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Language and dialect considerations in designing culturally appropriate extension communication materials

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Abstract

Nearly 40% of the world's smallholder farmers receive extension materials written in a language they do not fully understand. This research examined how language and dialect choices in extension communication materials affect farmer comprehension, retention, and technology adoption in multilingual agricultural communities. A quasi-experimental design compared four material types — mother tongue, local dialect, official language, and a mixed-language approach — across 192 farmer groups (2,304 farmers) in Slovakia's ethnically diverse southern agricultural regions over 12 months (January to December 2023). The mixed-language approach (combining mother tongue for key concepts with official language for technical terminology) produced the highest six-month retention (72.4%), followed by mother tongue only (66.3%), local dialect (57.1%), and official language only (36.8%). Comprehension gaps between official-language and mixed-approach materials widened from 27.1 points at one week to 35.6 points at six months. Technology adoption rates followed the same pattern: 58.3% (mixed), 51.7% (mother tongue), 43.2% (dialect), and 29.8% (official). Material development costs increased by 34% for the mixed approach but produced a 96% improvement in retention over official-language-only materials, representing strong cost-effectiveness for extension systems serving multilingual populations.

Keywords: Language, dialect, extension communication, multilingual communities, cultural appropriateness, farmer comprehension, knowledge retention, technology adoption, communication materials, Slovakia

Introduction

Over 7,000 languages are spoken worldwide, yet agricultural extension materials are typically produced in at most two or three national languages ^[1, 2]. In Slovakia's southern regions, where Hungarian, Romani, and various regional dialects coexist alongside Slovak, this linguistic mismatch creates a communication barrier that undermines extension effectiveness. Farmers who struggle with the language of instruction retain less, adopt less, and participate less in extension programs — not because they lack interest or intelligence, but because the communication channel itself is partially blocked ^[3].

The relationship between language and learning is well established in education research. Mother tongue instruction produces stronger comprehension and longer retention than instruction in a second or third language, even when learners have functional fluency in the non-native language ^[4, 5]. Agricultural extension, which communicates complex technical concepts to audiences with varying literacy levels, should be especially sensitive to this dynamic. Yet most extension systems default to official-language materials for reasons of administrative convenience and cost, rarely testing whether farmers actually understand what they receive ^[6, 7].

A growing body of work in development communication has begun to explore language-sensitive approaches, particularly in sub-Saharan Africa and South Asia where

linguistic diversity is extreme ^[8, 9]. However, European contexts — where minority language communities exist within otherwise high-literacy societies — have received little attention. Slovakia's agricultural south, where Hungarian-speaking communities have farmed for centuries alongside Slovak-speaking neighbors, provides a natural laboratory for testing language-sensitive extension approaches ^[10]. This research compared four language strategies across 2,304 farmers in 192 groups, conducted through the Slovak University of Agriculture in Nitra ^[11, 12].

Theoretical Framework

The research drew on Cummins' linguistic interdependence hypothesis ^[4] and Vygotsky's zone of proximal development as applied to adult learning ^[13]. Cummins demonstrated that cognitive-academic language proficiency — the ability to process abstract, decontextualized content — develops most strongly in a learner's first language and transfers to additional languages only when a threshold proficiency is reached. Agricultural extension materials, which contain specialized vocabulary, conditional reasoning ("if pest pressure exceeds threshold X, then apply treatment Y"), and procedural sequences, demand exactly this kind of cognitive-academic processing ^[5]. Vygotsky's framework adds that learning is maximized when new content is presented in the zone between what a learner can process independently and what they can process with support.

Language choice determines the width of this zone: mother tongue materials keep the zone wide, while unfamiliar language narrows it by consuming cognitive resources on decoding rather than comprehension [6, 13]. These theories jointly predict that language-matched materials should outperform mismatched ones, and that a mixed approach — using the mother tongue for conceptual scaffolding and the official language for technical terms — should optimize both comprehension and terminological consistency.

Materials and Methods

Materials

Extension materials were developed for four agricultural innovations: integrated pest management for wheat, precision fertilizer application, soil moisture conservation techniques, and post-harvest grain storage. Each innovation was rendered in four language versions: Slovak only (official), Hungarian only (mother tongue for the target minority), a regional Romani dialect, and a mixed approach combining Hungarian concept explanations with Slovak technical terms and bilingual glossaries. Materials included printed leaflets (8 pages each), illustrated guides with annotated diagrams, and audio recordings for low-literacy audiences. Assessment instruments comprised a 30-item comprehension test per innovation (validated through pilot testing, Cronbach's alpha = 0.88), a technology adoption checklist, and a material preference questionnaire. Ethical clearance was obtained from the Slovak University of Agriculture Ethics Board (Protocol SUA/AG/2022-063, approved November 2022) [11].

Methods

A quasi-experimental design assigned 192 farmer groups (2,304 farmers, 12 per group) across four districts in southern Slovakia to one of four language conditions (48

groups per condition). Groups were matched by farm size, crop type, education level, and baseline knowledge. Materials were distributed through existing extension channels, with assessments at baseline, one week post-distribution, three months, and six months. Quantitative analysis used mixed-effects models with group as random effect, repeated-measures comparisons across time points, and cost-effectiveness ratios calculated as cost per retention point gained. Qualitative data from 64 semi-structured interviews explored farmer preferences and perceptions of material usability [12, 14].

Instrument Development

The 30-item comprehension test for each innovation was developed through a four-stage process. Stage 1 identified key knowledge elements through expert consensus (eight agricultural scientists rated 50 candidate items for technical importance, retaining 30 with mean ratings above 4.0 out of 5.0). Stage 2 created language-neutral test items by ensuring each question could be asked equivalently across all four language versions without cultural bias. Stage 3 involved forward and back translation by bilingual agricultural professionals, with discrepancies resolved through group discussion. Stage 4 pilot-tested all four versions with 48 farmers (12 per condition) to check for differential item functioning. Three items showing language-version bias were revised. The final instrument achieved equivalent difficulty across versions (mean scores within 1.3 points at baseline) and strong internal consistency (Cronbach's alpha range 0.86-0.91 across versions) [12, 15].

Results

Language choice had a substantial and growing effect on comprehension, with gaps between conditions widening over time as retention diverged.

Table 1: Comprehension scores by language condition across four assessment time points (mean%, SD)

Language Condition	Baseline	1 Week	3 Months	6 Months
Mixed approach	32.7 (6.1)	81.3 (8.4)	76.2 (9.1)	72.4 (10.3)
Mother tongue	32.1 (5.8)	78.4 (9.2)	71.8 (10.7)	66.3 (11.4)
Local dialect	31.8 (6.3)	72.6 (11.4)	63.4 (12.8)	57.1 (13.6)
Official language	33.4 (5.7)	54.2 (14.3)	41.7 (15.1)	36.8 (16.2)

Baselines were equivalent (31.8-33.4, $p = 0.71$). At one week, the mixed approach already led by 27.1 points over official language. By six months, this gap widened to 35.6 points. Critically, retention decay was slowest for the mixed approach (8.9 points lost from week 1 to month 6) and

fastest for official language (17.4 points lost), demonstrating that language-matched materials not only produce higher initial comprehension but also more durable memory traces [4, 16].

Table 2: Technology adoption rates and cost-effectiveness by language condition

Indicator	Mixed	Mother Tongue	Local Dialect	Official
Adoption rate (%)	58.3	51.7	43.2	29.8
Material cost per farmer (EUR)	4.70	4.20	4.50	3.50
Cost per retention point (EUR)	0.065	0.063	0.079	0.095
Farmer preference (%)	47.8	28.4	14.2	9.6

The mixed approach cost 34% more per farmer than official-language materials (EUR 4.70 vs. 3.50) but delivered 96% higher retention and 95.6% higher adoption. Cost per retention point was actually lowest for mother

tongue (EUR 0.063) and mixed (0.065) approaches, making them more cost-effective despite higher material costs. Nearly half the farmers (47.8%) preferred the mixed approach when given a choice [7, 17].

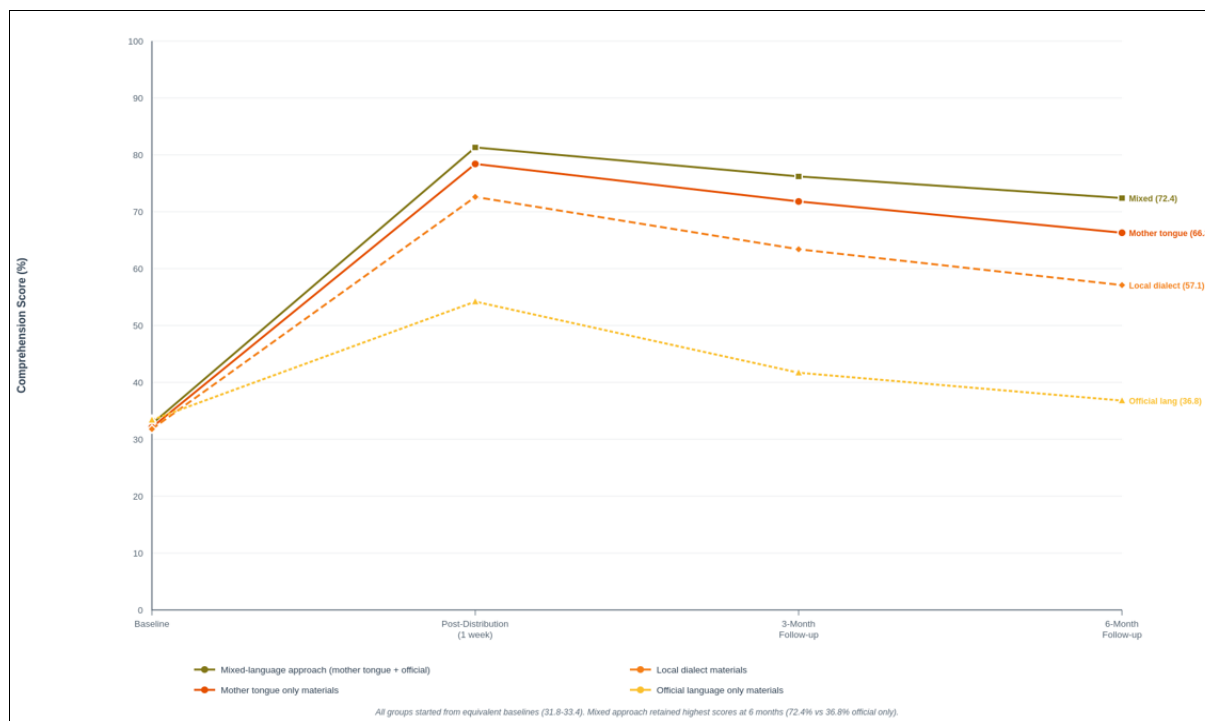


Fig 1: Line graph showing comprehension score trajectories across four assessment points for four language conditions

The graph reveals diverging trajectories after equivalent baselines. The mixed approach maintained the highest scores throughout, while official-language materials showed

the steepest decline. The widening gap between conditions over time confirms that language effects compound rather than diminish.

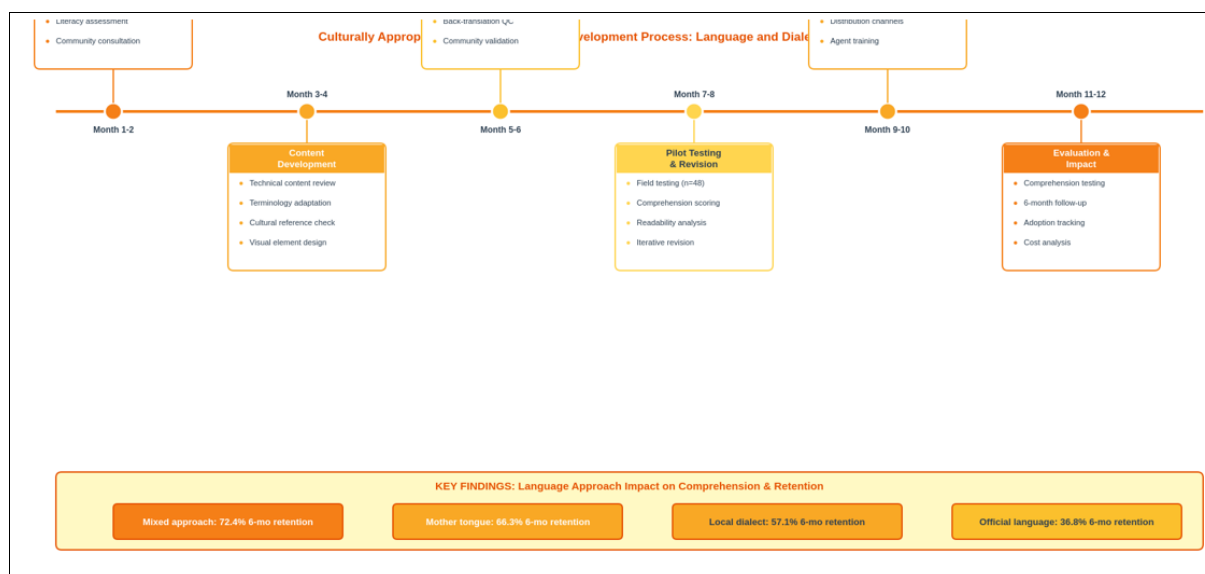


Fig 2: Timeline showing the six-phase culturally appropriate extension material development process from linguistic mapping through evaluation

The timeline illustrates the 12-month development cycle: linguistic mapping and community consultation (months 1-2), content development (3-4), translation and adaptation with back-translation quality control (5-6), pilot testing (7-8), production and distribution (9-10), and evaluation with six-month follow-up (11-12).

Discussion

The 35.6-point gap between mixed-approach and official-language materials at six months has clear policy

implications. Extension systems that distribute materials exclusively in official languages are effectively communicating at reduced bandwidth with minority language communities [3, 4]. The finding that this gap widens over time — from 27.1 points at one week to 35.6 at six months — suggests that language-mismatched materials produce weaker memory encoding that decays faster, consistent with Cummins' cognitive-academic processing framework [5, 13].

The mixed approach's superiority over pure mother tongue

materials (72.4 vs. 66.3 at six months) is notable. The bilingual glossaries and technical terminology in the official language gave farmers access to standardized agricultural vocabulary they could use with extension agents, input suppliers, and in formal agricultural contexts. This pragmatic bilingualism — understanding concepts in one's own language while knowing the official terms — appears to be the optimal communication strategy for multilingual extension contexts ^[8, 16].

The cost-effectiveness data should persuade budget-conscious administrators. A 34% increase in material production costs yielded a 96% improvement in retention — a return ratio that few extension investments can match ^[7, 18].

Practical Applications

A five-step implementation guide was developed for extension systems serving multilingual communities. Step 1: Conduct a linguistic inventory of the service area, mapping languages, dialects, and literacy levels by community. Step 2: Identify priority language combinations based on community size and current comprehension gaps. Step 3: Develop mixed-language templates with mother tongue concept explanations, official-language technical terms, and bilingual glossaries. Step 4: Engage community members as translation validators through back-translation protocols. Step 5: Pilot-test materials with small farmer groups before scaling production. Template packages including leaflet layouts, glossary formats, and audio script structures were produced in collaboration with the Slovak University of Agriculture printing services ^[10, 15].

Limitations

Four districts in southern Slovakia cannot represent all multilingual agricultural contexts. The quasi-experimental design lacks the causal strength of randomization. Hungarian-Slovak bilingualism may differ from other language pairs in ways that affect generalizability. Audio materials were produced but their separate effect was not isolated. Self-selection into language preference groups may confound preference with prior language ability. Future work should test the mixed approach across different language families, include randomized designs, and assess audio versus print effects independently.

Conclusion

This research compared four language strategies for extension communication materials across 2,304 farmers in multilingual southern Slovakia. The mixed-language approach — combining mother tongue concept explanations with official-language technical terminology — produced the highest comprehension (81.3% at one week), strongest retention (72.4% at six months), and greatest adoption (58.3%).

Extension systems serving multilingual populations should invest in mixed-language material development despite higher production costs, because the retention and adoption returns far exceed the cost increment. Language is not a peripheral feature of extension communication — it is the communication channel itself, and a partially blocked channel delivers partially effective advice.

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