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Nouh Alaoui Mhamdi
Faculty of Letters and Human Sciences Dhar El Mahraz
Sidi Mohamed Ben Abdellah University, Fez, Morocco
alaouimhamdi.nouh@usmba.ac.ma

PEDAGOGICAL PROOFING AND THE EXTENDED-REALITY ADOPTION GAP: A QUANTITATIVE STUDY OF ESP LECTURERS IN MOROCCAN HIGHER EDUCATION

Abstract

Extended reality (XR) is increasingly explored in English for specific purposes (ESP) in tertiary education, yet lecturers' willingness to integrate it into ESP teaching remains uneven. The present study adopts Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) as an associational lens to examine how lecturers' beliefs about the pedagogic value of XR for specialised language/discourse work relate to behavioural intention, alongside contextual and resource conditions in Moroccan public universities. An online questionnaire was completed by 279 ESP lecturers with prior XR exposure, measuring UTAUT2 constructs and key background variables. Correlations, multiple regression, and HC3-robust general linear models were used. Performance expectancy and hedonic motivation showed the strongest positive associations with intention, with personal innovativeness also positively associated with intention. Effort expectancy and facilitating conditions displayed attenuated and direction-shifting conditional associations under shared variance. Social influence contributed more modestly once other variables were modelled. Intention also aligned with Education Sciences, stable appointments, IT training, personal computer ownership, learning management system (LMS) or specialised software access, and greater teaching experience. The findings suggest that XR uptake in ESP relates to experiential beliefs and structural conditions, and motivate a tentative "pedagogical proofing" pathway for logging, discussing, and refining XR-supported ESP lesson designs.

Key words

behavioural intention, extended reality (XR), English for specific purposes (ESP), Moroccan higher education, pedagogical proofing, UTAUT2.

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1. INTRODUCTION

1.1. Context and problem

Extended reality (XR) technologies are associated with immersion and embodied interaction, yet their integration into English for specific purposes (ESP) teaching remains uneven. In ESP, instructional value is commonly measured through how pedagogic designs support participation in specialised communicative practices (discipline-linked genres, interactional routines, and multimodal meaning-making), including digitally mediated forms of specialised communication discussed in recent ESP scholarship (Cheng, 2026; Dontcheva-Navratilova, 2023; Guillén-Galve & Vela Tafalla, 2023). Studies in English as a foreign language (EFL) and ESP contexts indicate that XR applications can align with higher engagement and achievement when designs are scaffolded, while reporting limited gains where exposure, support, or onboarding are constrained (Jia et al., 2025; Rahmanu & Molnár, 2024; Shadiev et al., 2025). Teacher-focused research, including work in Morocco, suggests that lecturers' behavioural intention (BI) to use XR relates to perceived pedagogical benefit and to institutional conditions such as training, technical support, and infrastructure (Alaoui Mhamdi, 2025; Çetin Köroğlu, 2026; Ko & Shin, 2023). ESP lecturers in Moroccan higher education (HE) operate under comparable pressures, yet their intention to use XR for ESP-relevant communicative tasks, and the conditions under which course redesign becomes plausible rather than merely demonstrative, remain underexamined. The study addresses this gap by analysing how determinants drawn from the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) (Venkatesh et al., 2012) relate to ESP lecturers' BI to use XR, extending XR work conducted in the same national system (Alaoui Mhamdi, 2025).

1.2. XR in language education

Empirical studies in English and ESP/EAP courses suggest that XR-supported speaking, reading, and vocabulary tasks can align with higher motivation and performance under specific conditions. For ESP in particular, XR is salient insofar as it can stage specialised communicative events that approximate professional and academic participation (role-taking, register control, and multimodal performance) (Cheng, 2026). Recent work on digitally mediated genres and multimodal resources in specialised communication provides a relevant backdrop for considering XR under this pedagogic lens (Kathpalia, 2024; Lee, 2024; Maier & Engberg, 2023). Research on 360-degree and spherical video-based virtual reality (VR) reports that immersive scenes combined with structured feedback or reading strategies align with higher speaking performance and reading comprehension, while short head-

mounted display activities for business speaking sometimes show limited between-group differences where exposure and support are restricted (Hung et al., 2024; Shadiev et al., 2025). Augmented-reality (AR) and holographic systems for vocabulary and terminology learning are also associated with higher achievement, with outcomes described as contingent on scene selection, multimodal task design, and discipline-specific lexical demands (Hassan Ja'ashan et al., 2024; Jia et al., 2025; Khan et al., 2023). A systematic review of multimodal English instruction in HE suggests that the success of XR, VR, and 3D environments relates to infrastructure, teacher expertise, classroom atmosphere, and learner attitudes, such that BI to use XR is likely to align with these institutional and affective conditions (Rahmanu & Molnár, 2024).

1.3. Technology acceptance and UTAUT2

Technology-acceptance research indicates that BI relates to perceived performance gains, effort, social pressures, and enabling conditions. UTAUT and UTAUT2 conceptualise these determinants as performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC), with UTAUT2 extending the framework to include hedonic motivation (HM) and personal innovativeness (PI) to capture enjoyment and openness to experimentation (Anjulo Lambebo & Chen, 2025; Tram, 2025; Venkatesh & Davis, 2000; Venkatesh et al., 2012). UTAUT2-based studies in educational technology find that PE and EE relate to higher intention, while SI and FC appear to shape whether favourable perceptions are associated with stable intention (Anjulo Lambebo & Chen, 2025; Cui & Li, 2025; Tram, 2025). Work on teacher-facing XR and digital tools suggests that low prior experience can coexist with high motivation when support is perceived as adequate, whereas intention appears fragile where time, training, and technical assistance are seen as insufficient (Çetin Köroğlu, 2026; Ko & Shin, 2023). These strands suggest that UTAUT2 is a suitable lens on ESP lecturers' BI to use XR in relation to attitudinal and institutional conditions.

1.4. Moroccan HE and pedagogical proofing

Within the Moroccan system, successive Information and Communications Technology (ICT) initiatives appear associated with hardware provision, yet evaluation studies suggest that routine pedagogical use remains constrained by limited technical support, planning time, and fragmented governance (Alaoui Mhamdi, 2025; Boudine et al., 2024). XR work in schooling further indicates that combinations of institutional type, infrastructure, and digital training are related to perceived benefit, readiness, and satisfaction, and that digital material routines may align with lower XR attitudes, pointing to an XR adoption gap under structurally constrained conditions (Alaoui Mhamdi, 2025). In HE ESP settings, multimodal ESP

studies indicate that teachers' design of disciplinary tasks relates to institutional support, student profiles, and available semiotic resources, suggesting that XR integration may be sensitive to resource and workload constraints (Christoforou, 2025; Lam, 2024; Rahmanu & Molnár, 2024). The notion of pedagogical proofing describes how ESP lecturers trial and refine XR-supported tasks under local conditions and suggests that teaching experience and institutional resources, learning platforms, technical support, XR equipment loans, and personal computers, may be associated with whether XR is judged sustainable for specific ESP courses.

1.5. Framework, aims, and research questions

In light of this context, the study adopts UTAUT2 as an organising framework for examining ESP lecturers' BI to use XR in Moroccan higher education. Recruitment was conducted within three public universities as sites of access. Results are presented as analytic evidence relevant to comparable ESP settings rather than as statistical generalisation beyond the participating contexts. In this ESP framing, BI functions as a proximal indicator of lecturers' stated readiness to design and sustain XR-supported specialised discourse tasks (genre-simulated interaction, discipline-linked lexis/phraseology, and multimodal performance). UTAUT2 constructs are therefore specified in linguistic-pedagogic terms: performance expectancy indexes perceived value for specialised communication outcomes; effort expectancy indexes the perceived design and delivery workload of XR-supported tasks; facilitating conditions index access to infrastructural and semiotic resources (learning management system integration, specialised software, technical support, and equipment availability); social influence indexes perceived expectations from colleagues, management, and students; hedonic motivation and personal innovativeness index enjoyment and willingness to experiment during iterative pedagogical proofing. This specification situates the acceptance lens within ESP scholarship on specialised discourse, digital genres, and multimodal knowledge communication (Dontcheva-Navratilova, 2023; Guillén-Galve & Vela Tafalla, 2023; Lee, 2024; Maier & Engberg, 2023), while retaining an associational, noncausal interpretation of model relations (Anjulo Lambebo & Chen, 2025; Cui & Li, 2025; Tram, 2025; Venkatesh et al., 2012). Empirically, the study employs a quantitative, cross-sectional survey of 279 ESP lecturers and analyses associations among constructs through multivariate modelling using ordinary least squares/general linear models (GLM) with heteroskedasticity consistent (HC3) robust standard errors (with bootstrap intervals used as sensitivity checks where informative).

The study first aims to identify how UTAUT2 constructs, especially performance expectancy, effort expectancy, hedonic motivation, and personal innovativeness, are associated with ESP lecturers' BI to use XR. A second aim is to examine how social influence, facilitating conditions, role/position, and main discipline relate to variation in BI once these constructs are taken into account. A

third aim is to assess how institutional resources and teaching experience are associated with BI within lecturers' pedagogical proofing of XR tasks. On this basis, the following research questions organise the analysis:

1. RQ1. How do performance expectancy, effort expectancy, hedonic motivation, and personal innovativeness relate to ESP lecturers' behavioural intention to use XR?
2. RQ2. How are social influence and facilitating conditions associated with lecturers' behavioural intention to use XR?
3. RQ3. How do role/position and main discipline relate to behavioural intention to use XR after accounting for UTAUT2 constructs and personal innovativeness?
4. RQ4. How are institutional resources (platform access, technical support, XR equipment, and personal computers) and teaching experience associated with lecturers' behavioural intention to use XR?

Aligned with these questions and UTAUT2, the study advances hypotheses paired with the research questions.

- H1 (RQ1). Performance expectancy, effort expectancy, hedonic motivation, and personal innovativeness are associated with higher behavioural intention to use XR.
- H2 (RQ2). Stronger social influence and more favourable facilitating conditions are associated with higher behavioural intention to use XR.
- H3 (RQ3). Role/position and main discipline differ in behavioural intention to use XR after accounting for UTAUT2 constructs and personal innovativeness.
- H4 (RQ4). More favourable institutional resources and greater teaching experience are associated with higher behavioural intention to use XR.

Figure 1 summarises the conceptual model guiding the study, with BI to use XR in ESP courses as the proximal outcome, UTAUT2-related beliefs and contextual/resource factors treated as associated predictors, and pedagogical proofing framed as an emergent implementation trajectory.

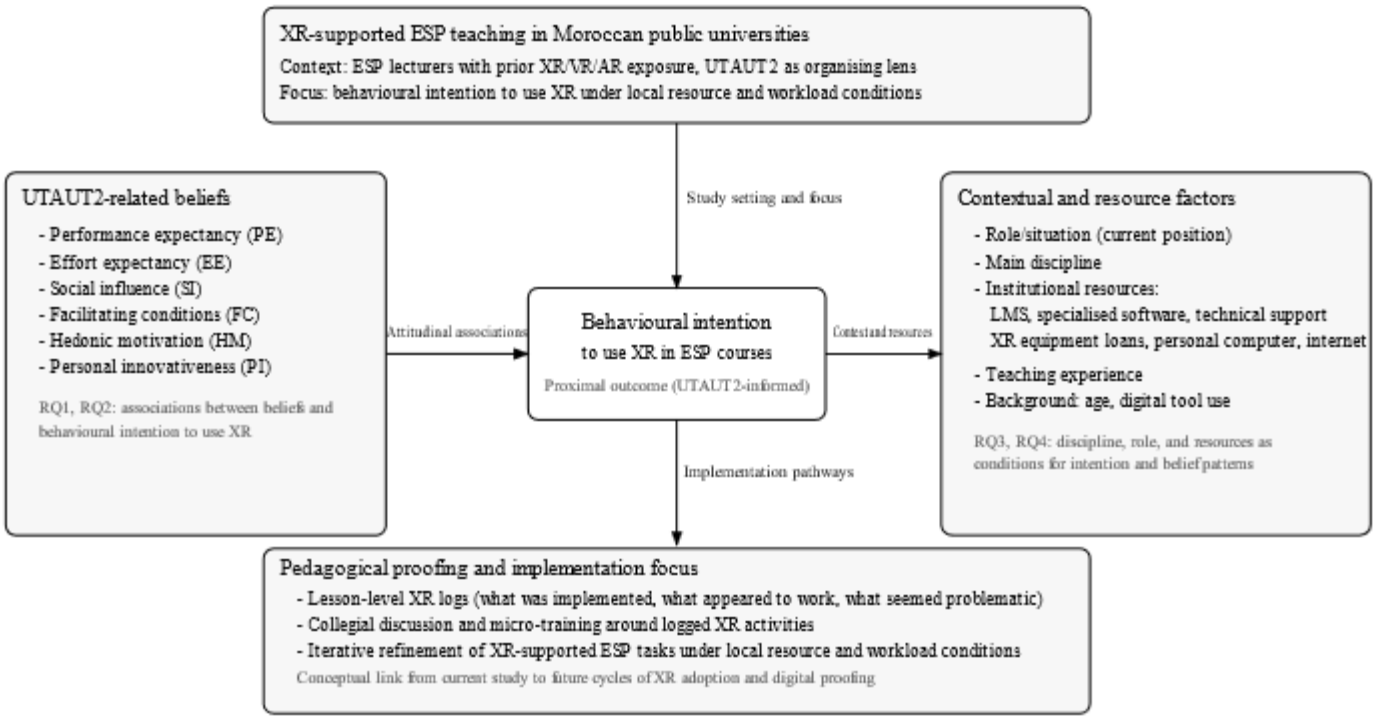

Figure 1. Conceptual model of XR adoption in ESP teaching: UTAUT2, contextual factors, and pedagogical proofing

2. LITERATURE REVIEW

2.1. Performance expectancy and experiential affordances in XR-enhanced ESP

Across technology-acceptance research, performance expectancy (PE) is often defined as the belief that a technology supports gains in job performance, and higher PE typically aligns with higher BI (Tram, 2025; Venkatesh et al., 2012). Reviews of chatbot and AI adoption also identify perceived usefulness as a strong correlate of intention (Anjulo Lambebo & Chen, 2025; Cui & Li, 2025). For ESP, "usefulness" is productively specified in relation to specialised discourse pedagogy: the extent to which an environment can support genre-like participation, role-based interaction, and multimodal communication that are central to contemporary specialised communication (Lee, 2024; Maier & Engberg, 2023). In language and ESP contexts, XR-enhanced tasks using 360-degree VR, AR, and holographic applications are frequently reported as supporting vocabulary learning, reading comprehension, oral production, or multimodal project work, particularly when carefully scaffolded (Christoforou, 2025; Hassan Ja'ashan et al., 2024; Jia et al., 2025; Khan et al., 2023;

Lam, 2024; Li, 2025; Liu et al., 2024; Shadiev et al., 2025). These patterns suggest that lecturers may interpret XR as pedagogically valuable when it aligns with discipline-specific communicative objectives.

At the same time, experiential constructs such as effort expectancy (EE) and hedonic motivation (HM) appear intertwined with perceived usefulness. Higher perceived ease of use and enjoyment usually relate to higher intention, and XR studies often describe immersive tasks as engaging when presence is combined with feedback or strategy support (Cui & Li, 2025; Jia et al., 2025; Khan et al., 2023; Ko & Shin, 2023; Liu et al., 2024; Tram, 2025). Yet reports of dizziness, cumbersome equipment, confusing interfaces, and time-consuming preparation suggest that ease and enjoyment are strongly conditioned by infrastructure, technical support, and workload (Alaoui Mhamdi, 2025; Çetin Köroğlu, 2026; Hung et al., 2024; Ko & Shin, 2023). Related evidence from online ESP learning indicates that modality conditions can be associated with learners' anxiety (including higher anxiety under more visually exposed participation modes), which may further condition perceived effort and enjoyment in mediated environments (Topalov et al., 2023). UTAUT2-based work outside XR also indicates that the distinct contribution of HM can weaken once usefulness and facilitating conditions are controlled (Anjulo Lambebo & Chen, 2025; Tram, 2025).

For ESP lecturers in Moroccan HE, it therefore remains uncertain whether XR is primarily framed as an efficiency-enhancing means of meeting ESP outcomes, whether EE and HM add explanatory value beyond PE, and whether these experiential constructs emerge as the strongest attitudinal correlates of BI once contextual variables and provisioning types are included (RQ1).

2.2. Social influence and facilitating conditions in technology adoption

Within UTAUT2, social influence (SI) denotes perceived expectations from important others, and higher perceived expectations from colleagues, leaders, or students usually align with higher self-reported BI to use the technology (Venkatesh et al., 2012). Reviews of AI and chatbot adoption suggest that peer and managerial cues, institutional campaigns, and policy messages frequently appear as correlates of intention, particularly when tools are framed as part of institutional strategies or quality assurance (Anjulo Lambebo & Chen, 2025). Facilitating conditions (FC), defined as perceived resources and organisational support, also tend to align with higher intention and use, especially for complex tools that rely on training, technical assistance, and platform access (Hassan Ja'ashan et al., 2024; Ko & Shin, 2023; Tram, 2025). In Morocco, evidence that institutional type, infrastructure, and IT training relate to perceived benefit and readiness suggests that specific provisioning profiles may shape how XR is judged in practice (Alaoui Mhamdi, 2025; Boudine et al., 2024).

Empirical work nevertheless indicates that social and organisational conditions do not function uniformly. In several AI and chatbot studies, SI relates to intention in bivariate analyses but becomes modest or nonsignificant once usefulness and support are held constant, suggesting that normative pressures may operate partly through expectancy beliefs (Anjulo Lambebo & Chen, 2025; Tram, 2025). XR research in Moroccan schooling describes institutional rhetoric around innovation coexisting with resource gaps and bureaucratic procedures, which may lead teachers to treat policy signals with some caution (Alaoui Mhamdi, 2025). In XR and holographic language learning, student-focused studies show that peer talk and teacher encouragement align with positive perceptions but provide limited insight into how lecturers themselves evaluate collegial expectations against the effort and risk of redesigning courses (Hassan Ja'ashan et al., 2024; Khan et al., 2023).

Taken together, these strands suggest that for ESP lecturers in Moroccan HE, SI and FC may matter most where they combine with credible resource configurations. RQ2 and RQ4 therefore examine whether social cues and specific forms of institutional provisioning, such as LMS access, specialised software, technical support, or loan-based equipment, appear associated with BI once experiential constructs and discipline or role conditions are considered.

2.3. Personal innovativeness, ESP teaching, and pedagogical proofing trajectories

Personal innovativeness (PI) is often conceptualised as a trait-like readiness to experiment with new technologies, and higher innovativeness tends to align with higher intention where enabling resources exist (Anjulo Lambebo & Chen, 2025; Venkatesh et al., 2012). Studies of pre-service teachers' VR perceptions suggest that strong motivation can coexist with low prior exposure, so some teachers may be keen to trial XR despite limited training, while still depending on organisational support to move beyond isolated pilots (Çetin Köroğlu, 2026). Multimodal ESP case studies indicate that teachers' willingness to design resource-intensive tasks appears closely tied to institutional backing, mentoring, and access to semiotic resources (Christoforou, 2025; Lam, 2024; Li, 2025), suggesting that innovativeness may operate through design-intensive experimentation when conditions allow.

Tensions arise where institutional barriers constrain such experimentation. Evaluation work in Moroccan HE and schooling describes recurrent gaps between hardware provision and pedagogical use, as well as uneven digital training and connectivity, which appear associated with relatively cautious attitudes toward XR (Alaoui Mhamdi, 2025; Boudine et al., 2024). Under these conditions, PI alone may not translate into sustained XR integration, and willingness to experiment may remain at the level of small pilots without institutional recognition or follow-up. This picture aligns with broader HE findings where individual openness is weakened by

unclear incentives, limited time, and fragmented support (Ko & Shin, 2023; Rahmanu & Molnár, 2024).

These patterns suggest that in ESP programmes, PI, role and discipline conditions, and concrete resource profiles may jointly structure lecturers' trajectories of adopting and refining XR-supported tasks. RQ3 and RQ4 therefore explore how innovativeness appears associated with BI once UTAUT2 constructs and contextual factors are modelled together, and how these configurations might support or constrain iterative pedagogical proofing processes in which lecturers test, document, and share XR-based ESP activities.

3. METHODOLOGY

3.1. Research design

A cross-sectional online survey examined associations between UTAUT2 constructs and BI to use XR in ESP teaching. UTAUT2 is treated as an organising lens, and estimates are interpreted as associative patterns rather than causal effects.

3.2. Setting

Data were collected online from ESP lecturers affiliated with three Moroccan public universities used as recruitment sites: Sidi Mohamed Ben Abdellah University (Fez, Taza), Moulay Ismail University (Meknès, Errachidia), and Ibn Tofail University (Kenitra). These universities are treated as sites of access rather than a population frame. Findings are presented as analytic evidence relevant to comparable higher-education ESP settings.

3.3. Participants

Participant eligibility required (a) prior exposure to VR/AR/XR or the metaverse (educational or leisure) and (b) current or recent HE teaching in EFL/ESP. Two screened cases reporting no prior exposure were excluded. Recruitment used two nonprobability channels within the participating universities: departmental email invitations and direct outreach to professional contacts. Invitation denominators were tracked via sent-mail logs and contact-list counts; link tracking was avoided to preserve anonymity. Table 1 summarises invitations and completions.

The sample comprised 279 ESP lecturers with prior XR/VR/AR exposure, all coming from Moroccan public universities, which were used as recruitment sites (see Table 2). The sample was predominantly early to mid-career (65.6%, aged 20-

34) and gender distribution was broadly balanced (53.8% female and 46.2% male participants). The most common current positions were doctoral candidates with teaching responsibilities (40.9%) and university teachers (29.0%), and teaching experience was concentrated at the early stage (45.2% < 1 year), alongside a substantial group reporting more than 10 years (23.7%).

Channel	Completions (n)	Invitations (n)	Attributable response rate
Bulk email (departmental lists)	230	500	46.0%
Direct outreach to personal contacts (1:1 email/WhatsApp)	49	60	~82%
Total	279	-	-

Table 1. Recruitment channels, completions, and invitation counts

Disciplinary affiliation was concentrated in Humanities and Social Science (43.0%) and STEM (25.8%), with smaller groups in Education Sciences (10.8%), Law/Economics/Management (10.7%), and Medicine/Health (9.7%). Most respondents reported IT-related training (37.5% extensive) and personal computer access (97.8%). Institutional provisioning most often involved LMS access (43.0%) or specialised software (15.1%), while 32.2% reported no university-provided digital resources; small cells (e.g., technical support) are interpreted cautiously.

Variable	Category	n	%
Age	20-24 years	69	24.7
	25-29 years	27	9.7
	30-34 years	87	31.2
	35-39 years	12	4.3
	40-44 years	33	11.8
	45 years or more	51	18.3
Gender	Female	150	53.8
	Male	129	46.2
Current positions	Doctoral candidate with teaching responsibilities	114	40.9
	Part-time university teacher	27	9.7
	University teacher (lecturer, adjunct lecturer, assistant professor)	81	29.0
	Secondary-school teacher and PhD student (with teaching duties)	27	9.6

Variable	Category	n	%
	Administrative staff with teaching duties	30	10.8
Teaching experience in years	Less than one year	126	45.2
	1-2 years	33	11.7
	3-5 years	48	17.2
	6-10 years	6	2.2
	More than 10 years	66	23.7
Main discipline	Humanities and Social Science	120	43.0
	Law / Economics / Management	30	10.7
	Science, Technology, Engineering, and Mathematics (STEM)	72	25.8
	Medicine / Health	27	9.7
	Education Sciences	30	10.8
IT training (information technologies)	None	90	32.3
	Short (up to 2 hours)	42	15.1
	Medium (3-6 hours)	42	15.1
	Extensive (more than 6 hours)	105	37.5
Personal computer for university work	No	6	2.2
	Yes	273	97.8
Main Internet connection for academic activities	Home broadband connection	174	62.4
	University connection	45	16.1
	Mobile connection (4G/5G)	60	21.5
Digital tool use for teaching/preparation	Never	15	5.4
	Rarely	6	2.2
	Sometimes	21	7.5
	Often	114	40.8
	Very often	123	44.1
Main digital resource provided by university	No resources	90	32.2
	Online learning platform (LMS)	120	43.0
	Specialised software for teaching or research	42	15.1
	Technical support (IT assistance)	3	1.1
	Loan of digital equipment (computers, tablets, XR, etc.)	24	8.6

Table 2. Participant (N = 279) characteristics

3.4. Measures and instrument adaptation

Measures reflected UTAUT2 (PE, EE, SI, FC, HM, PI) and BI. Items were adapted from Boel et al. (2023) by replacing "virtual reality" with XR; brief XR/VR/AR definitions preceded the scale to standardise interpretation. All items used a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree), and construct scores were computed as the mean of retained items. The adapted instrument is provided in the Appendix.

3.5. Reliability

Internal consistency was acceptable for applied analysis: PE (α = .863), EE (α = .929), SI (α = .921), FC (α = .775), HM (α = .931), PI (α = .863), and BI (α = .930). These coefficients are sample-specific and are reported as reliability evidence for the present scores.

3.6. Procedures

The questionnaire opened with eligibility screening and electronic consent, followed by XR/VR/AR definitions, the adapted UTAUT2 items, and background variables (role/position, discipline, resources, connectivity, teaching experience, and digital tool use frequency). Participation was voluntary and anonymous.

3.7. Data analysis

Analyses were conducted in SPSS v27.0.[1] Descriptives summarised constructs and background variables. Pearson correlations described zero-order associations among UTAUT2 constructs and BI (RQ1-RQ2). Multiple regression estimated conditional associations of PE, EE, SI, FC, HM, and PI with BI, with collinearity inspected via tolerance/variance inflation factor (VIF) and condition indices. To address RQ3-RQ4, a GLM/univariate analysis of variance (UNIANOVA) estimated adjusted BI means across role/position, discipline, and provisioning profiles while controlling for UTAUT2 predictors and relevant covariates. Pairwise contrasts used Bonferroni adjustment.

The sample was obtained through nonprobability recruitment within three Moroccan public universities used as sites of access, so results are treated as analytic evidence relevant to comparable ESP settings rather than as statistical

[1] IBM SPSS Statistics for Windows 27.0, https://www.ibm.com/support/pages/downloading-ibm-spss-statistics-27

generalisation. Eligibility required prior exposure to XR/VR/AR, which may align with higher perceived usefulness and BI than would be expected in the broader lecturer population. Measures were adapted with minimal wording change (VR → XR), internal consistency is reported for the present sample, and construct separation is evaluated through correlation patterns and colline arity diagnostics; no structural equation modelling (SEM)/confirmatory factor analysis (CFA) is advanced, so validity claims remain model-based rather than latent-variable based. Regression and GLM assumptions were screened using residual plots and distribution checks; heteroskedasticity-consistent (HC3) inference is used and bootstrap intervals are treated as sensitivity checks where informative, with influence inspected via standardised residuals and Cook's D. Standardised coefficients (β) and partial η^2 are reported, and interpretation prioritises effect magnitude and institutional plausibility over *p*-values alone.

3.8. Ethics

The study was conducted in accordance with the research ethics framework of Sidi Mohamed Ben Abdellah University. Under this framework, anonymous, minimal-risk online surveys that do not gather directly identifying information are not subject to formal Institutional Review Board procedures. Participation was voluntary: prospective respondents first viewed an online information sheet, then indicated electronic consent before accessing the questionnaire, and could discontinue at any point prior to final submission.

The instrument did not ask for names, institutional identifiers, email addresses, or IP addresses, and no such information was stored by the researcher. The questionnaire was delivered via Google Forms. Since this platform may process limited metadata (such as device type or approximate location) as part of its standard operation, this possibility was described in the consent text. Exported data were stored on password-protected drives, with access restricted to the researcher.

4. RESULTS

4.1. Descriptive statistics

Descriptive statistics for the continuous study variables are presented in Table 3. Overall, the sample reported frequent use of digital tools for teaching and preparation. Across the UTAUT2 measures, mean scores were above the scale midpoint, with hedonic motivation, personal innovativeness, effort expectancy, and performance expectancy being relatively high. Social influence and facilitating conditions were comparatively lower, though still above midpoint levels.

Behavioural intention to use XR in ESP courses was also relatively high. All scales used the full response range.

Variable	Coding / scale range	N	M	SD	95% CI for M
Age (ordinal scale)	1-6 (1 = 20-24 years, 6 = 45+ years)	279	3.24	1.79	[3.03, 3.45]
Teaching experience in years (ordinal scale)	1-5 (1 = < 1 year, 5 = > 10 years)	279	2.47	1.62	[2.28, 2.66]
Digital tool use for teaching/preparation	0-4 (0 = never, 4 = very often)	279	3.16	1.03	[3.04, 3.28]
Performance expectancy (PE)	1-5 Likert	279	3.75	0.86	[3.64, 3.85]
Effort expectancy (EE)[a]	1-5 Likert	279	3.88	0.90	[3.77, 3.98]
Social influence (SI)	1-5 Likert	279	3.26	0.86	[3.16, 3.36]
Facilitating conditions (FC)	1-5 Likert	279	3.03	0.95	[2.92, 3.14]
Hedonic motivation (HM)	1-5 Likert	279	4.00	0.94	[3.89, 4.11]
Personal innovativeness (PI)	1-5 Likert	279	3.91	0.81	[3.82, 4.01]
Behavioural intention (BI)	1-5 Likert	279	4.06	0.95	[3.95, 4.18]

Note. M = mean; SD = standard deviation; CI = confidence interval. All confidence intervals are normal-approximation 95% CIs for the mean.
[a] Effort expectancy corresponds to the FE_Mean variable in the SPSS dataset.

Table 3. Descriptive statistics for continuous study variables (N = 279)

4.2. Inferential statistics

4.2.1. Zero-order associations

BI to use XR showed statistically significant positive zero-order correlations with all UTAUT2 constructs. Correlations ranged from r = .28 with facilitating conditions (FC) to r = .72 with performance expectancy (PE), ps < .001 (two-tailed), with intermediate associations for effort expectancy (EE; r = .58), social influence (SI; r = .54), hedonic motivation (HM; r = .64), and personal innovativeness (PI; r = .55).

Inter-correlations among predictors were moderate to high. The largest were observed between EE and HM (r = .82) and between PE and EE (r = .80), with further substantial associations between PE and HM (r = .70) and between SI and FC (r = .61).

4.2.2. Multiple regression model

A multiple linear regression with BI as the dependent variable and the six UTAUT2 constructs as simultaneous predictors was statistically significant, $F(6, 272) = 94.91$, $p < .001$, with $R^2 = .677$ (adjusted $R^2 = .670$). As shown in Table 4, PE, SI, HM, and PI

were positively associated with BI in the joint model, whereas EE and FC carried negative coefficients under shared variance; all predictors were statistically significant at $p < .001$. The largest standardised association was observed for PE (β = .62), while the negative conditional coefficients for EE (β = −.38) and FC (β = −.28) suggest substantial overlap with other belief measures in this sample.

Collinearity diagnostics (tolerance = .211-.567; VIF = 1.76-4.73; condition index max = 30.42) indicate elevated shared variance, especially between EE and HM, so individual coefficients are interpreted as conditional associations rather than independent "effects." Influence and residual checks did not indicate problematic cases (standardised residuals −2.82 to 2.78; Cook's D max = 0.18), and all cases were retained.

Predictor	B	SE B	95% CI for B	β	*t*	*p*	VIF
Intercept	0.12	0.19	[−0.24, 0.49]	-	0.67	.506	-
Performance expectancy (PE)	0.69	0.07	[0.55, 0.82]	.62	9.72	< .001	3.39
Effort expectancy (EE)	−0.40	0.08	[−0.56, −0.24]	−.38	−5.01	< .001	4.73
Social influence (SI)	0.22	0.06	[0.10, 0.34]	.20	3.55	< .001	2.54
Facilitating conditions (FC)	−0.28	0.05	[−0.37, −0.19]	−.28	−5.90	< .001	1.88
Hedonic motivation (HM)	0.36	0.07	[0.23, 0.50]	.36	5.36	< .001	3.78
Personal innovativeness (PI)	0.41	0.05	[0.31, 0.52]	.35	7.64	< .001	1.76

Note. Dependent variable: BI_Mean. Model statistics: $R = .823$, $R^2 = .677$, adjusted $R^2 = .670$, $F(6, 272) = 94.91$, $p < .001$.

Table 4. Multiple regression of behavioural intention to use XR on UTAUT2 constructs ($N = 279$)

4.2.3. GLM with contextual factors and covariates

A univariate general linear model (UNIANOVA) was estimated with BI as the outcome. The model included four categorical factors (current position, main discipline, personal computer for academic work, and main digital resource provided by the university), three additional categorical controls (gender, received training, and main internet connection), and covariates (age, teaching experience, digital tool use frequency, and the six UTAUT2 scales), as summarised in Table 5. HC3-robust standard errors were requested. The overall model accounted for a large proportion of variance, $R^2 = .875$ (adjusted $R^2 = .861$).

As summarised in Table 5, the GLM indicated that behavioural intention varied significantly by current position, main discipline, personal computer availability, main digital resource provided by the university, IT training, and internet connection, whereas gender, age, and digital tool use frequency were not significant in this model. Among the UTAUT2 covariates, performance expectancy and hedonic motivation retained significant partial associations with behavioural intention, and teaching experience was also significant. By contrast, effort expectancy, social

influence, facilitating conditions, and personal innovativeness were not significant in the multivariable GLM.

Source	df	*F*	*p*	Partial η^2
Corrected model	28	62.36	< .001	.875
Current position	4	22.02	< .001	.260
Main discipline	4	31.31	< .001	.334
Personal computer (yes/no)	1	14.88	< .001	.056
Main digital resource provided	4	20.16	< .001	.244
Gender	1	0.04	.847	.000
Received IT training	3	22.73	< .001	.214
Internet connection (type)	2	3.14	.045	.025
Age	1	1.18	.278	.005
Teaching experience	1	14.03	< .001	.053
Digital tool use frequency	1	0.00	.992	.000
Performance expectancy (PE_Mean)	1	73.54	< .001	.227
Effort expectancy (FE_Mean)	1	1.95	.164	.008
Social influence (SI_Mean)	1	1.91	.168	.008
Facilitating conditions (FC_Mean)	1	0.05	.828	.000
Hedonic motivation (HM_Mean)	1	13.20	< .001	.050
Personal innovativeness (PI_Mean)	1	1.47	.226	.006

Table 5. HC3-robust GLM tests of between-subjects effects on behavioural intention (BI_Mean)

Bonferroni-adjusted pairwise comparisons and adjusted means are presented in Table 6. In summary, behavioural intention differed significantly across selected staff categories, disciplines, and university digital resource profiles.

A. Bonferroni-adjusted pairwise comparisons			
Comparison	**Mean difference**	**95% CI**	**p**
Part-time university teacher vs doctoral candidate with teaching duties	-1.29	[-1.78, -0.79]	<.001
Part-time university teacher vs full-time university teacher	-1.00	[-1.41, -0.59]	<.001
Education Sciences vs Humanities and Social Sciences	1.71	[1.09, 2.32]	<.001

A. Bonferroni-adjusted pairwise comparisons			
Education Sciences vs Law/Economics/Management	1.96	[1.42, 2.50]	<.001
Education Sciences vs STEM	1.60	[1.12, 2.08]	<.001
Education Sciences vs Medicine/Health	1.92	[0.74, 3.10]	<.001
Loan of digital equipment vs no resources	-1.83	[-2.44, -1.22]	<.001
Loan of digital equipment vs online learning platform (LMS)	-1.36	[-1.90, -0.82]	<.001
B. Adjusted means by personal computer availability			
Group	**Adjusted M**	**SE**	**95% CI**
Yes	3.85	0.08	[3.69, 4.01]
No	3.04	0.23	[2.58, 3.50]

Table 6. Bonferroni-adjusted pairwise comparisons and adjusted means for behavioural intention to use XR

Education Sciences showed higher adjusted behavioural intention than the other disciplinary groups included in the reported contrasts, whereas contexts centred on loaned digital equipment showed lower adjusted values than contexts reporting no resources or LMS access. Adjusted means were also higher among respondents with a personal computer for academic work than among those without.

5. DISCUSSION

The discussion of the results is organised according to the four research questions, followed by sections on pedagogical proofing, implications, and limitations, with all findings interpreted as correlational rather than causal. Here, "XR adoption" is specified in ESP terms as lecturers' stated readiness to design and sustain XR-supported specialised discourse tasks (genre-simulated interaction, register work, and multimodal performance), with digitally mediated genres and multimodality serving as a relevant reference point (Guillén-Galve & Vela Tafalla, 2023).

5.1. RQ1: Experiential UTAUT2 constructs and behavioural intention

RQ1 examined how performance expectancy, effort expectancy, hedonic motivation, and personal innovativeness relate to BI to use XR in ESP courses. The pattern supports H1 most clearly for PE and HM, which showed strong positive correlations with intention and retained influence in multivariable models. This aligns with

UTAUT2 research where perceived usefulness and enjoyment relate to intention (Anjulo Lambebo & Chen, 2025; Tram, 2025; Venkatesh et al., 2012). Under an ESP framing, these associations suggest that lecturers reporting higher intention also report stronger expectations that XR can support specialised discourse work (discipline-linked communicative events, interactional rehearsal, and multimodal performance), while also viewing such work as engaging. PI shows a more moderate but still positive association with intention, suggesting that openness to experimentation relates to willingness to trial XR-supported ESP tasks. EE correlated positively with intention but entered the regression with a negative coefficient under collinearity, so its distinct conditional contribution remains empirically uncertain.

5.2. RQ2: Social influence, facilitating conditions, and H2

RQ2 considered how social influence and facilitating conditions relate to BI. Both constructs correlated positively with intention, which seems compatible with evidence that perceived norms and support align with higher acceptance of educational technologies (Cui & Li, 2025; Ko & Shin, 2023). Once experiential constructs were controlled, however, SI retained only a modest positive association and FC became negative in the regression and nonsignificant in the GLM, so H2 appears supported mainly at the bivariate level. This attenuation resembles patterns in some AI and chatbot work where SI and FC weaken when expectancy beliefs are taken into account (Anjulo Lambebo & Chen, 2025), suggesting that in this sample much of their relation to intention may be channelled through perceived usefulness and enjoyment.

5.3. RQ3: Role, discipline, and conditioning contexts

RQ3 addressed how academic role and disciplinary affiliation relate to intention once UTAUT2 constructs and personal innovativeness are included. The findings appear to support H3: current position and main discipline explained sizeable portions of variance in BI, with Education Sciences showing higher adjusted intention than Humanities and Social Sciences, Law/Economics/Management, STEM, and Medicine/Health, and with part-time and secondary-school teachers reporting lower intention than full university teachers and administrative staff with teaching duties. This configuration seems consistent with work linking disciplinary cultures, assessment regimes, and contractual conditions to differing levels of openness to new technologies (Cui & Li, 2025; İbili et al., 2024; Rahmanu & Molnár, 2024). ESP programmes in Education Sciences may provide more scope for integrating XR tasks into coursework, while professional fields may be constrained by external examinations and accreditation. Role and discipline therefore appear to function as contextual conditions through which acceptance-related beliefs are expressed.

5.4. RQ4: Resources, teaching experience, and adoption conditions

RQ4 focused on how institutional resources and teaching experience relate to BI. H4 appears broadly supported: extensive IT training, personal computer ownership, several types of university-provided digital resources, and longer teaching experience were each associated with higher adjusted intention. The relatively low adjusted intention where the main provision consists of loaned equipment, compared with LMS access, specialised software, or technical support, appears to reinforce concerns that hardware-focused initiatives are not sufficient on their own (Alaoui Mhamdi, 2025; Boudine et al., 2024). Intermittent loans without integration into familiar platforms or ongoing support may be perceived as difficult to sustain, especially when lecturers already rely on personal computers and home broadband. The positive association between teaching experience and intention suggests that experienced lecturers may be better positioned to trial XR incrementally, though the cross-sectional design does not clarify temporal ordering.

5.5. Pedagogical proofing as an emergent implementation idea

The combined patterns for experiential constructs, resources, and contextual factors appear to support discussion of "pedagogical proofing" as a tentative implementation idea for XR in Moroccan HE. Figure 2 summarises this suggestion as an iterative cycle. At the top of the figure, contextual and experiential conditions, performance expectancy, hedonic motivation, personal innovativeness, disciplinary norms, role, and resource configurations, are shown as the backdrop against which lecturers decide whether XR is worth trialling in ESP courses. Under favourable conditions, XR lesson design and implementation appear more likely to be attempted.

The next stages in Figure 2 emphasise documentation and reflection at lesson level and show how contextual conditions, lesson logging, and collegial exchange may iteratively refine XR tasks and align with higher perceived usefulness, enjoyment, and intention. After each XR-supported ESP session, lecturers are invited to complete concise logs capturing what was implemented, what seemed to work, and what appeared problematic. These logs then feed into collegial exchange and micro-training, where lecturers share selected entries in meetings or informal communities of practice. Such exchanges seem to create conditions in which design ideas, perceived risks, and pragmatic workarounds circulate across roles and disciplines, potentially supporting those who currently report lower BI.

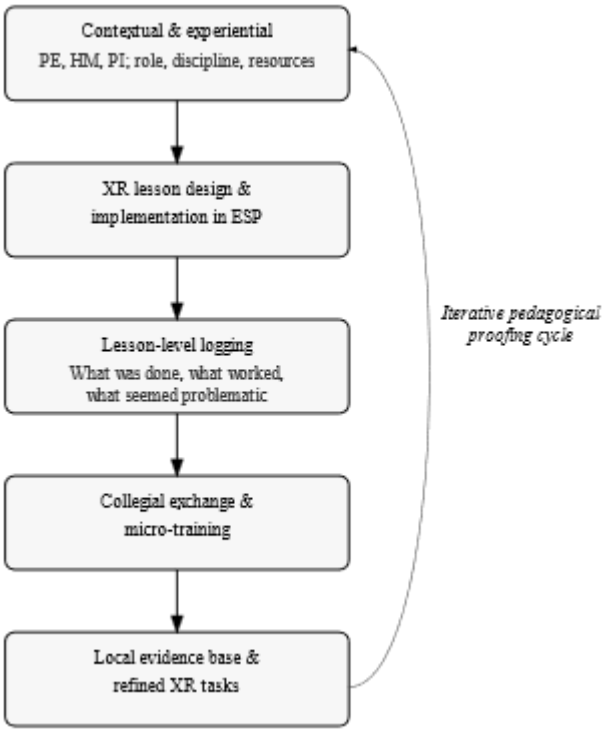

Figure 2. Pedagogical proofing cycle for XR-supported ESP teaching

Over time, the lower part of Figure 2 represents the accumulation of a local evidence base and the progressive refinement of XR tasks. Patterns emerging from logs and discussions may guide adjustments to scenario design, assessment alignment, and technical choices, which in turn appear likely to influence PE and HM. The loop-back arrow in the figure is intended to signal that these refinements feed into the broader contextual and experiential conditions, so that repeated cycles of pedagogical proofing may gradually strengthen the perceived usefulness and attractiveness of XR under realistic constraints.

This conceptualisation remains provisional and is not presented as a formalised method. Rather, Figure 2 depicts pedagogical proofing as an emergent, practitioner-led process through which lecturers in Moroccan HE may move from isolated XR pilots toward more systematic, locally grounded experimentation, with the possibility of extending such cycles to other digital tools as "digital proofing" practices evolve.

5.6. Implications for practice and policy

Several implications for practice and policy follow. First, given the prominence of performance expectancy and hedonic motivation, professional development can be oriented toward discipline-specific XR scenarios tied to identifiable ESP outcomes

(genre performance, role-based interaction, register expectations) rather than generic demonstrations. Work on specialised discourse under digitally mediated and multimodal conditions offers a relevant reference point for this focus (Cheng, 2026; Dontcheva-Navratilova, 2023; Lee, 2024). Second, the limited distinct contribution of social influence and facilitating conditions once experiential constructs are controlled suggests that institutional strategies can combine policy statements and equipment procurement with structured opportunities for staff to log, share, and refine XR-supported lessons, consistent with a pedagogical proofing ethos. Third, disciplinary and role-based differences indicate that XR initiatives may be differentiated, with higher-intention units acting as early-adopter hubs and lower-intention contexts receiving targeted design support focused on communicative task feasibility. Fourth, the resource pattern supports investment in LMS integration, specialised software, and accessible technical support rather than reliance on short-term equipment loans alone. Under these conditions, attention to participation demands and learner comfort in mediated interaction remains relevant, given evidence that modality conditions relate to anxiety and participation in ESP settings (Topalov et al., 2023).

5.7. Practical implementation pathway

An indicative implementation pathway can be sketched, subject to local adaptation, and is summarised in Figure 3 as a sequence of phased pilots, platform embedding, extension to lower-intention disciplines, and periodic review and adjustment. A first phase could focus on small-scale pilots in programmes with higher BI, where lecturers design XR activities, document them through lesson logs, and discuss results in structured debriefings. A second phase might emphasise embedding XR tasks within existing LMSs and clarifying technical support channels, so that XR is experienced as part of routine provision. A third phase could extend XR opportunities to disciplines with lower intention, using pilot logs as starting points for co-designed use cases that match local curricula and workload conditions. A final phase might consist of periodic reviews of logs, intention levels, and resource configurations, allowing institutions to adjust training and provisioning as XR and related technologies evolve.

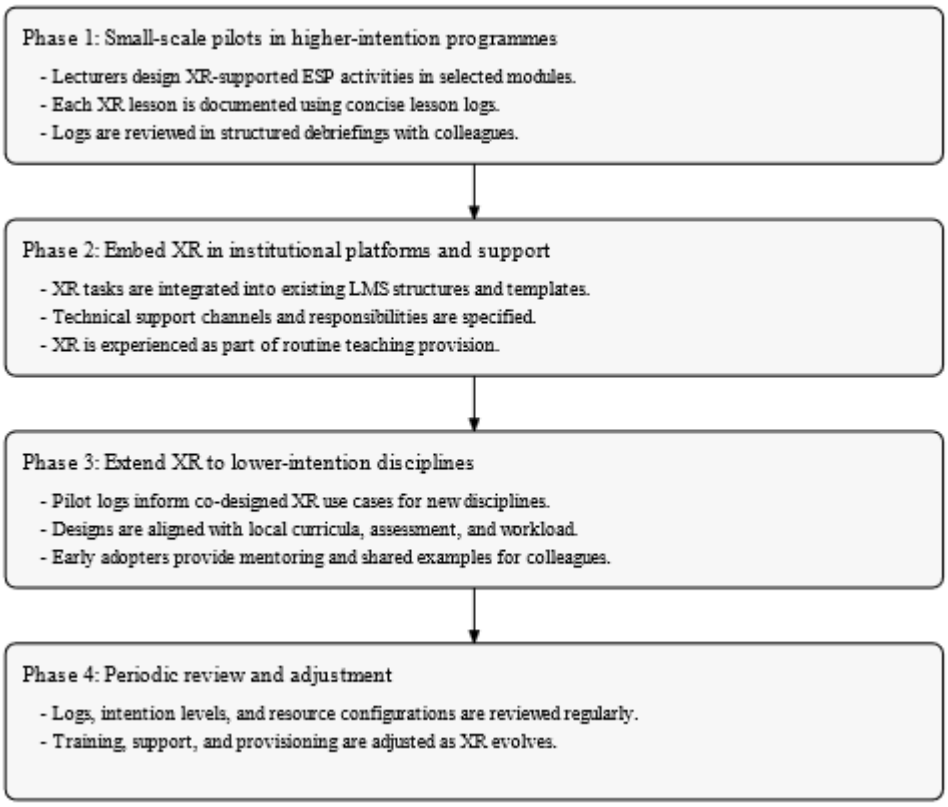

Figure 3. Indicative implementation pathway for XR-supported ESP teaching

5.8. Strengths and limitations of the study

This study contributes to ESP scholarship by examining how practising ESP lecturers' readiness to implement XR relates to beliefs about the pedagogic value and feasibility of XR-supported specialised discourse tasks under locally available provisioning conditions. The findings also suggest that, in this setting, performance expectancy and hedonic motivation retain stronger conditional associations with intention than effort expectancy and facilitating conditions once shared variance is taken into account.

The study's strengths include a sample of practising ESP lecturers with prior XR exposure from multiple public universities, satisfactory internal consistency of the adapted UTAUT2 scales, and the combined use of correlations, multiple regression, and HC3-robust GLM. Its limitations include the cross-sectional, self-report, and nonprobability design, which restricts claims to associative patterns in comparable institutional settings, the requirement of prior XR exposure, which is likely to align with higher overall intention, and the absence of potentially relevant contextual variables such as governance, workload, and institutional culture.

6. CONCLUSION

This study suggests that ESP lecturers' behavioural intention to use XR in Moroccan higher education is associated chiefly with performance expectancy and hedonic motivation, while the contribution of other UTAUT2-related beliefs becomes weaker once shared variance is taken into account. Intention also varies by disciplinary, professional, and resource conditions, with higher levels aligning with more stable support structures such as IT training, personal computer access, and LMS or specialised software provision. Taken together, the findings indicate that XR uptake in ESP is linked less to hardware alone than to whether lecturers judge XR-supported specialised discourse tasks to be pedagogically worthwhile and practically sustainable under local conditions.

As far as practice and policy are concerned, the pattern of associations suggests that XR initiatives in ESP may benefit from discipline-specific, outcome-aligned scenarios, stable platforms and support, and dedicated time for lecturers to refine tasks through pedagogical proofing practices such as lesson logging and collegial exchange. Future research could therefore combine longitudinal and mixed-method designs with SEM, which seems well suited to examining latent constructs and indirect pathways, and with comparative or multilevel studies that explore how institutional arrangements and collegial networks condition XR-related acceptance.

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NOUH ALAOUI MHAMDI is a PhD candidate in English language and education at Sidi Mohamed Ben Abdellah University, Faculty of Letters and Human Sciences Dhar El Mahraz, English Department, Fez, Morocco. His research focuses on extended reality in higher education, with particular attention to ESP, student empowerment, agency, and leadership. He has published several Scopus-indexed studies on virtual reality and metaverse integration in Moroccan education, including work in *Social*

Sciences & Humanities Open, *Lecture Notes on Data Engineering and Communications Technologies*, and the *International Conference on Virtual Learning* proceedings. He has also presented at international conferences in Italy, England, Portugal, and Morocco. ORCID: 0009-0004-3556-8648

Appendix

UTAUT2-XR instrument (adapted, 5-point scale)

Performance Expectancy (PE)
PE1. Using **XR** in my courses would be useful for teaching my courses.
PE2. Using **XR** enables me to achieve the goals for my students more quickly.
PE3. Using **XR** increases the productivity of my courses.

Effort Expectancy (EE)
EE1. My interaction with **XR** technology would be clear and understandable.
EE2. It would be easy for me to become skilful at using **XR**.
EE3. I would find **XR** easy to use.
EE4. Learning to operate **XR** is easy for me.

Social Influence (SI)
SI1. People who influence my behaviour think that I should use **XR** in my courses.
SI2. People who are important to me think that I should use **XR**.
SI3. People whose opinions I value prefer that I use **XR**.
SI4. The **departmental leadership** is helpful in the use of **XR**.
SI5. In general, the **university management** supports the use of **XR**.

Facilitating Conditions (FC)
FC1. I have the resources necessary to use **XR** in my courses.
FC2. I have the knowledge necessary to use **XR** in my courses.
FC3. A specific person or service is available for assistance with **XR** difficulties.

Hedonic Motivation (HM)
HM1. Using **XR** is fun.
HM2. Using **XR** is enjoyable.
HM3. Using **XR** is very entertaining.

Personal Innovativeness (PI)
PI1. If I hear about a new information technology, I would look for ways to experiment with it.
PI2. Among my peers, I am usually the first to try out new information technologies.
PI3. I like to experiment with new information technologies.
PI4. In general, I am inclined to try out new information technologies.

Behavioural Intention (BI)
BI1. I intend to use **XR** in the next six months.
BI2. I predict I would use **XR** in the next six months.
BI3. I plan to use **XR** in the next six months.