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Country, Cohort, or Context? Disentangling Extramural Digital Engagement Among CLIL Learners In Ireland, Italy, and Türkiye

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Abstract

Content and Language Integrated Learning (CLIL) classrooms across Europe increasingly coexist with dense, learner-controlled digital ecologies beyond the school gate. Extramural digital engagement has been linked repeatedly to second language development. Yet little evidence documents how CLIL learners across national systems distribute their extramural digital time or whether its relevance is comparable across contexts. This study addresses that gap using 2024 survey data from COST Action 21114, the CLIL Network for Languages in Education. The sample comprised 533 CLIL learners aged 10 to 21 in Ireland (n = 124), Italy (n = 216), and Türkiye (n = 193). Factor analysis of a 23-item digital activity scale yielded three dimensions: socio-communicative and entertainment, educational and informational, and gaming engagement, each showing good to excellent reliability (α = .80 to .93). Welch analyses of variance, Games-Howell tests, multivariate analysis of variance, hierarchical regression, and chi-square tests examined cross-national variation. Country predicted large differences in socio-communicative engagement and smaller differences elsewhere. A significant country-by-gender interaction emerged. Age best predicted educational engagement, not gender or parental education. Turkish learners reported the most access barriers. Findings extend extramural research and inform CLIL pedagogy across diverse national contexts.

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Introduction

Content and Language Integrated Learning, commonly abbreviated as CLIL, is one of the most widely adopted approaches to bilingual education in Europe (Coyle et al., 2010; Nikula et al., 2026). CLIL positions learners to acquire subject content and an additional language at the same time. Classic CLIL theory treats the classroom as the primary site of language and content learning (Coyle, 2007). Coyle's 4Cs framework, comprising content, communication, cognition, and culture, has guided CLIL pedagogy for almost two decades (Coyle et al., 2010; Coyle &

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Meyer, 2021). Yet the language and content practices that CLIL learners encounter no longer stop at the classroom door. Contemporary adolescents inhabit dense digital ecologies. They stream video, use social media, exchange instant messages, play multiplayer games, and increasingly use generative artificial intelligence tools. Much of this activity happens in a language other than the learner's first language (Liu, 2024). It operates largely outside institutional control.

This extramural dimension of language contact has attracted sustained attention in second language acquisition research (Zhang et al., 2021). Extramural language learning is broadly defined as language activity that occurs outside the classroom. It is not driven by a formal pedagogical agenda. Its intersection with CLIL specifically remains underexamined. CLIL is a context in which language is simultaneously a medium and an object of instruction. This dual role makes the extramural question especially relevant for CLIL learners.

Several converging strands of theory and evidence justify expecting a link between extramural digital engagement and CLIL outcomes. Research on incidental vocabulary acquisition through gaming and multimedia exposure shows that repeated, contextually embedded encounters with target language forms support lexical development (Soyoof et al., 2022; Wu et al., 2025). Work on learner engagement in immersive digital environments suggests that self-selected digital activity can produce deep processing (Lee et al., 2023). Motivational theory offers a further explanation. Dörnyei's L2 Motivational Self System frames sustained language engagement as driven by learners' ideal and ought-to selves, together with their evaluation of the learning experience itself (Dörnyei & Ushioda, 2021). Self-determination theory adds that autonomous, self-chosen activity, such as most extramural digital practice, tends to be more intrinsically motivating and better sustained than externally imposed classroom tasks (Ryan & Deci, 2000). Extramural digital engagement is therefore not simply incidental exposure. It is plausibly linked to the motivational architecture that sustains long-term language learning.

Large-scale evidence specific to CLIL learners supports this view. Lázaro-Ibarrola (2024, 2025) found that the intensity of extramural exposure interacts with in-school CLIL intensity in predicting learner proficiency. The two sources of exposure contribute additively to language gains rather than substituting for one another. Extramural digital engagement is therefore not a peripheral leisure activity. It is a potentially consequential part of the wider ecology in which CLIL learning takes place.

At the same time, digital divide research cautions against assuming that extramural digital engagement is either homogeneous or equally available across learner populations. Van Dijk's resources and appropriation theory distinguishes several sequential levels of digital inequality. These include motivation, physical access, skills, and use (van Dijk, 2020). Even where basic access is widespread, second-level divides in how technology is used and third-level divides in the outcomes that usage produces remain considerable (van Deursen & van Dijk, 2019; van Kessel et al., 2022). These disparities raise the possibility that CLIL learners in different national contexts engage with digital technology at different rates. They may also derive different pedagogical value from that engagement. This possibility has rarely been tested using a common instrument across more than one country simultaneously.

The present study was conducted within COST Action 21114, CLIL Network for Languages in Education, known as CLILNetLE. This pan-European research network has, since 2022, synthesized research on the linguistic, disciplinary, and increasingly technological dimensions of CLIL provision across more than twenty countries (Hüttner et al., 2026). As part of this network's empirical agenda, a Digital Literacies Student Survey was administered to CLIL learners in multiple countries. The survey captured extramural digital activity, its perceived relevance to CLIL subject learning, device access, and the challenges learners experience with digital technology at home and at school. The present article draws on the subset of survey responses collected in Ireland, Italy, and Türkiye. It examines, for the first time using this instrument, whether and how extramural digital engagement patterns differ across CLIL learners in markedly different educational and sociolinguistic contexts.

Literature Review

Theoretical Background

Three theoretical traditions jointly motivate the present study. The first is CLIL pedagogical theory itself. Coyle's 4Cs framework positions communication and cognition as inseparable from content and culture in CLIL classrooms (Coyle, 2007; Coyle et al., 2010). Later refinements emphasize pluri-literacies for deeper learning. These extend the 4Cs model to the multiple modes, including digital modes, through which learners construct subject knowledge (Coyle & Meyer, 2021). CLILNetLe's own conceptual work has argued for adding an explicit technological digital dimension to this framework, alongside the linguistic and semiotic dimensions long recognized in CLIL theory (Hüttner et al., 2026). If digital practice is now a legitimate component of CLIL competence, then learners' extramural digital lives are directly relevant to CLIL theory, not merely a background variable.

The second tradition is motivational theory. Dörnyei's L2 Motivational Self System proposes that sustained language engagement depends on learners' ideal L2 self, their ought-to L2 self, and their evaluation of the learning experience (Dörnyei & Ushioda, 2021). Self-determination theory adds that autonomously chosen activities satisfy learners' needs for competence, autonomy, and relatedness more effectively than imposed tasks (Ryan & Deci, 2000). Extramural digital activity is almost by definition self-selected. It should therefore carry particular motivational weight for language development, a claim supported by evidence that gaming and social media engagement sustain long-term learner investment even among academically disengaged students (Wu et al., 2025).

The third tradition is digital divide theory. Van Dijk's resources and appropriation theory models digital inequality as a causal sequence. Motivation and physical access precede skills, which in turn precede beneficial use and outcomes (van Dijk, 2020). This model implies that raw engagement frequency, the kind of measure used in most extramural learning research, does not by itself indicate equal opportunity. Two learners may report similar engagement levels while experiencing very different qualities of access, connectivity, and skill support (van Deursen & van Dijk, 2019). This distinction between engagement intensity and access adequacy is central to the interpretation of the present study's findings, particularly the comparison of Turkish, Italian, and Irish learners.

These three traditions are not simply listed side by side in the present study. They are combined into one explanatory chain. CLIL theory specifies the object of interest. It identifies digital practice as a legitimate part of CLIL competence, which is why it is worth measuring at all (Hüttner et al., 2026). Motivational theory specifies the mechanism. It explains why learners choose to engage with digital practice outside the classroom, since self-selected activity satisfies core psychological needs more fully than imposed classroom tasks (Ryan & Deci, 2000; Dörnyei & Ushioda, 2021). Digital divide theory specifies the boundary condition. It explains why motivated engagement does not automatically translate into equal opportunity, since access, skills, and outcomes depend on structural resources that sit outside individual motivation (van Dijk, 2020). Read together, CLIL theory defines what counts as relevant engagement, motivational theory explains why learners pursue it, and digital divide theory explains who can convert that pursuit into meaningful practice. The present study tests this integrated sequence as a whole, rather than three unrelated theoretical claims.

CLIL and the Expanding Digital Ecology of Language Learning

CLIL research has traditionally concentrated on classroom internal variables. Teacher scaffolding, task design, and the integration of language and content objectives have been treated as the principal determinants of learner outcomes (Coyle et al., 2010; Nikula et al., 2026). Classroom interaction studies have shown how CLIL learners develop subject-specific vocabulary through sustained, teacher-mediated exchanges (Rieder-Bünemann et al., 2022). Yet the same body of research warns that classroom interaction patterns can also foster inequalities rather than opportunities, depending on how language and content are integrated in practice (Llinares & Evnitskaya, 2021). Reported pedagogical practices vary considerably even within a single

country. A study of Austrian secondary CLIL classrooms found substantial diversity in how teachers balanced content and language goals, with implications for how consistently any given national CLIL system actually implements its stated approach (Bauer-Marschallinger et al., 2023). Over the past five years, the CLILNetLE network has argued for a broader view. Bi- and multilingual disciplinary literacies now explicitly include a technological digital dimension, alongside the more established linguistic and semiotic dimensions of CLIL competence (Hüttner et al., 2026). This reflects a simple observation. Subject-specific and everyday academic language are increasingly encountered through digital multimodal channels. Video explainers, interactive simulations, and online reference tools are accessed both inside and outside school. Survey evidence collected across the CLILNetLE network indicates that CLIL provision in most participating countries still privileges written and oral language skills over multimodal or digitally mediated practices (Nikula et al., 2026). This suggests a gap between learners' digital lives outside school and the pedagogical practices they encounter within it.

Extramural language exposure and its measurement

Extramural English, and its broader analogue, extramural language learning, have been operationalized in many ways. Some studies use simple frequency counts of specific activities. Others use multidimensional scales capturing both quantity and qualitative engagement. Zhang et al. (2021) demonstrated that activity type, rather than raw time spent, was the strongest predictor of self-reported language gains. Activities requiring productive output, such as gaming with communicative partners or content creation, showed stronger associations with proficiency than passive consumption. This finding has been echoed in more recent scale development work. Uztosun and Sundqvist (2025) developed and validated a multidimensional extramural English engagement scale for the Turkish context. Socially interactive and entertainment-oriented items are loaded separately from more deliberately educational items. This factor structure closely parallels the socio-communicative and educational informational dimensions identified in the present study. Imsa-ard (2025) similarly found that distinct extramural English activity types were differentially associated with vocabulary knowledge and affective variables among EFL undergraduates. Extramural engagement is therefore best treated as multidimensional, not as a single composite score.

Within CLIL specifically, Lázaro-Ibarrola (2024, 2025) has produced some of the most methodologically rigorous evidence to date. Using multilevel models, she disentangled the relative contributions of in-school CLIL intensity and extramural English exposure among young learners in Spanish primary education. Both sources of exposure contributed independently and additively to proficiency gains. Extramural exposure partially compensated for lower CLIL intensity in some learner profiles. Socioeconomic status moderated learners' access to high-quality extramural input. This moderating role of socioeconomic and contextual factors is directly relevant here. Ireland, Italy, and Türkiye differ substantially in CLIL implementation history, language education policy, and digital infrastructure.

Digital Gaming and Informal Second Language Learning

Learners in this era, who are also called the digital natives, favor using technology in their education process (Tütüniş et al, 2022). Among the categories of extramural digital activity, gaming has received disproportionate empirical attention. Gaming combines high engagement with repeated formal meaning-mapping opportunities and increasingly sophisticated in-game communicative demands. Meta-analytic and experimental work on incidental vocabulary acquisition through gameplay has consistently found positive, if modest, effects on receptive and productive lexical knowledge (Soyoof et al., 2022). These effects are moderated by game genre, the presence of multiplayer communication, and learners' pre-existing proficiency. Qualitative case study evidence extends this picture. Even academically underperforming learners can develop advanced second language competence through sustained, self-directed gaming. One documented case involved a self-identified gaming enthusiast whose in-game English exposure appeared to outstrip

the linguistic demands of formal instruction (Wu et al., 2025). Immersive and virtual reality gaming environments show similar promise for sustaining learner engagement over time (Lee et al., 2023). Access to such technologies remains uneven across national contexts. This motivated the inclusion of a dedicated gaming dimension in the present study's factor structure.

The Digital Divide and Cross-National Disparities in Adolescent Digital Engagement

A parallel strand of research documents persistent inequalities in adolescents' digital access, skills, and outcomes across Europe. Using Eurostat survey data, van Kessel et al. (2022) demonstrated substantial cross-country variation in internet access and digital capacity. Southern and Southeastern European countries typically reported lower rates of high-quality connectivity than Northwestern European countries, even as first-level access gaps narrowed overall. This pattern is consistent with van Dijk's broader claim that first-level access divides close relatively quickly, while second- and third-level divides persist for much longer (van Dijk, 2020; van Deursen & van Dijk, 2019). Subsequent analyses using PISA data show that once basic access is controlled, socioeconomic status, parental education, and school-level resourcing continue to predict adolescents' digital skills. Second-level digital divides, differences in the quality and purposefulness of digital engagement, persist even in high-access environments. Any comparison of extramural digital engagement across national CLIL populations must therefore account for the possibility that observed differences reflect structural access disparities. They may not simply reflect motivational or pedagogical factors. This consideration directly informed the inclusion of a digital access challenges measure in the present study.

The Irish, Italian, and Turkish CLIL Contexts

Ireland, Italy, and Türkiye were selected because they represent three structurally distinct entry points into CLIL provision within the CLILNetLE network. All three countries share active participation in the same COST Action. This ensures comparable data collection protocols. Ireland has a relatively recent and still developing CLIL policy landscape. Immersion and content-based provision have historically been associated with Irish medium education rather than foreign language CLIL. Irish CLIL learners in the present sample are therefore drawn from an emergent implementation context. Italy has one of the longest-standing and most institutionally embedded CLIL traditions in Europe. CLIL modules have been mandated in upper secondary curricula since national reforms in the early 2010s. This provides a mature implementation context with well-established teacher training pathways. Türkiye represents a rapidly expanding CLIL context. It sits at the geographic and infrastructural periphery of the European CLILNetLE network. Substantial recent investment in bilingual and English medium secondary provision coexists with documented disparities in digital infrastructure relative to Western Europe (Uztosun & Sundqvist, 2025; van Kessel et al., 2022). Turkish CLIL research supports this characterization of a rapidly developing context. CLIL practice has been shown to raise Turkish teachers' awareness of English as a lingua franca, suggesting that CLIL implementation in Türkiye is still actively shaping teacher and learner language attitudes rather than operating within a settled, long-established system (Yalçın et al., 2020). Parallel research on Turkish English language teachers documents highly variable levels of digital technology integration, even during periods of enforced remote instruction, indicating that digital pedagogical capacity in Turkish language education remains uneven (Demirkol Orak, 2023; Demirkol Orak & Alagözlü, 2025). This tripartite contrast, an emergent, a mature, and a rapidly expanding CLIL context, offers a theoretically motivated basis for examining whether extramural digital engagement tracks broader differences in CLIL implementation maturity and digital infrastructure. Cross-national CLIL comparisons remain rare even among mature European systems. One recent study comparing Finnish and Spanish CLIL classrooms found that learners' command of cognitive discourse functions, such as describing, comparing, and evaluating, differed by national context even when classroom tasks were nominally similar (Llinares & Nikula, 2023). This precedent supports the expectation

that national context, not merely individual learner characteristics, meaningfully shapes CLIL related outcomes, extramural digital engagement included.

Parental Education, Socioeconomic Proxies, and Adolescent Digital Engagement

Parental education is one of the most frequently used proxies for household socioeconomic status in educational research. It has been linked to both the quantity and quality of adolescents' digital engagement. Van Dijk's resources and appropriation theory help explain why. Household resources shape motivation and physical access, which in turn shape skills and beneficial use (van Dijk, 2020). Parental digital mediation practices and the transmission of educationally oriented technology use norms operate through the same causal chain. Cross national survey evidence shows that once basic internet access is statistically controlled, parental education and household socioeconomic status continue to predict adolescents' digital skills and the purposefulness of their technology use (van Kessel et al., 2022). This is a second-level digital divide effect. It persists even in relatively high-access European contexts. Ireland, Italy, and Türkiye differ in the distribution of parental education within the present sample. Turkish participants' parents reported comparatively lower average educational attainment than Irish or Italian participants' parents. Parental education was therefore retained as a covariate in the regression model reported in the findings section. This allows its independent contribution to be distinguished from the contributions of age, gender, and country membership.

Originality, Significance, and the Gap Addressed by the Present Study

Three gaps remain unaddressed by the existing literature. First, extramural digital engagement and CLIL have each been studied extensively. Almost no published research has measured extramural digital engagement using a common, multidimensional instrument administered simultaneously across CLIL learners in more than one national context. Claims about cross-national variation have therefore relied on indirect comparison across studies using different instruments, samples, and analytic approaches. Second, the existing extramural learning literature has disproportionately focused on English as the target language and on learners in Northern European or East Asian contexts (Liu, 2024; Uztosun & Sundqvist, 2025). The inclusion of CLIL learners across Irish, Italian, and Turkish contexts extends the empirical base of extramural learning research to a broader and more linguistically diverse population. Third, prior studies have rarely examined extramural digital engagement as a multidimensional construct while simultaneously modeling country, gender, age, and parental education as joint predictors within a single analytic framework. The present study's combination of exploratory factor analysis, multivariate analysis of variance, and hierarchical regression addresses this methodological gap directly. By locating extramural digital engagement within CLIL theory, motivational theory, and digital divide theory simultaneously, and by testing its structure and correlates across three structurally distinct national contexts, the present study offers original evidence with direct relevance to CLIL curriculum design, teacher education, and digital equity policy across the CLILNetLE network and beyond.

Building on the theoretical and empirical foundations reviewed above, the present study pursued four research questions.

RQ1: What is the underlying dimensional structure of CLIL learners' extramural digital engagement? Do the resulting subscales demonstrate adequate reliability?

RQ2: Do CLIL learners in Ireland, Italy, and Türkiye differ in their levels of socio communicative, educational informational, and gaming related extramural digital engagement?

RQ3: Do age, gender, parental education, and country jointly and interactively predict extramural digital engagement? Which of these variables emerges as the strongest individual level correlate of educational informational engagement specifically?

RQ4: Do CLIL learners in the three countries differ in the extent to which they report experiencing barriers to extramural digital access?

Methodology

Research design

The present study employed a cross-sectional, quantitative, comparative survey design. Cross-sectional survey designs are well suited to the study's aims because the research questions concern the structure and distribution of extramural digital engagement across three distinct national populations at a single point in time, rather than change within individuals over time. The design is comparative in the sense that the same instrument, translated and adapted for local administration but structurally identical across contexts, was administered to independent samples of CLIL learners in Ireland, Italy, and Türkiye, allowing between-country comparison while holding measurement content constant. Following recommendations for cross-national survey research within the CLILNetLE network, no experimental manipulation or random assignment was involved; the design is therefore correlational and comparative rather than causal, a limitation that is addressed explicitly in the Discussion.

Participants and Sampling

Participants were 533 CLIL learners aged 10 to 21 years (M = 16.78, SD = 3.03), recruited through participating schools affiliated with COST Action 21114 in Ireland (n = 124), Italy (n = 216), and Türkiye (n = 193). Sampling followed a convenience and network-based approach typical of large-scale COST Action data collection: national management committee members and CLILNetLE-affiliated researchers in each country contacted CLIL-providing schools within their professional networks and invited eligible classes to participate. Within participating classes, all students present were invited to complete the survey, meaning that participation was at the class level rather than through individual-level random sampling. Table 1 presents the demographic composition of the analytic sample by country. Chi-square tests of independence confirmed that the three national samples differed significantly in age-band composition, $chi2(4, N = 533) = 229.95$, $p < .001$; gender composition, $chi2(6, N = 533) = 34.56$, $p < .001$; and parental education composition, $chi2(10, N = 533) = 115.63$, $p < .001$. The Irish sample was predominantly early adolescent and evenly split by gender; the Turkish sample was older on average and disproportionately female (74.1%); and the Italian sample showed the most balanced age spread across the three bands. These demographic differences are treated as substantive features of the three national contexts rather than nuisance variation, and age in particular is examined explicitly as a covariate in subsequent analyses.

Additional information on participants' CLIL background clarifies the comparability of the three samples. The main CLIL language differed by country. Most Irish participants studied through Irish, the historical language of Irish-medium education, rather than through a foreign language (85.5%). Italian participants studied predominantly through English (91.7%), consistent with Italy's foreign language CLIL model. Turkish participants were more evenly split between Turkish (60.6%) and English (38.9%) as their main CLIL language. Participants also differed in how many school subjects they studied through their main CLIL language. Irish participants reported the widest subject range (M = 5.56, SD = 4.07), followed closely by Turkish participants (M = 5.55, SD = 4.70), while Italian participants reported a narrower range (M = 2.28, SD = 2.27), consistent with Italy's single subject CLIL modules. Most participants in all three countries reported several years of CLIL experience in their main subject area (59.4% in Ireland, 51.2% in Italy, and 41.8% in Türkiye). A sizeable minority, however, reported only a few days of experience, particularly in Türkiye (22.9%) and Ireland (16.8%). This variation in CLIL intensity and duration was not entered as a covariate in the primary analyses, since the survey captured it at the level of individual subjects rather than as a single composite measure. It is treated here as an important contextual qualifier for the cross-national comparisons reported below, and it is revisited in the Limitations section.

Because the recruitment strategy relied on existing professional and institutional networks, the samples should be regarded as purposive rather than nationally representative, a point discussed further in the Limitations section. Age distributions differed substantially across countries: the Irish sample was concentrated in early adolescence (13-16 years, 89.7%), the Italian sample spanned early to late

Table 1: Demographic characteristics of CLIL learners by country

Characteristic	Ireland (n = 124)	Italy (n = 216)	Türkiye (n = 193)	Total (N = 533)
Age in years, M (SD)	14.33 (1.35)	16.22 (2.92)	19.33 (2.05)	16.78 (3.03)
Age group, n (%)				
9-12 years	2 (1.7)	18 (8.7)	2 (1.3)	
13-16 years	105 (89.7)	62 (29.8)	9 (5.7)	
17-21 years	10 (8.5)	128 (61.5)	147 (93)	
Gender, n (%)				
Female	63 (50.8)	102 (47.2)	143 (74.1)	
Male	57 (46)	106 (49.1)	45 (23.3)	
Other	1 (0.8)	4 (1.9)	2 (1)	
Prefer not to say	3 (2.4)	4 (1.9)	3 (1.6)	
Parental education, n (%)				
Primary	2 (2.4)	1 (0.5)	29 (15.5)	
Lower secondary	11 (13.3)	20 (10)	44 (23.5)	
Upper secondary	23 (27.7)	74 (36.8)	55 (29.4)	
Undergraduate	16 (19.3)	14 (7)	43 (23)	
Postgraduate (Master)	24 (28.9)	60 (29.9)	11 (5.9)	
Postgraduate (PhD)	7 (8.4)	32 (15.9)	5 (2.7)	

Note. Percentages are calculated within country and may not sum to 100 due to rounding. Parental education reflects the highest level of education attained by either parent. Age group x Country, $x^2(4, N = 533) = 229.95$, $p < .001$; Gender x Country, $x^2(6, N = 533) = 34.56$, $p < .001$; Parental education x Country, $x^2(10, N = 533) = 115.63$, $p < .001$.

adolescence with a plurality in the 17-21 year band (61.5%), and the Turkish sample was concentrated almost entirely in the 17-21 year band (93.0%). This age distribution is described in full in Table 1 and is treated as a substantive covariate throughout the analysis rather than as a nuisance variable to be ignored.

Rationale for Country Selection

Ireland, Italy, and Türkiye were selected for four converging reasons. First, all three countries maintained active, complete DLSS data collection within the fieldwork window, ensuring comparable timing and instrument administration across sites. Second, as outlined in before, the three countries occupy structurally distinct positions with respect to CLIL implementation maturity, ranging from an emergent Irish context through a long-established Italian context to a rapidly expanding Turkish context, offering meaningful contextual variation without requiring an unmanageably large number of comparison groups. Third, the three countries differ appreciably in documented digital infrastructure and second-level digital divide indicators (van Kessel et al., 2022), allowing the study to examine whether extramural engagement differences track these broader structural patterns. Fourth, restricting the comparison to three countries, rather than pooling all available CLILNetLE country datasets, allowed sufficient statistical power for the planned multivariate and interaction analyses while keeping group sizes large enough (all n > 100) to support the assumption-sensitive procedures, including Welch-corrected analysis of variance and Games-Howell post hoc comparisons, that were required once variance homogeneity assumptions were found to be violated.

Data Collection Tools

Data were collected using the Digital Literacies Student Survey (DLSS), a structured, self-report questionnaire developed collaboratively within COST Action 21114 and administered online via the

Qualtrics survey platform. An initial draft of the DLSS was prepared during a Short Term scientific Mission (STSM) at the University of Vienna, which reviewed existing digital literacies research and produced the survey's first version for subsequent piloting and refinement across CLILNetLE partner countries (Strati, 2023). The survey instrument, reproduced in the project's survey documentation, was organized into thirteen thematic sections covering informed consent, demographic and linguistic background, main and secondary CLIL language use, extramural digital activity frequency, perceived importance of digital activity for CLIL subject learning, school and CLIL context characteristics, device access and use both at home and at school, perceived barriers to digital technology use, and beliefs about language use in CLIL classrooms.

For the purposes of the present analysis, five blocks of items were retained. First, demographic items captured age (recoded from the instrument's internal numeric coding into years, then grouped into three age bands: 9-12, 13-16, and 17-21 years, consistent with the original questionnaire response format), gender (female, male, other, prefer not to say), and the highest level of education attained by either parent (six ordered categories from primary to postgraduate doctoral education). Second, a 23-item extramural digital activity frequency scale (Q4.1 in the source instrument) asked learners how often they engaged with each of 23 digital activity types, including social media, multiplayer and single-player gaming, instant messaging, video and music streaming, virtual and augmented reality, artificial-intelligence-based applications, and free and paid educational applications, in their main CLIL language, using a five-point frequency scale ranging from 1 (never) to 5 ([almost] daily). Third, a nine-item device-use frequency scale (Q12.3) captured how often learners used nine categories of digital device, including mobile phones, tablets, laptop and desktop computers, games consoles, smartwatches, e-book readers, smart televisions, and smart home technologies, outside school, using an analogous five-point frequency scale. Fourth, a seven-item CLIL language-awareness scale (Q16.1), drawn from the CLILNetLE Working Group 1 item pool, captured learners' agreement with statements concerning subject-specific language use in CLIL classrooms (for example, that different subjects use language differently and that CLIL teachers encourage the use of authentic, expert-produced texts), rated on a five-point scale from 1 (strongly disagree) to 5 (strongly agree). Fifth, a set of dichotomous items (Q14.1) asked learners to classify each of twelve potential barriers to digital technology use, including limited access to devices, limited internet connectivity, limited digital skills, and school policy restrictions, as always, sometimes, or never a problem, both inside and outside school.

The instrument was administered in each country's main language(s) of schooling following forward translation and review by CLILNetLE national representatives, with English retained as the coordinating reference version. Prior to the substantive items, participants and, for younger participants, their parents or guardians, provided informed consent following the CLILNetLE research ethics protocol; participants could withdraw at any point by closing the survey window, and all responses were recorded anonymously with no identifying information collected.

Data Preparation

Country-level datasets were exported from Qualtrics as cleaned Excel files and merged into a single analytic file using a shared column structure, resulting in a working dataset of 533 cases and 423 variables prior to variable reduction. All 533 respondents had provided informed consent (Q1.3 = 1) and were retained in the analytic sample; no additional case-level exclusions were applied, since the underlying files were the project's cleaned analytic exports (Progress = 100 for the majority of cases, M = 90.60, SD = 21.92, with the small minority of partial completions reflecting item-level rather than section-level non-response, consistent with routing logic in the source instrument). Item-level missing data were handled using pairwise and listwise deletion as appropriate to each analysis; sample sizes for each statistical test are reported alongside the corresponding result, since planned comparisons and multivariate models required complete data on all variables entered into

a given model. Ordinal frequency and agreement items were treated as approximately interval for the purposes of composite scoring and parametric analysis, consistent with common practice in applied linguistics and educational psychology research using five-point Likert-type response formats.

Ethical Considerations

The DLSS project received ethical clearance through the coordinating institution's research ethics committee (University of Vienna) under the umbrella of COST Action 21114, and country-level data collection was additionally reviewed by national partner institutions in Ireland, Italy, and Türkiye in accordance with local ethical requirements for research involving minors. Since the sample included participants below the age of legal majority in all three countries, informed assent was obtained from student participants, and, where required by local school or institutional policy, informed consent was additionally obtained from parents or legal guardians prior to survey administration. Participation was voluntary, anonymous, and could be withdrawn at any point by closing the browser window without penalty; because responses were anonymous, individual withdrawal of previously submitted data was not technically possible, a limitation disclosed to participants in the survey's information sheet. No financial or academic incentives were offered for participation. All data were stored securely on the Qualtrics platform during the collection and initial cleaning phase, and the analytic files used in the present study contained no directly identifying information.

Data Analysis

All analyses were conducted using Python-based statistical computing packages (pandas, SciPy, statsmodels, factor_analyzer, and pingouin), which implement the equivalent estimation procedures conventionally associated with IBM SPSS Statistics, including principal-axis exploratory factor analysis, Cronbach's alpha reliability estimation, Welch-corrected one-way analysis of variance, Games-Howell post hoc pairwise comparisons, multivariate analysis of variance via Wilks' lambda, hierarchical ordinary least squares regression, and Pearson chi-square tests of association. The analytic strategy proceeded in five stages, corresponding to the four research questions.

To address RQ1, the dimensional structure of the 23-item extramural digital activity scale was examined using exploratory factor analysis with principal-axis extraction and promax (oblique) rotation, on the grounds that theoretically related dimensions of digital engagement were expected to correlate rather than remain orthogonal. Sampling adequacy was assessed using the Kaiser-Meyer-Olkin measure and Bartlett's test of sphericity, and the number of factors to retain was determined using the Kaiser criterion (eigenvalues greater than 1) in conjunction with interpretability of the resulting factor loading matrix. Internal consistency of the resulting subscales, together with the device-use and CLIL language-awareness scales, was assessed using Cronbach's alpha.

To address RQ2, composite subscale scores (unweighted item means) were computed for each extramural engagement dimension. Prior to conducting comparative tests, the homogeneity of variance assumption was examined using Levene's test for each dependent variable; because this assumption was violated in all three cases, Welch's F was used in place of the classical Fisher F statistic for the one-way country comparisons, and Games-Howell post hoc tests, which do not assume equal variances or equal sample sizes, were used for pairwise follow-up comparisons. Effect sizes are reported as partial eta-squared for the omnibus tests and as Hedges' g for pairwise comparisons.

To respond to RQ3, a two-way multivariate analysis of variance (Country x Gender, restricted to participants identifying as female or male owing to insufficient cell sizes for the remaining gender categories) was conducted on the three extramural engagement subscales jointly, using Wilks' lambda as the primary multivariate test statistic. In parallel, a hierarchical ordinary least squares regression model predicting educational-informational engagement was estimated in two steps: age, gender, and parental education were entered in Step 1, followed by country (dummy-coded, with Ireland as the reference category) in Step 2, allowing the incremental variance explained by country membership, over and

above individual-level demographic variables, to be quantified via the R-squared change and its associated F-change test. Variance inflation factors were inspected to rule out problematic multicollinearity among predictors. Pearson correlations among age, the three extramural engagement subscales, device-use frequency, and CLIL language awareness were computed to characterize the broader nomological network surrounding the engagement subscales.

To answer RQ4, a Pearson chi-square test of independence was used to examine whether the proportion of learners reporting a given digital access barrier as always a problem differed across the three countries, with Cramer's V reported as a measure of effect size. Across all inferential tests, statistical significance was evaluated at alpha = .05, and exact p values are reported except where p < .001.

Findings

Dimensional Structure and Reliability of the Extramural Digital Engagement Scale

Prior to factor extraction, the suitability of the 23-item extramural digital activity matrix for factor analysis was confirmed: the Kaiser-Meyer-Olkin measure of sampling adequacy was .94, comfortably exceeding the conventional .60 threshold, and Bartlett's test of sphericity was significant, chi2(253, N = 443) = 6631.55, p < .001, indicating that the item correlation matrix departed substantially from an identity matrix and was therefore suitable for factoring. Examination of the eigenvalue scree, presented in Table 2, revealed three eigenvalues exceeding the Kaiser criterion of 1.0 (10.26, 2.65, and 1.32 respectively), and a three-factor promax-rotated solution was retained on this basis.

The rotated factor loading matrix, summarised in Table 3, produced a clearly interpretable three-factor structure. The first factor was defined by high loadings from social media, instant messaging, video streaming, mobile phone-based applications, online video sharing, mobile photography, online music streaming, and online shopping items (loadings ranging from .54 to 1.00) and was labeled "Socio-Communicative and Entertainment Engagement." The second factor was defined by high loadings from online learning platforms, virtual and augmented reality, free and paid educational applications, e-book readers, artificial intelligence applications, e-textbooks, digital projectors and whiteboards, online courses, digital reading devices, and digital storytelling items (loadings ranging from .38 to .87) and was labeled Educational-Informational Engagement. The third factor was defined predominantly by multiplayer and single-player gaming items, together with a secondary loading from online forums and discussion boards (loadings ranging from .45 to .96) and was labeled "Digital Gaming Engagement." Together, the three factors accounted for 62.2% of the total variance in the item set (proportion of variance: Factor 1 = 26.8%, Factor 2 = 25.6%, Factor 3 = 9.8%), a level of explained variance that compares favorably with prior multidimensional extramural engagement scales (Uztosun & Sundqvist, 2025).

Internal consistency reliability was good to excellent across all three subscales. The nine-item Socio-Communicative and Entertainment Engagement subscale demonstrated a Cronbach's alpha of .93; the eleven-item Educational-Informational Engagement subscale demonstrated an alpha of .89; and the

Table 2: Sampling adequacy and eigenvalues for the exploratory factor analysis of the 23-item extramural digital engagement scale

Index	Value
Kaiser-Meyer-Olkin measure of sampling adequacy	0.94
Bartlett's test of sphericity, x^2	6631.55
df	253
p	< .001
Eigenvalue, Factor 1	10.26
Eigenvalue, Factor 2	2.65
Eigenvalue, Factor 3	1.32
Eigenvalue, Factor 4	0.85
Eigenvalue, Factor 5	0.81
Eigenvalue, Factor 6	0.72
Eigenvalue, Factor 7	0.65
N (listwise)	443

Note. Three factors were retained based on the Kaiser criterion (eigenvalues > 1.0) and interpretability of the rotated loading matrix. Only the first seven eigenvalues are shown for brevity.

Table 3. Promax-rotated factor loadings for the 23-item extramural digital engagement scale

Item	F1	F2	F3
Social Media	0.93	-0.19	0.02
Multiplayer	0.05	-0.20	0.96
Instant Messaging	0.88	-0.05	-0.04
Video Streaming	0.78	0.00	0.04
Phone-Based Apps	1.00	-0.15	-0.04
Online Video Sharing	0.77	-0.12	0.22
Learning Platform	0.22	0.38	0.01
VR	-0.05	0.60	0.21
Online Shopping	0.62	0.31	-0.05
Mobile Photography	0.75	0.16	-0.09
Digital Storytelling	0.25	0.43	0.18
Online Forums and Discussion Boards	0.08	0.40	0.45
Free Educational Apps	-0.23	0.73	0.12
Paid Educational Apps	-0.10	0.66	0.21
Online Music Streaming	0.90	-0.14	0.02
E-Book Reader	0.19	0.81	-0.20
Ai	0.19	0.41	0.21
E-Text Books	0.01	0.83	-0.19
Digital Projectors and Whiteboards	-0.19	0.86	-0.12
Single Player	-0.03	0.02	0.86
Online Courses	-0.08	0.83	0.05
Digital Reading Devices	0.11	0.87	-0.20

Note. F1 = Socio-Communicative and Entertainment Engagement (α = .93); F2 = Educational-Informational Engagement (α = .89); F3 = Digital Gaming Engagement (α = .80). Extraction method: principal-axis factoring; rotation method: promax. Loadings ≥ |.40| defining each factor are interpreted as salient. Proportion of variance explained: F1 = 26.8%, F2 = 25.6%, F3 = 9.8%; cumulative variance explained = 62.2%.

three-item Digital Gaming Engagement subscale demonstrated an alpha of .80. The full 23-item scale, treated as a unidimensional composite for reference purposes only, demonstrated an alpha of .94. The auxiliary nine-item extramural device-use scale demonstrated modest reliability (alpha = .59), likely reflecting the categorical, non-substitutable nature of the underlying devices (for example, owning a smartwatch does not preclude or require owning a games console), and results involving this composite are therefore interpreted cautiously. The seven-item CLIL language-awareness scale demonstrated acceptable reliability (alpha = .73).

Descriptive Comparison of Engagement Dimensions Across Countries

Table 4 presents descriptive statistics for the three extramural engagement subscales, the device-use composite, and the CLIL language-awareness composite, disaggregated by country. Visual inspection of the descriptive pattern suggested a consistent ordering across the three engagement dimensions, with Turkish learners reporting the highest mean engagement, followed by Italian learners, followed by Irish learners, a pattern most pronounced for Socio-Communicative and entertainment engagement (Ireland M = 1.81, SD = 1.34; Italy M = 3.18, SD = 1.00; Türkiye M = 3.94, SD = 0.74).

Table 4: Descriptive statistics for engagement and auxiliary composite scores by country

Variable	Ireland	Italy	Türkiye
Socio-Communicative& Entertainment Engagement	1.81 (1.34)	3.18 (1.00)	3.94 (0.74)
Educational-Informational Engagement	1.89 (1.00)	1.99 (0.76)	2.53 (0.98)
Digital Gaming Engagement	1.58 (1.15)	2.21 (1.21)	2.47 (1.28)
Extramural Device-Use Frequency	2.96 (0.71)	2.84 (0.62)	2.54 (0.87)
CLIL Language Awareness	3.54 (0.61)	3.56 (0.63)	3.84 (0.79)

Note. Values are M (SD). All composites were scored on a five-point scale (1 = never/strongly disagree, 5 = [almost] daily/strongly agree). Sample sizes vary by variable owing to listwise deletion of missing items; see Table 5 for exact n per comparison.

Country Differences in Extramural Engagement

Since Levene's tests indicated significant heterogeneity of variance across the three country groups for all three engagement subscales (Socio-Communicative and Entertainment Engagement: $F(2, 521) = 6.60$, $p = .001$; Educational-Informational Engagement: $F(2, 503) = 4.19$, $p = .016$; Digital Gaming Engagement: $F(2, 514) = 11.30$, $p < .001$), Welch-corrected one-way analyses of variance were used in place of classical ANOVA for all three omnibus comparisons, with Games-Howell post hoc tests used for pairwise follow-up. Results are summarized in Table 5.

For socio-communicative and entertainment engagement, the omnibus Welch test was significant and the associated effect size was large, $F(2, 267.15) = 137.46$, $p < .001$, partial eta-squared = .38. Games-Howell comparisons indicated that all three pairwise differences were significant: Turkish learners reported significantly higher engagement than Italian learners (Hedges' $g = 0.86$, $p < .001$), Italian learners reported significantly higher engagement than Irish learners (Hedges' $g = 1.20$, $p < .001$), and the Ireland-Türkiye contrast was the largest observed in the study (Hedges' $g = 2.11$, $p < .001$).

For educational-informational engagement, the omnibus Welch test was significant with a small-to-moderate effect size, $F(2, 266.62) = 22.31$, $p < .001$, partial eta-squared = .09. Games-Howell comparisons indicated that Irish and Italian learners did not differ

Table 5: Welch One-Way Analyses of Variance and Games-Howell Post Hoc Comparisons for Engagement Subscales by Country

Subscale / Comparison	F	df1	df2	p
Socio-Communicative & Entertainment Engagement	137.46	2	267.15	<.001
Ireland vs. Italy (Hedges' g = 1.20)				<.001
Ireland vs. Türkiye (Hedges' g = 2.11)				<.001
Italy vs. Türkiye (Hedges' g = 0.86)				<.001
Educational-Informational Engagement	22.31	2	266.62	<.001
Ireland vs. Italy (Hedges' g = 0.11)				0.648
Ireland vs. Türkiye (Hedges' g = 0.64)				<.001
Italy vs. Türkiye (Hedges' g = 0.62)				<.001
Digital Gaming Engagement	20.49	2	300.79	<.001
Ireland vs. Italy (Hedges' g = 0.54)				<.001
Ireland vs. Türkiye (Hedges' g = 0.72)				<.001
Italy vs. Türkiye (Hedges' g = 0.20)				0.112

Note. Welch's F used because Levene's test indicated unequal variances for all three subscales (F1: $F(2, 521) = 6.60$, $p = .001$; F2: $F(2, 503) = 4.19$, $p = .016$; F3: $F(2, 514) = 11.30$, $p < .001$). Partial eta-squared: F1 = .384 (large), F2 = .089 (small-to-moderate), F3 = .070 (small). Post hoc comparisons used the Games-Howell procedure, which does not assume equal variances or sample sizes.

significantly from one another (Hedges' g = 0.11, p = .648), whereas Turkish learners reported significantly higher educational-informational engagement than both Irish learners (Hedges' g = 0.64, p < .001) and Italian learners (Hedges' g = 0.62, p < .001).

For digital gaming engagement, the omnibus Welch test was significant with a small effect size, F(2, 300.79) = 20.49, p < .001, partial eta-squared = .07. Games-Howell comparisons indicated that Irish learners reported significantly lower gaming engagement than both Italian learners (Hedges' g = 0.54, p < .001) and Turkish learners (Hedges' g = 0.72, p < .001), while the Italy-Türkiye contrast did not reach significance (Hedges' g = 0.20, p = .112).

Taken together, this pattern indicates that country differences were most pronounced, and most consistently ordered (Ireland < Italy < Türkiye) for socio-communicative and entertainment activity, whereas country differences in gaming were driven primarily by the contrast between the Irish sample and the other two countries, and country differences in educational-informational engagement were driven primarily by the distinctiveness of the Turkish sample relative to both European comparison countries.

These comparisons describe differences associated with country membership. They do not establish that country itself, independent of age, educational stage, and sample composition, caused the observed differences. This distinction is addressed directly in the Discussion.

Joint and Interactive Effects of Country, Gender, and Demographic Predictors

A two-way multivariate analysis of variance was conducted on the three engagement subscales jointly, with country (Ireland, Italy, Türkiye) and gender (Female, Male) as between-subjects factors (N = 487 participants identifying as female or male with complete data on all three subscales). The overall model intercept was significant, Wilks' lambda = .65, F (3, 479) = 86.97, p < .001, confirming non-zero mean engagement levels. The main effect of Country was significant and substantial, Wilks' lambda = .69, F (6, 958) = 32.13, p < .001, consistent with the univariate results reported above. The main effect of Gender was not significant, Wilks' lambda = .998, F (3, 479) = 0.31, p = .821, indicating that, averaged across countries, female and male learners did not differ appreciably in their overall pattern of extramural digital engagement. Critically, the Country by Gender interaction was significant, Wilks' lambda = .94, F (6, 958) = 4.89, p < .001, indicating that the association between gender and engagement was not uniform across countries; the absence of a main effect for gender should therefore not be read as evidence that gender is unrelated to engagement within specific national contexts, but rather that any gender association is contingent on country. Full results are presented in Table 6.

Table 7 presents the Pearson correlation matrix among age, the three engagement subscales, device-use frequency, and CLIL language awareness (N = 361 with complete data on all six variables). Age correlated most strongly with Socio-Communicative and Entertainment Engagement (r = .51, p < .001) and more modestly with Educational-Informational Engagement (r = .28, p < .001) and Digital Gaming Engagement (r = .24, p < .001). The three engagement subscales were positively intercorrelated with one another (r ranging from .55 to .66, all p < .001), consistent with the oblique promax rotation used in the exploratory factor analysis and indicating

Table 6. Two-way multivariate analysis of variance: country x gender on the three extramural engagement subscales

Effect	Wilks' Λ	df (hyp.)	df (error)	F	p
Intercept	0.647	3	479	86.97	<.001
Country	0.693	6	958	32.13	<.001
Gender	0.998	3	479	0.31	0.821
Country x Gender	0.941	6	958	4.89	<.001

Note. N = 487 (participants identifying as female or male with complete data on all three subscales). Dependent variables: Socio-Communicative & Entertainment, Educational-Informational, and Digital Gaming Engagement, entered jointly.

that learners who engage more with one dimension of extramural digital activity also tend to engage more with the others, without the dimensions being redundant. Device-use frequency correlated weakly and inconsistently with the engagement subscales, and negatively with age (r = -.13, p = .013), suggesting that older learners in this sample used a narrower range of discrete devices, a plausible pattern given the consolidation of functionality onto smartphones among older adolescents. CLIL language awareness correlated significantly, but weakly, only with Educational-Informational Engagement (r = .14, p = .007).

To further probe the individual-level predictors of Educational-informational engagement, a hierarchical ordinary least squares regression was estimated (N = 398 participants identifying as female or male with complete data on all predictors). In Step 1, age, gender, and parental education were entered as predictors; this model was significant, F(3, 394) = 7.43, p < .001, R-squared = .054, with age emerging as the only significant individual predictor (B = 0.070, SE = 0.016, p < .001); gender (B = -0.050, p = .595) and parental education (B = -0.004, p = .917) were non-significant. In Step 2, country was entered as a set of dummy-coded predictors (Ireland as reference); this model was significant, F(5, 392) = 6.61, p < .001, R-squared = .078, representing a significant increment over Step 1, R-squared change = .024, F change (2, 392) = 5.15, p = .006. In the full model, age remained a significant predictor (B = 0.046, SE = 0.019, p = .016); the Türkiye dummy approached but did not reach conventional significance (B = 0.273, SE = 0.165, p = .099), and the Italy dummy was non-significant (B = -0.125, SE = 0.133, p = .349); gender and parental education remained non-significant throughout. Variance inflation factors for all predictors in the final model ranged from 1.08 to 3.05, well below conventional thresholds for problematic multicollinearity (typically 5 or 10), indicating that the moderate correlation between age and country membership did not compromise the stability of the regression coefficients. Full regression results are presented in Table 8.

Cross-National Differences in Digital Access Barriers

Table 9 presents the cross-tabulation of country by whether learners classified limited access to technology and devices outside school as always a problem. A Pearson chi-square test indicated a significant association, chi2(2, N = 533) = 30.52, p < .001, Cramer's V = .24, representing a small-to-moderate effect. Turkish learners were substantially more likely to report this barrier as always present (23.3% of the Turkish sample) than either Italian learners (7.4%) or Irish learners (5.6%). A parallel test examining limited internet connectivity at school did not reach significance, chi2(2, N = 533) = 3.95, p = .139, indicating that the cross-national disparity in access barriers was more pronounced for extramural, home-based access than for school-based connectivity.

Discussion

The present study examined the dimensional structure of extramural digital engagement among CLIL learners. It compared engagement levels across three structurally distinct national contexts. It modelled the joint and interactive contribution of demographic variables and country membership.

Table 7: Pearson Correlations among age, extramural engagement subscales, device-use frequency, and CLIL language awareness

Variable	1	2	3	4	5	6
1. Age	—					
2. Socio-Comm.	0.51***	—				
3. Educ.-Inform.	0.28***	0.58***	—			
4. Gaming	0.24***	0.55***	0.66***	—		
5. Device Use	-0.13*	-0.05	0.12*	0.08	—	
6. CLIL Awareness	0.09	0.08	0.14**	0.08	-0.03	—

Note. N = 361 (listwise). *p < .05. **p < .01. ***p < .001.

Table 8. Hierarchical regression predicting educational-informational engagement from demographic variables and country

Predictor	B	SE	t	p
Step 1				
Intercept	1.020	0.343	2.978	0.003
Age	0.070	0.016	4.379	<.001
Gender (male = 1)	-0.050	0.094	-0.532	0.595
Parental education	-0.004	0.035	-0.105	0.917
Step 2				
Intercept	1.242	0.346	3.583	<.001
Italy (vs. Ireland)	-0.125	0.133	-0.938	0.349
Türkiye (vs. Ireland)	0.273	0.165	1.656	0.099
Age	0.046	0.019	2.419	0.016
Gender (male = 1)	0.025	0.096	0.264	0.792
Parental education	0.029	0.036	0.787	0.432

Note. N = 398. Step 1: R^2 = .054, F (3, 394) = 7.43, p < .001. Step 2: R^2 = .078, ΔR^2 = .024, F change (2, 392) = 5.15, p = .006, F (5, 392) = 6.61, p < .001. Variance inflation factors in the final model ranged from 1.08 to 3.05, indicating no problematic multicollinearity.

Table 9: Reported digital access barriers ("always a problem") by country: limited access to technology outside school

Response	Ireland n (%)	Italy n (%)	Türkiye n (%)	Total N
Always a problem	7 (5.6)	16 (7.4)	45 (23.3)	68
Not always a problem	117 (94.4)	200 (92.6)	148 (76.7)	465

Note. N = 533. $x^2(2)$ = 30.52, p < .001, Cramer's V = .24. A parallel test for limited internet connectivity at school was non-significant, $x^2(2)$ = 3.95, p = .139.

It compared cross-national experiences of digital access barriers. Each aim is discussed in turn. The study's originality, significance, and limitations are considered afterward.

A Three-Dimensional Structure for Extramural Digital Engagement in CLIL

The exploratory factor analysis yielded a clean, interpretable three-factor solution. The three factors were socio-communicative and entertainment engagement, educational informational engagement, and digital gaming engagement. Together they explained a substantial proportion of item variance. All three subscales showed good to excellent reliability. This structure converges closely with the factor solution reported by Uztosun and Sundqvist (2025) in their development of a dedicated extramural English engagement scale for Turkish learners. In that study, social interactive and entertainment-oriented items, likewise, were separated from more deliberately educational items. Two independently derived factor structures now converge on the same basic distinction. One was developed specifically to measure extramural English engagement. The other emerged from a broader CLIL digital literacies instrument not originally designed around factor-analytic assumptions. This convergence lends validity to a central claim of the present theoretical framework. Extramural digital engagement is not a unidimensional construct. It comprises at least a socio-communicative and an educational/informational dimension. These dimensions behave differently in relation to learner and contextual variables, consistent with Zhang et al.'s (2021) finding that activity type, not raw exposure time, best predicts language learning outcomes.

The emergence of gaming as a distinct third dimension is also consistent with theory. Gaming was separated from both social communicative and educational engagement in the present data. This matches the specialized body of research on incidental vocabulary acquisition through gameplay (Soyoof et al., 2022; Wu et al., 2025). That research treats gaming as a qualitatively distinct mode of language exposure. Gaming is characterized by interactivity, goal directedness, and repeated exposure to specialized lexical fields. It is not simply a subtype of general entertainment or deliberate educational activity. The immersive and often narrative-rich nature of gaming environments may also explain why gaming engagement, like educational informational engagement, showed only a modest association with age in the present data, unlike the much stronger age association observed for socio-communicative and entertainment engagement.

Cross-National Variation in Engagement: Infrastructure, Culture, Or Measurement Artefact

Before turning to substantive interpretation, a central caution should be restated. The three national samples differ considerably in age, educational stage, and gender composition. The interpretations that follow should be read as exploratory accounts of associated patterns, not as demonstrations that country alone caused the observed differences. The observed cross-national ordering invites several interpretations. Turkish learners reported the highest levels of engagement across all three dimensions. Italian learners followed, then Irish learners. One interpretation, grounded in digital divide theory, would predict the opposite pattern. Türkiye has been documented as facing greater infrastructural digital divide challenges than Ireland or Italy (van Kessel et al., 2022; van Dijk, 2020). Turkish learners nonetheless reported the highest engagement levels. They also reported significantly more frequent access barriers, discussed in section 6.4. This suggests that engagement intensity and access adequacy are empirically dissociable constructs. Learners can be highly engaged with digital technology while simultaneously experiencing meaningful barriers to that engagement. This pattern echoes van Dijk's (2020) resources and appropriation theory directly. Raw engagement or usage intensity does not straightforwardly index the quality or reliability of underlying access (van Deursen & van Dijk, 2019).

A second interpretation concerns the substantial age confound between country and engagement. The Turkish sample was concentrated overwhelmingly in the 17 to 21-year age band. The Irish sample was concentrated in the 13 to 16-year band. Age correlated strongly with socio-communicative and entertainment engagement in particular ($r = .51$). A meaningful proportion of the apparent country effect on this dimension is very likely attributable to the older average age of the Turkish sample. This interpretation is partially, though not fully, supported by the regression analysis. Age remained a robust predictor of educational informational engagement even after the country was entered. The incremental contribution of the country was comparatively modest (R-squared change = .024), and the Türkiye coefficient did not reach conventional significance once age was controlled. For educational informational engagement specifically, age appears to operate as a more proximal predictor than country membership. The much larger and more robust country effect observed for socio-communicative engagement is less easily reduced to age alone. Its effect size, partial eta squared = .38, considerably exceeds what the zero-order age correlation would predict in isolation.

A third interpretation draws on CLIL implementation maturity, consistent with the theoretical framework outlined in section 2.1. In an emergent CLIL context such as Ireland's, learners' identification of a single, salient main CLIL language for extramural activity may be less consolidated than in Italy's long-established system or Türkiye's rapidly expanding provision. This could depress reported extramural engagement in that specific language, even where general digital engagement remains high. This interpretation cannot be tested directly with the present data. It offers a plausible avenue for future research combining the present instrument with independent measures of CLIL program intensity and learners' subjective language dominance.

The Role of Gender and Its Dependence on National Context

The absence of a significant main effect for gender, combined with a significant country-by-gender interaction, is one of the more theoretically interesting findings of this study. Much of the existing literature on gender and digital engagement, particularly gaming, has reported consistent, if moderate, gender differences favoring male engagement. The present finding qualifies this literature. Gender differences were not uniform across countries. They were contingent on national context. This cautions against generalizing gender engagement associations documented in a single national sample to CLIL learner populations more broadly. It also echoes a broader concern in CLIL research that classroom and extramural conditions can foster unequal opportunities for different learner subgroups rather than a uniformly beneficial experience (Llinares & Evnitskaya, 2021). Self-determination theory offers one possible explanation (Ryan & Deci, 2000). Autonomy supportive contexts may differ by country in ways that interact with gendered patterns of technology access at home, though this remains speculative given the present data. Given the pronounced gender imbalance in the Turkish sample, specifically 74.1% female, the interaction should be interpreted with caution. It is best treated as a hypothesis for confirmation in more gender-balanced future samples.

Digital Access Barriers as a Distinct Construct from Engagement Intensity

Turkish learners were both the most digitally engaged and the most likely to report persistent, extramural access barriers. This dissociation underscores a point increasingly emphasized in digital divide theorizing. Engagement intensity, access adequacy, and digital skill are analytically distinct constructs (van Dijk, 2020; van Deursen & van Dijk, 2019; van Kessel et al., 2022). They need not covary in the direction that infrastructural indicators alone would predict. This dissociation is consistent with independent evidence on Turkish English language teachers, whose digital technology integration has been shown to vary considerably even under conditions of enforced remote instruction, suggesting that access constraints and engagement patterns can diverge sharply within the same national system (Demirkol Orak, 2023; Demirkol Orak & Alagözlü, 2025). From a CLIL pedagogical perspective, this dissociation carries a practical implication. Even highly digitally engaged CLIL learners may be operating under access constraints. These constraints can limit the reliability, and potentially the pedagogical value, of their extramural digital practice. This is an important caveat for CLIL teachers and curriculum designers. High self-reported engagement should not be read as evidence of unconstrained digital opportunity.

Pedagogical Implications

The findings carry several implications for CLIL pedagogy and teacher education. Educational informational engagement was consistently the least frequent of the three extramural dimensions across all three countries. Prior evidence shows that extramural and in-school CLIL exposure contribute additively to learner proficiency (Lázaro-Ibarrola, 2024, 2025). CLIL teachers may find value in explicitly scaffolding learners' extramural engagement with educational digital informational resources in the CLIL language. Teachers could curate subject-relevant online courses, AI assisted study tools, or digital reading material. They should not assume that learners' generally high socio-communicative digital engagement will transfer spontaneously to subject-specific language development. This kind of scaffolding echoes classroom research showing that CLIL learners' subject-specific vocabulary develops most reliably through sustained, structured exposure rather than incidental contact alone (Rieder-Bünemann et al., 2022). Reported classroom practice, however, is not always consistent even within a single national system (Bauer-Marschallinger et al., 2023), which suggests that any digital scaffolding strategy will need to be adapted to considerable within-country variation in teacher practice, not only to the cross-country differences documented here. Coyle and Meyer's (2021) pluriliteracies model offers a ready-made pedagogical vocabulary for this scaffolding work, since it already treats multimodal, including digital, meaning-making as central to deeper CLIL learning. The persistence of significant access barriers among a

substantial minority of Turkish learners suggests that any pedagogical strategy relying on extramural digital engagement should incorporate in-school alternatives or device-lending provisions for learners facing structural access constraints. This is consistent with broader digital equity recommendations in the CLIL literature (Hüttner et al., 2026) and with van Dijk's (2020) argument that technological, educational, and social interventions must work together to close second and third level digital divides. These suggestions remain tentative. They are derived from self-reported engagement patterns rather than from direct observation of classroom practice or learning outcomes, and they should be tested through classroom based research before being adopted as firm recommendations.

Implications for the CLILnetLe Network and CLIL Teacher Education

Beyond classroom level pedagogy, the present findings carry implications for the CLILNetLE network's broader agenda. This agenda characterizes and supports bi and multilingual disciplinary literacies across member countries. The network's own conceptual work has argued for including a technological digital dimension alongside more established linguistic and semiotic dimensions of CLIL competence (Hüttner et al., 2026). The present findings offer empirical substance to that conceptual argument. The technological digital dimension is itself internally differentiated. It is unevenly distributed across member countries. CLIL teacher education programs operating within or alongside the CLILNetLE network may benefit from incorporating explicit training. Teachers should learn to recognize and pedagogically scaffold the socio-communicative, educational informational, and gaming-related digital practices that learners bring into the classroom. Digital competence should not be treated as a generic, undifferentiated add-on to existing CLIL methodology. Survey evidence collected across the wider CLILNetLE network suggests that CLIL provision in most participating countries continues to privilege written and oral language skills over multimodal or digitally mediated practices (Nikula et al., 2026). The comparatively low educational informational engagement observed across all three countries in the present sample, relative to socio-communicative engagement, may reflect a genuine mismatch. Learners' extramural digital literacies may not align with those most actively cultivated in CLIL classrooms. These are proposed as tentative directions for the network to consider, not as findings about actual classroom practice, since the present data do not include direct observation of teaching.

The cross-national differences documented here also carry implications for how the CLILNetLE network designs and interprets future cross-country data collection. The significant country-by-gender interaction, together with the substantial confound between country and age composition, suggests that future network-wide surveys would benefit from harmonized, stratified sampling targets. Comparable age band and gender quotas across participating countries would allow cleaner disentangling of country, cohort, and gender effects than was possible with the present convenience-based samples. Such methodological refinement would strengthen the network's capacity to draw robust, comparative conclusions about digital literacies' development across its diverse membership. This membership spans long-established Western European CLIL systems, emergent contexts such as Ireland, and rapidly expanding contexts such as Türkiye.

Limitations and Future Research

Several limitations qualify the interpretation of the present findings. First, and most importantly, the cross-sectional design precludes causal inference regarding the direction of any association between extramural digital engagement and CLIL outcomes. The present study did not include an independent measure of language or content proficiency. Future research combining the present instrument with standardized proficiency assessment would allow the engagement proficiency relationships implied by the broader literature to be tested directly (Lázaro-Ibarrola, 2024, 2025; Zhang et al., 2021).

Second, the substantial co-found between country and age composition means that country effects reported here should be interpreted as country and cohort effects, not as pure national or cultural effects. Future cross-national CLIL research would benefit from age-stratified or age-matched

sampling designs. Multilevel modeling approaches, capable of partitioning variance attributable to age, cohort, and country simultaneously, would also help once a larger number of countries and a larger sample per age band become available. The three national samples also differed in gender composition and in the range and duration of CLIL subjects studied, as reported in section 3.2. Because these variables were not statistically controlled in the primary models, the reported country and gender effects should be interpreted with considerable caution and should not be attributed to national context alone.

Third, the purposive, network-based sampling strategy common to COST Action data collection means that the three national samples cannot be assumed to be representative of their respective national CLIL learner populations. Replication using probability-based or nationally representative sampling frames would strengthen generalizability.

Fourth, the modest reliability of the auxiliary device use composite, $\alpha = .59$, suggests that this measure should be refined or replaced with device-specific items in future applications of the instrument.

Fifth, the marked gender imbalance within the Turkish sample limits confidence in the generalizability of the observed country-by-gender interaction. Future research should prioritize gender-balanced recruitment to test whether this interaction replicates.

Finally, the present analysis relied on self-report frequency and importance ratings. Common method variance cannot be ruled out as a partial explanation for the observed intercorrelations among engagement subscales. Future work incorporating behavioral or platform-derived engagement indicators alongside self-report measures and explicit measures of the L2 Motivational Self System (Dörnyei & Ushioda, 2021) and perceived autonomy support (Ryan & Deci, 2000) would help triangulate and extend the present findings.

Conclusion

Extramural digital engagement among CLIL learners is best understood as a multidimensional construct. It comprises socio-communicative and entertainment, educational and informational, and gaming-related components. It varies substantially, though not uniformly, across national contexts differing in CLIL implementation maturity and digital infrastructure. The present study makes three original contributions. First, it provides, to the authors' knowledge, the first empirical test of a multidimensional extramural digital engagement structure administered using a single common instrument across CLIL learners in three distinct national contexts simultaneously. This moves beyond the indirect, cross-study comparisons that have characterized the extramural learning literature to date. The clean, three-factor structure obtained here converges with an independently developed Turkish extramural English scale (Uztosun & Sundqvist, 2025). This offers a degree of cross-context measurement validation not previously demonstrated for CLIL specific extramural engagement research. Second, the study extends the empirical base of extramural learning research beyond its traditional concentration in Northern European, East Asian, and English as target language contexts (Liu, 2024; Uztosun & Sundqvist, 2025). It offers evidence directly relevant to the substantial and growing population of CLIL learners in emergent and rapidly expanding implementation contexts. These populations have been comparatively neglected in the extramural learning literature. Third, by jointly modeling country, age, gender, and parental education within a unified multivariate and regression framework, and by testing and finding a significant country by gender interaction, the study shows that simple, single-predictor accounts of extramural engagement variation are inadequate. Future research and pedagogical intervention should anticipate context-dependent, rather than universal, demographic patterning of digital engagement. Collectively, these contributions offer an original, theoretically informed description of how extramural digital engagement varies across differently positioned CLIL learner populations. The present findings should be read as a preliminary empirical contribution. They measure learners' self-reported extramural engagement. They do not measure CLIL pedagogy, classroom practice, or language learning outcomes directly. The study therefore offers indirect support for the technological digital dimension proposed within CLIL theory (Hüttner et al., 2026), rather than a direct test

of CLIL learning processes. Its main contribution lies in showing that engagement, motivation, and access can be studied jointly within CLIL research, using CLIL theory (Coyle et al., 2010; Coyle & Meyer, 2021; Hüttner et al., 2026), motivational theory (Dörnyei & Ushioda, 2021; Ryan & Deci, 2000), and digital divide theory (van Dijk, 2020; van Deursen & van Dijk, 2019) within a single empirical design.

Using data from 533 CLIL learners in Ireland, Italy, and Türkiye collected within COST Action 21114, the present study demonstrated that country membership was associated with large differences in socio-communicative engagement. More modest differences emerged for educational, informational, and gaming engagement. A significant interaction with gender cautions against generalizing demographic patterns across national contexts. Turkish learners emerged as both the most digitally engaged and the most likely to report persistent barriers to extramural digital access. This underscores the analytic distinction between engagement intensity and access adequacy, a distinction predicted directly by van Dijk's (2020) resources and appropriation theory. These findings extend extramural language learning research to previously underrepresented CLIL populations. These country-level differences were accompanied by substantial differences in age, educational stage, and gender composition across the three samples, and they should not be attributed to national context alone.

They also offer preliminary, indirect support for the technological digital dimension that CLILNetLE's conceptual work has proposed (Hüttner et al., 2026), though this study examined learners' self-reported engagement rather than CLIL pedagogy or classroom learning outcomes directly. Any pedagogical recommendation drawn from these findings should therefore be treated as tentative, pending direct classroom-based evidence. The present study nonetheless offers a cautious, empirically grounded starting point for context-sensitive, rather than universal, approaches to integrating learners' extramural digital lives into CLIL pedagogy.

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