

DEVELOPING FUTURE ENGINEERS' GRAMMATICAL COMPETENCE THROUGH A COGNITIVE APPROACH

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Abstract

This article proposes a cognitive approach to developing future engineers' grammatical competence in English within the pedagogical context of technical universities in Uzbekistan. It treats grammar as a resource for expressing technical meanings, organising professional knowledge, and communicating engineering decisions. The proposed methodology connects grammatical forms with the cognitive processes of noticing, categorisation, conceptualisation, and reflection. It incorporates contextualised language analysis, visual representations, guided discovery, and communicative tasks based on engineering situations. Learning activities focus on describing mechanisms, explaining processes, comparing technical alternatives, and expressing conditions and causal relationships. Particular attention is given to the relationship between students' existing linguistic knowledge and the demands of English technical communication, including potential influences from Uzbek and Russian. The article outlines a teaching sequence that progresses from interpreting grammatical meaning to guided practice and independent use in professional discourse. Assessment combines grammatical accuracy, appropriateness of form–meaning choices, coherence, and successful completion of communicative tasks. As a methodological proposal, the article presents anticipated pedagogical benefits rather than findings from an implemented intervention. It provides a framework for classroom application and subsequent empirical evaluation, with the aim of connecting grammar instruction more closely to the communicative needs of future engineers.

Keywords: Grammatical competence, cognitive approach, future engineers, technical English, engineering education, contextualised grammar instruction, form–meaning connections, professional communication, guided discovery, reflective learning.

Introduction

BO‘LAJAK MUHANDISLARNING GRAMMATIK KOMPETENSIYASINI KOGNITIV YONDASHUV ASOSIDA RIVOJLANTIRISH

Annotatsiya:

Ushbu maqolada O‘zbekiston texnika universitetlarida bo‘lajak muhandislarning ingliz tilidagi grammatik kompetensiyasini rivojlantirishga qaratilgan kognitiv yondashuvga asoslangan metodika taklif etiladi. Grammatika texnik mazmunni ifodalash, kasbiy bilimlarni tartibga solish va muhandislik qarorlarini tushuntirish vositasi sifatida talqin qilinadi. Taklif etilayotgan metodika grammatik shakllarni payqash, kategoriyalashtirish, konseptuallashtirish va refleksiya kabi kognitiv jarayonlar bilan bog‘laydi. U kontekst asosidagi til tahlili, vizual tasvirlar, yo‘naltirilgan kashfiyot va muhandislik vaziyatlariga mos kommunikativ topshiriqlarni birlashtiradi. O‘quv faoliyati mexanizmlarni tavsiflash, texnologik jarayonlarni tushuntirish, texnik yechimlarni taqqoslash hamda shart va sabab-oqibat munosabatlarini ifodalashga yo‘naltiriladi. Talabalarning mavjud lingvistik bilimlari bilan ingliz tilidagi texnik muloqot talablari o‘rtasidagi bog‘liqlikka, jumladan, o‘zbek va rus tillarining ehtimoliy ta’siriga alohida e’tibor qaratiladi. Maqolada grammatik ma’noni anglashdan yo‘naltirilgan mashqlarga, so‘ngra kasbiy nutqda mustaqil qo‘llashga o‘tishni nazarda tutuvchi ta’lim ketma-ketligi bayon etiladi. Baholash grammatik aniqlik, shakl va ma’no uyg‘unligi, nutqning izchilligi hamda kommunikativ topshiriqning bajarilishini qamrab oladi. Maqola metodik taklif sifatida amalga oshirilgan tajriba natijalarini emas, balki kutilayotgan pedagogik afzalliklarni yoritadi. Taklif etilgan yondashuv grammatikani o‘qitishni bo‘lajak muhandislarning kasbiy kommunikativ ehtiyojlari bilan yaqinlashtirishga xizmat qiladigan amaliy asos yaratadi va keyingi empirik tekshiruvlar uchun yo‘nalish belgilaydi.

Kalit so‘zlar: Grammatik kompetensiya, kognitiv yondashuv, bo‘lajak muhandislar, texnik ingliz tili, muhandislik ta’limi, kontekstga asoslangan grammatik ta’lim, shakl va ma’no bog‘liqligi, kasbiy muloqot, yo‘naltirilgan kashfiyot, refleksiv o‘rganish.

Introduction

Engineering education requires students to communicate technical knowledge accurately, explain complex processes, and justify professional decisions. English grammar supports these activities by enabling learners to express relationships between objects, actions, conditions, and consequences. For future engineers, grammatical competence therefore extends beyond remembering rules or completing isolated exercises. It involves selecting appropriate linguistic structures to construct meanings in descriptions, reports, presentations, and collaborative discussions. When students understand how grammatical choices influence technical meaning, they can communicate with greater precision. This connection between language, thinking, and professional practice provides a rationale for examining grammar instruction through a cognitive approach in technical universities.

In Uzbekistan, this pedagogical focus is relevant to university settings where students encounter English alongside Uzbek and Russian. Learners may enter technical programmes with different language backgrounds, levels of grammatical knowledge, and opportunities to use English. Such variation creates a need for instruction that connects unfamiliar grammatical structures with existing knowledge while recognising differences between languages. Engineering content offers contexts for establishing these connections. Describing a machine, interpreting a diagram, or explaining an experimental procedure requires students to organise information logically. These activities allow teachers to address grammatical development through meaningful professional tasks that relate directly to students' disciplinary studies.

A central instructional challenge is the possible distance between knowing a grammatical rule and applying it during communication. A student may correctly identify a passive construction in an exercise but struggle to describe a manufacturing process independently. Similarly, knowledge of conditional forms does not necessarily ensure accurate explanations of system behaviour under changing operating conditions. Teaching must therefore address how learners interpret situations, identify relevant relationships, and select language to represent them. A cognitive approach offers a basis for designing this process by directing attention to meaning, conceptual organisation, and the connections students establish between grammatical forms and communicative purposes.

Within the proposed methodology, grammatical learning is understood as an active process of observing patterns, comparing examples, constructing explanations, and testing choices in context. Visual materials can help students connect sentence structures with spatial, temporal, and causal relationships. Guided discovery can encourage learners to explain why a particular form suits a technical situation. Reflection can make their reasoning available for discussion and revision. These practices require careful sequencing because disciplinary complexity and language demands may compete for attention. Tasks should consequently develop from accessible examples towards independent communication, with support adjusted to students' linguistic readiness and familiarity with the engineering content.

This article aims to develop a pedagogically coherent framework for improving future engineers' grammatical competence through cognitively oriented English instruction. Its focus is the alignment of grammatical meaning, engineering tasks, classroom support, and assessment. The guiding question concerns how these elements can be organised to help students transfer grammatical knowledge into professional communication. The article presents a methodological proposal rather than an experimentally validated intervention; accordingly, its analytical claims concern instructional design and anticipated learning opportunities. Attention is given to practical implementation in technical university classrooms, where teachers must balance language objectives with disciplinary relevance, available teaching time, and learner diversity.

Methods

The study adopts a conceptual methodological design to develop a framework for teaching English grammar to future engineers at technical universities in Uzbekistan. Its purpose is to specify instructional procedures and assessment principles rather than measure the effectiveness of an implemented intervention. The framework connects cognitive processes with grammatical choices required in engineering communication. Accordingly, the proposed procedures address noticing, comparison, categorisation, contextual interpretation, and reflection. No participants were recruited, and no classroom data were collected for this article. The procedures described below constitute a model for subsequent classroom implementation and empirical evaluation, with adaptations to institutional conditions and learner needs.

Instructional planning begins with a needs analysis linking engineering communication tasks to relevant grammatical resources. Teachers identify situations in which students describe equipment, explain procedures, compare solutions, report observations, or predict consequences. They then select language features according to their contribution to these purposes. For example, passive constructions support descriptions that foreground processes, while conditional constructions express relationships between operating conditions and expected outcomes. An initial diagnostic task is proposed to establish students' existing resources and recurring difficulties. Students describe a familiar technical diagram and explain a simple process, providing a basis for adjusting task complexity and the amount of support.

Each instructional unit follows a sequence of contextual observation, guided interpretation, supported production, and independent application. First, students examine a short technical text alongside a diagram or process illustration. They identify grammatical patterns and discuss the meanings these patterns convey. Next, the teacher uses questions to guide comparison between alternative constructions, asking learners to explain changes in emphasis, time reference, or causal interpretation. Students subsequently complete scaffolded tasks, such as reconstructing a process description or matching statements to operating conditions. Finally, they produce a technical explanation that requires the target structures without supplying a sentence template for every intended meaning.

Cognitive support is incorporated through visual mapping, focused comparison, and verbal explanation. Diagrams represent sequences and relationships that students subsequently express in sentences. Contrasting examples make differences between grammatical options available for inspection, while brief explanations encourage learners to articulate their choices. Where appropriate, teachers invite comparisons with Uzbek or Russian to explore differences in expressing meaning without assuming that every error results from language transfer. Support is gradually reduced as learners demonstrate readiness for more independent performance. Pair activities require students to clarify ambiguous statements and revise technical explanations, creating opportunities to connect grammatical accuracy with the listener's understanding.

The proposed assessment combines a common analytic rubric with comparable tasks administered before and after instruction in a future implementation. The rubric evaluates grammatical accuracy, appropriateness of form–meaning

choices, coherence, and communicative task completion as separate dimensions. A delayed task would examine whether learners retain and transfer their knowledge to unfamiliar engineering content. To strengthen scoring consistency, two assessors would independently evaluate anonymised samples and discuss discrepancies using agreed descriptors. Learner reflections and classroom observations could contextualise performance changes. Any empirical implementation would require informed consent, confidential handling of student work, and reporting that distinguishes observed outcomes from anticipated pedagogical benefits.

Results

The conceptual analysis produced an instructional framework linking grammatical competence to the interpretation and expression of engineering meanings. Its principal result is the organisation of grammar teaching around communicative demands rather than an isolated sequence of forms. Within this framework, grammatical content is selected according to what students need to describe, explain, compare, or predict. This arrangement establishes a connection between language objectives and disciplinary activities. Because the study did not involve classroom implementation, these results represent methodological outputs. They do not demonstrate improvements in student achievement, establish causal effects, or provide evidence of superiority over alternative approaches to instruction.

A second outcome is the specification of relationships between engineering tasks and grammatical choices. Process descriptions provide contexts for examining active and passive constructions, including decisions about whether the agent or operation deserves emphasis. Equipment comparisons create opportunities to use comparative structures and qualify claims according to technical criteria. Troubleshooting scenarios connect conditional constructions with possible faults, diagnostic decisions, and expected consequences. Reporting observations requires attention to tense and aspect so that completed procedures can be distinguished from general operating principles. These relationships support task selection while allowing teachers to combine several grammatical resources within a single professional communication activity.

The framework also yields a teaching sequence that makes students' interpretation of grammatical meaning available for classroom discussion.

Contextual observation introduces a technical situation before focused grammatical analysis. Guided interpretation directs attention to how alternative forms represent that situation differently. Supported production gives students opportunities to test their interpretations with diagrams, prompts, and peer assistance. Independent application then requires them to select structures in response to a communicative purpose. The resulting sequence provides a basis for lesson planning and for identifying where difficulties occur. A learner's problem can therefore be investigated at the level of interpretation, selection, or sentence construction.

Another methodological result is an assessment structure that separates grammatical accuracy from other dimensions of performance. Accurate sentences alone cannot indicate whether a technical explanation communicates the intended relationship. Conversely, successful task completion may coexist with grammatical weaknesses requiring further attention. The proposed rubric therefore treats accuracy, form–meaning appropriateness, coherence, and task completion as related but distinct dimensions. This separation enables teachers to describe performance more precisely and select subsequent learning activities accordingly. Comparable assessment tasks and a delayed transfer task are included as design requirements for future evaluation, although their reliability and sensitivity remain to be established through implementation.

Finally, the framework identifies conditions that should inform adaptation in technical university classrooms. Task difficulty depends on both linguistic demands and students' familiarity with engineering content. Visual support must clarify the target relationship rather than introduce unnecessary information. Comparisons with Uzbek and Russian require attention to individual language backgrounds, while collaborative tasks need opportunities for each student to produce and revise language. These conditions define practical questions for piloting the methodology. The present contribution is consequently a structured instructional and assessment proposal whose feasibility, effectiveness, and capacity to support transfer require investigation through classroom evidence collected in subsequent empirical research studies.

Discussion

The proposed framework positions grammatical competence as an interaction between linguistic knowledge, conceptual understanding, and purposeful

communication. Its pedagogical value lies in connecting grammatical choices with the relationships that engineering students need to express. A passive construction, for instance, becomes meaningful when learners decide whether a process description should foreground an operation or its performer. This perspective can help teachers explain why grammatical alternatives matter in professional discourse. However, the conceptual coherence of this relationship should not be mistaken for demonstrated effectiveness. Whether these connections improve students' performance remains an empirical question requiring systematic investigation under clearly described classroom conditions. The relationship between contextual learning and explicit instruction deserves particular attention. A cognitive approach need not exclude explanations of grammatical rules. Instead, explanations can emerge from analysis of examples and support subsequent application. Guided discovery may be useful when students possess sufficient language resources to recognise patterns, but unfamiliar structures may require more direct teacher support. The appropriate balance should depend on diagnostic evidence and task demands. If learners must simultaneously interpret difficult engineering content and unfamiliar grammar, they may struggle to identify the intended relationship. Instructional sequencing therefore needs to manage both sources of difficulty while preserving a meaningful communicative purpose.

The multilingual context of technical education in Uzbekistan introduces another dimension for consideration. Uzbek and Russian can serve as resources for discussing how languages represent time, agency, conditions, and information emphasis. Carefully selected comparisons may help learners recognise differences that are difficult to notice through English examples alone. Nevertheless, teachers should avoid treating students as a linguistically uniform group or attributing every grammatical difficulty to first language influence. Prior instruction, limited practice, task unfamiliarity, and incomplete understanding of technical content offer alternative explanations. Diagnostic interpretation should consider these possibilities before determining whether contrastive explanation is the most suitable instructional response.

Assessment is central to evaluating the framework because different measures may reveal different patterns of development. Controlled exercises can indicate recognition or accurate production under restricted conditions, whereas technical explanations require students to coordinate grammar with content and

organisation. Neither task type independently captures the entire construct. Combining performance dimensions may provide a fuller account, provided that scoring criteria remain distinguishable and assessors apply them consistently. A delayed task involving unfamiliar content would also help examine transfer beyond practised examples. However, differences in topic knowledge must be considered when interpreting performance, since disciplinary familiarity can influence the quality of an explanation.

Several limitations shape the interpretation and future development of this proposal. Without participant data, the article cannot establish learning gains, classroom feasibility, or the relative contribution of individual instructional components. Future research should compare the framework with a clearly specified alternative while accounting for initial proficiency, instructional time, and teacher support. Classroom observations and learner explanations could help investigate how students engage with the proposed cognitive processes. Collaboration between English teachers and engineering lecturers would strengthen task relevance, although its practical demands require examination. Implementation should also document preparation time and resource availability to determine whether the methodology can be sustained.

Conclusion

Developing future engineers' grammatical competence requires instruction that connects linguistic forms with the meanings students need to communicate in professional settings. This article has proposed a cognitive approach in which grammar supports the description of mechanisms, explanation of processes, comparison of alternatives, and prediction of consequences. The central methodological principle is that learners should examine how grammatical choices shape technical meaning and then apply those choices purposefully. This principle provides a foundation for integrating language learning with engineering education while retaining explicit attention to accuracy, coherence, and the communicative demands of technical discourse in both spoken and written professional contexts.

The proposed methodology organises learning through contextual observation, guided interpretation, supported production, and independent application. These stages connect the recognition of grammatical patterns with their purposeful use. Visual representations, comparative examples, and reflective explanations

provide support for interpreting relationships before expressing them linguistically. Teachers can adjust this support according to students' proficiency and familiarity with disciplinary content. The framework does not prescribe an identical procedure for every grammatical feature or learner group. Instead, it offers a sequence within which instructional decisions follow the communicative objective, the target meaning, and the difficulties identified through diagnostic tasks and ongoing observation of performance.

For technical universities in Uzbekistan, the framework offers a way to address grammatical development within a multilingual learning environment. Students' knowledge of Uzbek and Russian may support comparison and explanation when these resources are relevant to a particular difficulty. Such comparisons should remain responsive to individual backgrounds rather than assume shared patterns of language use. Equally, the selection of engineering materials should reflect students' disciplinary preparation. Cooperation between language teachers and engineering lecturers can inform the design of accessible, professionally meaningful tasks. Its practical implementation requires coordination so that disciplinary authenticity remains compatible with language objectives and available classroom time.

Assessment should examine whether students can select appropriate grammatical resources and use them to convey understandable technical meanings. The proposed dimensions of accuracy, form–meaning appropriateness, coherence, and task completion provide a basis for developing classroom rubrics. Their usefulness must nevertheless be tested through consistent scoring procedures and tasks that represent the intended learning objectives. Evaluation should also extend beyond immediately practised examples. Delayed performance and unfamiliar technical situations can provide evidence relevant to retention and transfer, provided that differences in content knowledge are considered. These assessment principles establish priorities for future investigation rather than confirm the validity of an existing instrument.

The article's contribution is a structured methodological proposal, not evidence of an experimentally established improvement in learning. No claim about effectiveness can be made without classroom implementation and systematic analysis. Subsequent research should investigate feasibility, learning outcomes, learner experiences, and the demands placed on teachers. Comparisons with clearly described instructional alternatives would help determine whether the

proposed approach offers measurable benefits and under which conditions. Ultimately, the framework advances a pedagogical direction: grammar instruction should help future engineers understand the relationship between linguistic choice and technical meaning, and develop the capacity to communicate that meaning independently across relevant professional situations.

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