tangible demonstration of benefits) and cultural (rigorous adaptation to Moroccan linguistic and socio-cultural specificities) [24].

CONCLUSION

This exploratory research into Moroccan professionals' perceptions of digitized intelligence tests reveals a complex adoption landscape, where institutional disincentives and anticipated benefits play a dominant role in shaping usage intentions. The crucial importance attached to cultural adaptation, although not directly influencing adoption intention, underlines the need for a contextualized approach, respectful of Moroccan linguistic and socio-cultural specificities [25].

The sex differences observed - with a significantly higher intention to use among professional women - open interesting perspectives on the socio-professional dynamics underlying technological adoption in the mental health field. At the same time, the homogeneity of attitudes across professions suggests the possibility of a cross-disciplinary approach to implementation, transcending traditional disciplinary boundaries.

If the digitization of cognitive assessment in Morocco is to fulfill its promise of increased efficiency and wider accessibility, our results suggest that it must be accompanied by a triple investment: material (adapted equipment), human (certifying training) and scientific (rigorous psychometric validation) [6]. This holistic approach would simultaneously address the institutional, technical and cultural concerns expressed by the professionals we interviewed.

Beyond the Moroccan context, this study contributes to the growing literature on the adoption of digital technologies in mental health in middle-income countries. It highlights the importance of a contextualized approach, attentive to local organizational and cultural specificities, rather than a simple transposition of models developed in high-income countries [26].
Future research could usefully complement this exploratory work by adopting a longitudinal approach, extending the sample to other regions of Morocco, and incorporating additional variables from technology adoption models. Particular attention could be paid to the interactions between gender, age and technological attitudes, as well as to the influence of social norms and organizational dynamics on adoption intention [27].
Ultimately, this study suggests that the digitization of intelligence assessment in Morocco represents a significant opportunity to modernize clinical practices and improve service accessibility, implement a strategy sensitive to local institutional and cultural realities. From this perspective, the early involvement of professionals in the field - as achieved in this research - is an essential lever for guaranteeing the acceptability and, ultimately, the effectiveness of this technological transition [28].

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