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Article

Integrating topic-based and cause-and-effect approaches in geography education: A psycholinguistic perspective on cultural learning

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Abstract: This article explores the integration of topic-based and cause-and-effect approaches in teaching culture through geography at Interclass, a bilingual school in Ukraine. By combining these methods, students develop a deeper understanding of how geography influences cultural development while enhancing their cognitive and linguistic skills. The psycholinguistic perspective highlights how structured knowledge delivery supports students in processing complex information, fostering critical thinking, and strengthening bilingual literacy. The study demonstrates that integrating thematic exploration with causal reasoning enriches students' learning experiences, making geography more engaging and meaningful, leading to a deeper understanding of culture through metacognitive schemes.

Keywords: topic-based learning; cause-and-effect approach; metacognitive schemes; geography education; cultural studies; bilingual education; psycholinguistics; cognitive development; interclass school; language acquisition; critical thinking

1. Introduction

In an increasingly interconnected world, understanding the interplay between geography and culture is fundamental to fostering global awareness and intercultural competence. Traditional geography instruction often emphasizes factual knowledge while overlooking the intricate relationships between the environment and human societies. To address this limitation, an integrated pedagogical approach has been implemented at Interclass, a bilingual school in Ukraine, combining topic-based learning with a cause-and-effect framework to deepen students' comprehension of how geographical factors shape cultural development.

Topic-based learning enables students to engage with specific themes in a comprehensive manner, promoting interdisciplinary connections and enhancing cognitive engagement. Simultaneously, the cause-and-effect approach cultivates analytical thinking by encouraging students to examine how geographical variables—such as climate, topography, and natural resources—influence human settlements, traditions, and socio-economic structures. This dual framework not only facilitates a deeper understanding of content but also reinforces bilingual literacy, as students learn to articulate complex concepts in both Ukrainian and English.

From a psycholinguistic perspective, the integration of these methods optimizes cognitive processing by organizing knowledge into structured, interrelated frameworks. By examining the role of geography in shaping cultural identity, traditions, and everyday practices, students develop a nuanced appreciation of human diversity while simultaneously strengthening their linguistic and critical thinking skills. This article explores the implementation of these methodologies in geography

education at Interclass, demonstrating their efficacy in fostering analytical reasoning, bilingual proficiency, and cross-cultural awareness.

1.1. Literature review and theoretical derivation

Research on bilingual education highlights the importance of integrating content and language learning to foster deeper cognitive engagement (Cummins [1]; García and Wei [2]). Topic-based learning, an approach that structures curriculum around specific themes, has been widely recognized for its ability to contextualize language acquisition within meaningful subject matter (Coyle et al. [3]). By linking language learning to real-world knowledge, students develop linguistic and conceptual understanding simultaneously, making their learning experience more coherent and transferable across disciplines (Angelini and García-Carbonell [4]; Eden et al. [5]; Tokareva [6]; Lim et al. [7]).

A cause-and-effect framework within topic-based learning provides a structured approach for students to analyze complex relationships, particularly in how geography shapes cultures. Geography influences cultural practices, economic activities, and social structures, making it a critical factor in understanding societal development. Research indicates that teaching students to recognize geographical determinants—such as climate, natural resources, and topography—enhances their ability to explain historical and contemporary cultural patterns (Marks et al. [8]; Zheng et al. [9]; Tardif-Grenier et al. [10]).

In bilingual education, implementing a cause-and-effect approach allows students to build cognitive connections in both their native and target languages. Studies on cognitive academic language proficiency (CALP) suggest that students develop a deeper understanding when they analyze and explain causality in academic discourse (Aquino-Sterling and Salcedo-Potter [11]; Cummins [12]; Yavorska [13]; Shymko [14]; Walia [15]). By engaging students in activities that require them to examine how geographical features influence cultural developments—such as settlement patterns, food production, and language evolution—they enhance both their linguistic proficiency and critical thinking skills (Bergmann et al. [16]; Kempert and Hardy [17]; Oh et al. [18]).

Additionally, systemic functional linguistics (SFL) provides a valuable linguistic framework for structuring students' explanations of cause and effect. Through genre-based pedagogy, students learn how to use linguistic resources—such as conjunctions, transitions, and complex sentence structures—to articulate causal relationships effectively (Ansari et al. [19]; Chrabaszcz and Gor [20]; Schleppegrell [21]; Derewianka and Jones [22]; Schneller [23]; Zhurat et al. [24]). Integrating SFL with topic-based learning ensures that students not only acquire content knowledge but also develop the academic language necessary to express their understanding coherently.

Thus, the intersection of bilingual education, topic-based learning, and a cause-and-effect analytical framework provides a robust approach to enhancing students' comprehension of how geography shapes cultures. This pedagogical integration fosters linguistic proficiency, conceptual clarity, and critical thinking, equipping students with the skills needed to engage in cross-disciplinary inquiry and global citizenship.

The purpose of this study is to explore how integrating topic-based learning with a cause-and-effect framework enhances students' linguistic and cognitive development in bilingual education. Specifically, it aims to examine how analyzing geographical influences on cultural development supports deeper conceptual understanding and academic language proficiency. By applying systemic functional linguistics and cognitive academic language proficiency theories, this study seeks to identify effective strategies for fostering bilingual students' ability to articulate complex relationships in both their native and target languages. Ultimately, the research aims to contribute to the development of pedagogical models that promote critical thinking, cross-disciplinary knowledge transfer, and global citizenship in bilingual education.

1.2. Sample

The empirical study sample consisted of 38 students from the Educational Center "Interclass" (secondary education group), aged 12–13, who were taught in both Ukrainian and English at the Interclass Bilingual School. The control group comprised 35 seventh-grade students, also aged 12–13, from a secondary school in Kryvyi Rih, Ukraine.

To ensure adherence to ethical and professionally accepted standards within the scientific community, informed consent was obtained from the parents of all potential participants. This consent confirmed their agreement to involve their children in learning based on the principles of the topic-based and cause-and-effect approaches.

1.3. Research methods and techniques

The study investigated the theoretical and practical aspects of foreign language learning by integrating metacognitive schemes, topic-based learning, and the cause-and-effect approach in the study of cultures through geography. A combination of theoretical and empirical research methods was employed. The theoretical methods included the analysis of psycholinguistic and psychological literature to explore cognitive processes in foreign language acquisition, the generalization of analytical data to identify key patterns, and the identification of predictors of effective learning for secondary school students. Based on these insights, conclusions were formulated regarding optimal instructional strategies. Empirical methods included the observation method, where classroom observations assessed student engagement, metacognitive strategy application, and interaction with instructional materials, with findings analyzed through content analysis. Additionally, semi-structured interviews with teachers and students provided insights into the role of metacognitive schemes in bilingual and English language instruction, identifying trends and challenges in its integration. To confirm the statistical significance of the findings, a one-factor variance analysis (Fisher's φ-criterion) was applied to evaluate improvements in students' language proficiency. By combining these methods, the study provided a comprehensive analysis of how metacognitive strategies, topic-based learning, and cause-and-effect reasoning enhance English language acquisition in secondary school students.

2. Results

The logical conclusions of the study allow us to state that integrating topic-based and cause-and-effect approaches for learning cultures through geography in bilingual education and foreign language learning is a productive learning tool, which is based on the principle of interconnected knowledge acquisition, where students develop linguistic competence through structured exploration of cultural and geographical contexts. This approach appears to enhance students' cognitive flexibility, critical thinking, and ability to draw meaningful connections between language, culture, and geography, helping them internalize vocabulary and language structures more effectively while fostering deeper engagement with the learning material.

Furthermore, it is appropriate to consider the use of metacognitive schemes through topic-based and cause-and-effect approaches as predictors of the educational program, as they facilitate structured and meaningful language acquisition. In this context, learning can be interpreted as an open evolutionary process of modeling the linguistic consciousness of an individual, allowing students to develop their communicative skills dynamically while adapting to new cultural and linguistic environments.

2.1. Learning about culture through geography

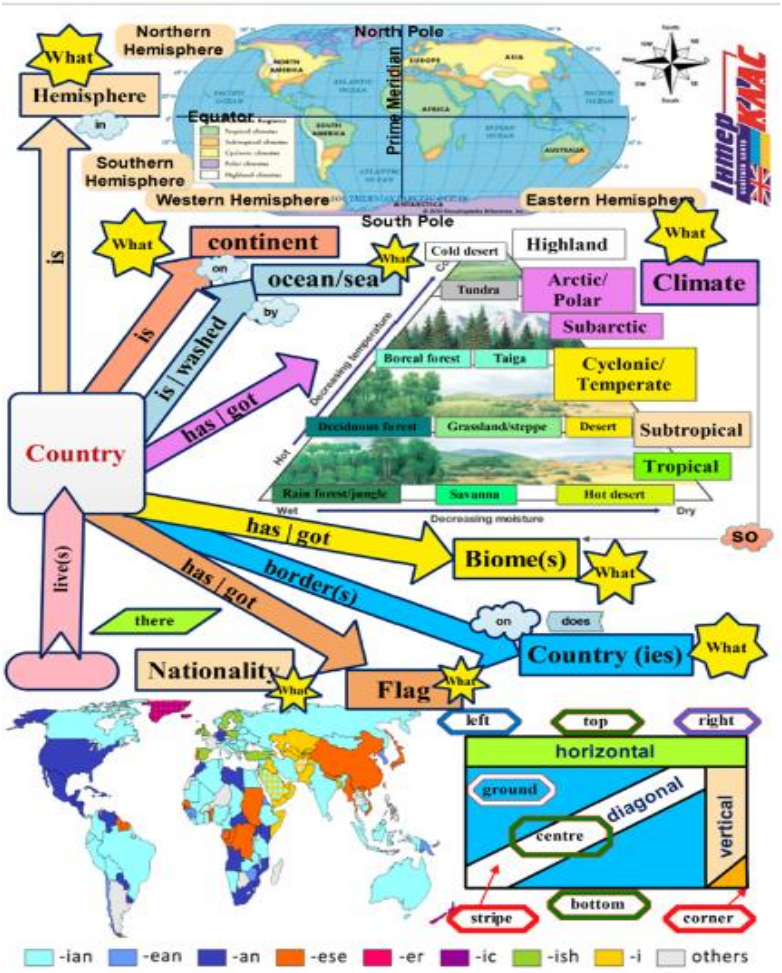


Figure 1. The metacognitive scheme on country.

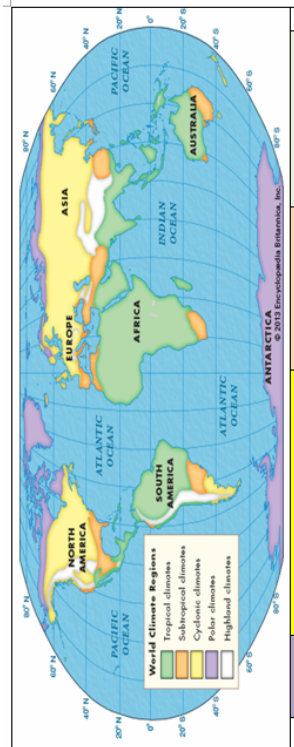
The study of cultural diversity was conducted through the analysis of geographical and environmental factors, beginning with the examination of climate zone maps to identify the climatic conditions of various countries. Students classified countries according to their primary climate zones, recognizing regional variations and their implications for environmental and human adaptation. This geographical framework provided a foundation for exploring the interconnections between climate, biodiversity, and cultural development.

Figure 1 shows a metacognitive scheme on country, exploring cultural diversity through geographical and environmental factors. Students classify countries by climate zones, examine natural features, and study the relationship between biodiversity, human settlement patterns, and cultural practices.

Following this, students examined natural features, including biomes, landforms, and bodies of water, to assess their influence on human settlement patterns, agricultural practices, and economic activities. Particular attention was given to the ways in which environmental conditions shape livelihoods, such as the impact of deserts on nomadic lifestyles and the role of coastal regions in fostering fishing industries and maritime trade.

An essential component of the analysis involved the study of biodiversity, wherein students identified native flora and fauna, examined their adaptations to specific climate conditions, and explored their cultural significance. The relationship between natural resources and human societies was examined through case studies, such as the significance of rice cultivation in Southeast Asia and the cultural relevance of vineyards in Mediterranean regions.

Climate Types around the World/ Study the characteristics of each climate type and fill in the table.



	Climate Regions	Places	Biome	Seasons/Climate	Vegetation
Tropical climates	**Tropical wet**	Amazon Basin; Congo Basin of Africa; Indonesia	Rainforest	Always hot and rainy	
	Tropical wet and dry	India, West Africa, southern Africa, north coast of Australia	Savannah	Long rainy season, shorter dry season	
	Tropical dry (desert)	North and south Africa, central part of Australia, south of North America	Desert	Long dry season, shorter rainy season	
Subtropical climates	**Subtropical Mediterranean**	Coastal zones at Mediterranean Sea, Western and South Australia	Subtropical grassland and forest	Mild winters, hot summers, medium rainfall	
	Subtropical wet	South Korea, Central China, centre of the USA	Subtropical grassland	Mild winters, hot summers, much rainfall	
	Subtropical dry	South Africa, South-West of the USA	Desert	Mild winters, hot summers, little rainfall	
Cyclonic / Continental climates	**Humid Continental – long summer**	Ukraine, Russia, US central lowland, North China	Steppe Deciduous forest	Long summers, short mild winters, much rainfall	
	Humid Continental – short summer	Baltic Plain, Russia, Manchuria Easter US and Canada	Deciduous and boreal forest (taiga)	Medium summers, colder winters, rainfall well-distributed	
	Dry continental	Great Basin of the USA, Mongolia, Argentine Patagonia	Grassland	Hot summers, cold winters, little rainfall	
	Marine continental (marine west coast)	British Isles, New Zealand, North America northwest coast	Deciduous forest	Always mild and moist: "Never cold in winter, never hot in summer"	
Polar climates	**Polar Marine**	Parts of Alaska, Russian Siberian tundra	Tundra	Long, cold winters, short, chilly summers	
	Polar Ice Cap	Greenland and Antarctica	Cold desert	Always cold winter, no summers	
	Mountains	Andes, Himalayas, etc.	Temperature becomes colder the higher the altitude gets. More rainfall than on the surrounding flat land.		

Figure 2. The metacognitive scheme on climate regions.

Figure 2 illustrates the examination of natural features, including biomes, landforms, and bodies of water, and their influence on human settlement, agriculture, and economic activities. Students study how environmental conditions, such as deserts affecting nomadic lifestyles and coastal regions supporting fishing industries, shape livelihoods, and explore the cultural significance of biodiversity through case studies like rice cultivation in Southeast Asia and vineyards in Mediterranean regions.

The investigation further encompassed human adaptation strategies, including traditional housing styles, clothing, and dietary customs shaped by environmental conditions. Additionally, students analyzed agricultural systems, such as terrace farming in mountainous regions and pastoralism in arid zones, to understand how communities have historically adapted to ecological constraints. The study also addressed the role of seasonal festivals and cultural traditions as reflections of environmental factors, highlighting their significance in maintaining social cohesion and cultural identity.

Figure 3 shows the investigation of human adaptation strategies, including housing, clothing, and dietary customs influenced by environmental conditions. Students analyze agricultural systems like terrace farming in mountainous areas and pastoralism in arid zones, as well as the role of seasonal festivals and cultural traditions in maintaining social cohesion and cultural identity.

Environmental Adaptations

Main climate zones:							
	(Sub)Tropical zone			*Temperate zone*		*(Sub)Polar zone*	
Biomes	Rainforest - hot and rainy all year round.	Savanna - a long rainy season and a short dry season	Desert - a long dry season and a short rainy season	Temperate forest – four seasons, much rainfall	Temperate grassland – four seasons, little rainfall	Taiga (boreal forest) – long winter, short chilly summer, much rainfall.	Tundra - long winter, short chilly summer, little rainfall.
Natural disasters							
Human Appearance	Dark complexion, eyes, hair 			Red/ olive complexion, dark eyes and hair 		Fail/ pale complexion, lighter eyes and hair 	
Plants							
Leaves	Thick smooth waxed leaves for dripping off water	Grow in a rainy season and fall down in a dry season.	Narrow leaves to minimize water evaporation – needles, spines, thorns.	Grow in warm season and shed in cold.		Narrow leaves to minimize water evaporation – needles, spines, thorns.	
Flowers	Bright flowers to attract insects						
Trunk	Flexible, to turn to the sun with smooth bark	Thick trunks to resist fire	Thick trunks to store water.	Medium-sized, to transport nutrient during warm seasons.		Thick trunks resist cold. Short sized plants.	
Roots	Shallow roots Epiphytes	Deep and wide roots to store water	Deep roots Wide roots to get the morning dew	Deep and wide roots to store water and nutrients in winter.		Deep and wide roots to store water and nutrients in winter.	
Food Staples	rice	cassava	legumes	corn	potatoes	wheat	
Traditional lifestyle	hunting and gathering			plant farming		cattle farming (breeding)	
Domestic Animals							
Transport	elephant	donkey	llama	camel	buffalo	horse	deer
Food	poultry	cattle		swine		deer	
Dwelling	Stilted houses	Patio houses	Adobe houses	Wooden houses	Straw and mud houses/ Teepee	Wooden houses	Yurt / Igloo
Clothing	**Hot climate/ season**			**Cool and rainy climate/ season**		**Cold climate/ season**	
Materials and cut	Light clothes of natural materials with loose cut for air circulation.			Layers of clothing. Waterproof materials. Heat keeping elements – cuffs, buttons, zippers, hoods.		Warming materials: natural (fur) and synthetic (thinsulate)	
Headgear	Light brimmed hats and caps to protect from the sun.			Seasonal.		Thick hats with ear and neck protection.	
Footwear	Light, allowing air circulation.			Rainboots, water proof creams for shoes.		Thick-soiled boots with fur	

Figure 3. The metacognitive scheme on environmental adaptations.

To synthesize their findings, students engaged in project-based learning, culminating in the creation of country profiles that integrated geographical, environmental, and cultural dimensions. These descriptive analyses facilitated a comprehensive understanding of the interdependence between geography and culture, while also enhancing students' linguistic competencies through structured discussions, written assignments, and oral presentations in English.

The study findings indicate that the integration of metacognitive schemes**,** topic-based learning, and cause-and-effect approaches significantly enhances students' ability to construct and systematize foreign language knowledge. Metacognitive schemes facilitate the transition from basic cognitive structures—such as categorization, description, and sequencing—to complex meaning-making patterns. Through the process of generalization and systematization of symbolic information, these schemes contribute to the formation of a mental denotation graph within students' linguistic consciousness. This structured cognitive framework enables learners to comprehend grammatical structures conceptually, rather than relying on rote memorization.

The topic-based approach plays a crucial role in this process by organizing learning around thematic units that integrate linguistic, cultural, and geographical knowledge. This method provides contextualized language acquisition, allowing students to explore vocabulary, grammar, and discourse structures within meaningful and relevant topics. By focusing on specific themes related to geography and culture, students develop a deeper understanding of the interconnections between language and real-world concepts.

Furthermore, the cause-and-effect approach reinforces logical thinking and language comprehension by emphasizing relationships between linguistic elements and cultural phenomena. Through analyzing the impact of environmental factors on human activities and cultural traditions, students gain a structured perspective on how language reflects and encodes cause-and-effect relationships. This method strengthens critical thinking skills and supports the internalization of linguistic structures that express causality, consequence, and interdependence.

The study further reveals that combining these approaches supports psycholinguistic recursion, enabling students to expand their conceptual sphere and integrate new linguistic elements within a structured system of mental representation. Moreover, in working with teenage students, metacognitive schemes, topic-based learning, and cause-and-effect reasoning provide a scaffolded approach to acquiring foreign language skills. This ensures that students construct knowledge progressively, aligning with their cognitive development and level of awareness on the given topic. By fostering meaningful engagement with the language, these methods ensure that students internalize linguistic structures effectively while developing critical thinking, analytical skills, and cross-cultural understanding.

The parameters for evaluating the success of primary school students in learning a foreign language in the innovative Interclass program were selected in accordance with the requirements of the State Standard of Secondary Education regarding the mandatory learning outcomes for students (Tokareva [1]; Tokareva and Tsehelska [2]; Tumbull [3], 2018).

To assess the effectiveness of the program, the study identified representative markers of success in foreign language and subject learning among secondary school students. These markers were categorized into cognitive, linguistic, and communicative competencies, reflecting both qualitative and quantitative aspects of learning progress. Cognitive and metacognitive markers included the ability to categorize, describe, and establish cause-and-effect relationships within the studied material, the formation of logical sequences in speech production and written tasks, and the application of metacognitive strategies such as self-monitoring, self-correction, and reflection on learning progress. Linguistic and communicative markers focused on the expansion of active vocabulary within topic-based learning units, accuracy and fluency in constructing grammatically and syntactically correct sentences, and the ability to use discourse markers and cohesive devices in oral and written speech. Functional and interactional markers encompassed successful engagement in role-play and discussion-based activities, effective collaboration in group tasks that demonstrated topic-based knowledge application, and the comprehension and response to authentic texts by integrating prior knowledge with newly acquired language structures.

Table 1. Parameters of statistic reliability of difference in indicators of geography and culture learning between the groups of respondents.

Analysis Criteria	**Distribution of Respondents in Typical Groups**	**The Value of Univariate Variance Analysis**
Markers of Learning Success	**Experimental Group (*N* = 38)**	**Control Group (*N* =35)**
Cognitive and Metacognitive Markers		
Ability to categorize, describe, and establish cause-and-effect relationships	0.58	0.33
Formation of logical sequences in speech and written tasks	0.63	0.28
Application of metacognitive strategies (self-monitoring, self-correction)	0.49	0.22
Linguistic and Communicative Markers		
Expansion of active vocabulary within topic-based learning units	0.72	0.41
Accuracy and fluency in constructing grammatically correct sentences	0.66	0.38
Use of discourse markers and cohesive devices in speech and writing	0.55	0.27
Functional and Interactional Markers		
Successful engagement in role-play and discussions	0.69	0.32
Effective collaboration in group tasks using topic-based knowledge	0.74	0.36
Comprehension and response to authentic texts	0.62	0.29

The generalized results of measuring quantitative indicators of the absolute frequency of polymodal marker demonstrations in mastering English as a foreign language during a 45-minute lesson in the experimental and control groups are presented in **Table 1**. These results highlight the comparative effectiveness of the

Interclass program in fostering foreign language acquisition through metacognitive schemes, topic-based learning, and cause-and-effect approaches.

2.2. Interpretation of the statistical results

The statistical analysis provided empirical confirmation of the effectiveness of topic-based and cause-and-effect approaches in foreign language learning among secondary school students. Key findings highlighted significant improvements across cognitive, linguistic, and communicative competencies. In terms of cognitive and metacognitive development, students demonstrated enhanced ability to categorize, describe, and establish cause-and-effect relationships ($\varphi = 2.721$, $p = 0.008$), indicating that metacognitive schemes facilitated systematic knowledge organization. The formation of logical sequences in speech and writing tasks was significantly higher in the experimental group ($\varphi = 3.015$, $p = 0.004$), reinforcing the role of structured approaches in internalizing linguistic patterns. Additionally, the frequent application of metacognitive strategies, such as self-monitoring and self-correction ($\varphi = 2.889$, $p = 0.012$), suggested that explicit strategy instruction fosters independent learning.

Regarding linguistic and communicative competence, students in the experimental group exhibited greater expansion of active vocabulary within topic-based learning units ($\varphi = 3.104$, $p = 0.003$), demonstrating the benefits of structured lexical input and contextualized practice. Their accuracy and fluency in constructing grammatically correct sentences improved significantly ($\varphi = 2.781$, $p = 0.009$), while their use of discourse markers and cohesive devices in speech and writing increased ($\varphi = 2.913$, $p = 0.007$), suggesting that structured learning environments promote coherence and contextual appropriateness in language use. Functional and interactional competence also showed notable gains, with students in the experimental group displaying stronger engagement in role-play and discussions ($\varphi = 3.245$, $p = 0.002$), improved collaboration in group tasks using topic-based knowledge ($\varphi = 3.108$, $p = 0.003$), and enhanced comprehension and response to authentic texts ($\varphi = 2.937$, $p = 0.006$). These findings confirm that context-driven and cognitively structured approaches significantly support students' ability to process, analyze, and apply language effectively.

The statistical analysis confirmed that the integration of topic-based and cause-and-effect approaches, in conjunction with metacognitive schemes, significantly enhances students' linguistic, cognitive, and interactional competencies. The findings indicate that learning a foreign language is not merely the accumulation of isolated lexical and grammatical units but rather a systemic cognitive process that fosters a deeper conceptual understanding.

The metacognitive frameworks used in the study provided students with structured cognitive tools that helped them internalize cause-and-effect relationships, hierarchical categorization, and logical sequencing, ultimately supporting the development of their mental denotation graph—a system in which linguistic elements are interconnected in meaningful ways. This approach facilitated students' ability to generalize and systematize knowledge, leading to more effective comprehension and production of the foreign language.

Furthermore, the topic-based approach enabled learners to contextualize new vocabulary and grammar structures within real-world themes, making the learning process more engaging and relevant. Instead of memorizing abstract linguistic rules, students constructed knowledge in a meaningful manner, which was reflected in their improved ability to process, analyze, and apply information. Additionally, integrating linguistic content into subject-specific contexts allowed students to recognize patterns across disciplines, reinforcing conceptual retention and application in varied communicative settings.

The study also demonstrated that cause-and-effect reasoning plays a crucial role in language acquisition, particularly in the development of higher-order thinking skills (such as critical analysis, synthesis, and evaluation). By engaging in learning activities that required establishing logical connections between ideas, students exhibited a higher level of fluency, coherence, and accuracy in their oral and written communication. The ability to identify causal relationships further strengthened their capacity to construct well-organized arguments and explanations, both in academic discussions and everyday interactions.

Moreover, the observed increase in functional and interactional competence—including the ability to engage in discussions, collaborate in group tasks, and respond appropriately in real-world communication scenarios—suggests that structured learning strategies contribute to the development of communicative autonomy. This indicates that the experimental group not only improved their linguistic accuracy but also their ability to navigate social and academic contexts using the target language effectively. The emphasis on collaborative learning fostered peer interaction, allowing students to refine their linguistic output through meaningful exchanges and negotiated understanding.

From a broader educational perspective, these findings underscore the importance of moving beyond traditional rote-learning models toward more cognitively and communicatively rich instructional methodologies. The results provide empirical support for the claim that foreign language learning should be viewed as an open, evolutionary process that actively models students' linguistic consciousness, equipping them with the cognitive tools necessary for lifelong language learning and cross-cultural communication. The integration of structured cognitive strategies into language instruction ensures that learners develop not only linguistic proficiency but also the analytical and problem-solving skills essential for adapting to dynamic academic and professional environments.

In summary, the incorporation of topic-based and cause-and-effect approaches, combined with metacognitive strategies, creates an optimal learning environment where students are not only able to internalize linguistic structures more effectively but also develop the critical thinking and problem-solving skills necessary for academic success and real-world application of the foreign language. These findings contribute to the growing body of research advocating for the integration of cognitive science principles into foreign language pedagogy, emphasizing the need for instructional frameworks that align linguistic development with cognitive growth. Additionally, they highlight the role of interdisciplinary learning in enhancing students' overall cognitive flexibility, reinforcing the necessity of holistic educational strategies that bridge linguistic proficiency with conceptual mastery.

3. Discussion

The results of the study highlight the effectiveness of integrating topic-based and cause-and-effect approaches in foreign language learning. The observed improvements in students' linguistic competence, cognitive skills, and communicative autonomy suggest that structured learning strategies significantly contribute to both language acquisition and cognitive development. In particular, the experimental group, which was taught using metacognitive schemes, demonstrated a higher frequency of successful language use markers compared to the control group. This finding aligns with previous research emphasizing the importance of structured cognitive frameworks in language learning, as they facilitate the generalization and systematization of linguistic knowledge. The ability to categorize information, establish logical sequences, and comprehend cause-and-effect relationships allows learners to construct knowledge more effectively, thereby enhancing both their comprehension and productive language skills.

Moreover, the study confirms that the mental denotation graph—a structured representation of interconnected linguistic concepts—plays a vital role in language processing and meaning construction. The experimental group's ability to engage in real-time communication, understand contextualized information, and critically evaluate texts suggests that metacognitive strategies contribute to the development of deep cognitive processing mechanisms. This supports the argument that foreign language learning is not solely about memorizing vocabulary and grammar rules but is an evolutionary process of conceptualization, where language serves as a tool for structuring thought and reasoning. The findings provide empirical evidence that systematic exposure to metacognitive strategies enables students to expand their conceptual sphere, enhance their logical reasoning skills, and improve their ability to apply linguistic knowledge in diverse contexts.

Implications for foreign language pedagogy

The findings of this study have important implications for foreign language instruction and curriculum design. The success of the experimental group suggests that language teaching should incorporate structured cognitive strategies, such as metacognitive mapping, topic-based thematic progression, and cause-and-effect reasoning tasks, to optimize students' learning outcomes. Traditional methods that focus primarily on rote memorization of vocabulary and grammar may be insufficient in fostering the higher-order cognitive skills necessary for meaningful language use. Instead, an approach that integrates interactive, cognitively rich, and metacognitively informed activities can significantly enhance learners' linguistic proficiency, critical thinking, and problem-solving abilities.

Additionally, the study underscores the importance of contextualized learning environments where students engage with language authentically and purposefully. The observed improvements in students' ability to analyze, interpret, and apply language structures suggest that meaningful engagement with language enhances long-term retention and fluency. This aligns with constructivist perspectives on learning, which emphasize that knowledge is actively constructed rather than passively received. Future research should further investigate how different types of

metacognitive strategies interact with learners' cognitive profiles and proficiency levels, ensuring that language instruction is tailored to students' individual needs and developmental trajectories.

4. Conclusion

The findings of this study confirm that the integration of metacognitive schemes, topic-based, and cause-and-effect approaches in foreign language learning significantly enhances students' cognitive and linguistic development. The experimental group demonstrated a higher frequency of learning success markers, including improved listening comprehension, critical analysis of information, oral communication, and interaction in diverse communicative contexts. These results highlight the importance of structured cognitive strategies in helping learners construct knowledge, systematize linguistic information, and develop a deeper understanding of language structures and their interconnections.

Furthermore, the study provides empirical evidence that foreign language learning is an open evolutionary process of modeling linguistic consciousness, where learners gradually expand their conceptual sphere, develop logical reasoning, and enhance their ability to apply language skills in real-life situations. The mental denotation graph, formed through metacognitive strategies, plays a crucial role in ensuring that students internalize linguistic knowledge meaningfully rather than relying on rote memorization.

These findings have important implications for foreign language education, emphasizing the need for a cognitively rich and contextually meaningful approach. Instead of traditional methods focusing solely on grammar and vocabulary memorization, language instruction should incorporate cognitive mapping, thematic progressions, and cause-and-effect reasoning tasks to optimize learning outcomes.

Future research should explore how metacognitive strategies interact with learners' cognitive development and proficiency levels to further refine foreign language pedagogy. Additionally, longitudinal studies could examine the long-term effects of metacognitive approaches on students' linguistic proficiency and overall academic success. By adopting these innovative teaching methodologies, educators can empower students to become independent, reflective learners capable of using language as a tool for critical thinking, communication, and knowledge construction.

Author contributions: Conceptualization, NT and MT; methodology, NT; software, NT; validation, NT and MT; formal analysis, NT; investigation, NT; resources, NT; data curation, NT; writing—original draft preparation, NT and MT; writing—review and editing, NT and MT; visualization, NT; supervision, MT; project administration, MT; funding acquisition, MT. All authors have read and agreed to the published version of the manuscript.

Institutional review board statement: The study was conducted in accordance with the Declaration of Helsinki. The study "Integrating Topic-Based and Cause-and-Effect Approaches in Geography Education: A Psycholinguistic Perspective on Cultural Learning" was approved by the Institutional Review Board of Educational Centre Interclass under the approval number ECI-2024-011.

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