



O'zbekiston Respublikasi
Maktabgacha va maktab
ta'limi vazirligi

ISSN: 2992-9008
UDK: 37

TA'LIM VA TARAQQIYOT

Ilmiy-uslubiy jurnali



2026-YIL 4-SON

www.journal.namspi.uz

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Nashr sanasi: 30.08.2026

"Ta'lim va taraqqiyot" ilmiy-uslubiy jurnali elektron to'plam sifatida O'zbekiston Respublikasi Prezidenti Administratsiyasi huzuridagi **Axborot va ommaviy kommunikatsiyalar agentligi (AOKA)ning 2022-yil 25-oktabrdagi № 045044 raqamli guvohnomasi** asosida chop etiladi. Jurnal **Oliy Attestatsiya komissiyasining 2024-yil 30-noyabrdagi (№ 364/5) yig'ilishi qaroriga asosan pedagogika fanlari bo'yicha falsafa fanlari doktori (PhD) va fan doktori (DSc) ilmiy darajasiga talabgorlarning dissertatsiya ishlari yuzasidan asosiy ilmiy natijalarini chop etish uchun tavsiya etilgan.** UDK: 37, Xalqaro standartlashtirish raqami (ISSN): 2992-9008.

Maqolalarning ilmiy saviyasi va keltirilgan ma'lumotlar uchun mualliflar javobgar hisoblanadi.

DEVELOPING ENGLISH SCIENTIFIC-TECHNICAL READING COMPETENCE IN FOOD TECHNOLOGY EDUCATION: A STRUCTURAL-FUNCTIONAL ANALYSIS

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Abstract. This article presents a structural-functional analysis of English scientific-technical reading competence as a target outcome of professional training in Food Technology programs. While previous studies have addressed individual dimensions of ESP reading—vocabulary knowledge, strategy use, or disciplinary content—few have articulated an integrated model that specifies how these dimensions interrelate and what functions they serve within food technology education. Drawing on ESP theory, cognitive reading models, and empirical research in food science education, this study develops a four-component model comprising linguistic, cognitive-strategic, professional-content, and socio-cultural dimensions. Each component is analyzed in terms of its constituent knowledge and skills, its developmental trajectory, and its contribution to the overall competence. The analysis further identifies five functions—informational, communicative, developmental, motivational, and gatekeeping—that reading competence serves in academic and professional contexts. The article concludes by proposing pedagogical principles for integrated reading instruction and outlining directions for empirical validation of the proposed model.

Keywords: English for Specific Purposes, reading competence development, food technology education, scientific-technical texts, integrated instruction

РАЗВИТИЕ КОМПЕТЕНЦИИ В ЧТЕНИИ НАУЧНО-ТЕХНИЧЕСКИХ ТЕКСТОВ НА АНГЛИЙСКОМ ЯЗЫКЕ В ОБРАЗОВАНИИ ПО ТЕХНОЛОГИЯМ ПИЩЕВЫХ ПРОМЫШЛЕНИЙ: СТРУКТУРНО-ФУНКЦИОНАЛЬНЫЙ АНАЛИЗ

Аннотация. В данной статье представлен структурно-функциональный анализ компетенции в чтении научно-технических текстов на английском языке как целевого результата профессиональной подготовки в программах по технологиям пищевых продуктов. Хотя предыдущие исследования рассматривали отдельные аспекты чтения на английском языке для специальных целей (ESP) — знание лексики, использование стратегий или содержание дисциплины — лишь немногие разработали интегрированную модель, которая определяет взаимосвязь этих аспектов и их функции в образовании по технологиям пищевых продуктов. Опираясь на теорию ESP, когнитивные модели чтения и эмпирические исследования в области образования по наукам о пищевых продуктах, в данном исследовании разработана четырехкомпонентная модель, включающая лингвистические, когнитивно-стратегические, профессионально-содержательные и социокультурные аспекты. Каждый компонент анализируется с точки зрения составляющих его знаний и навыков, траектории развития и вклада в общую компетенцию. Анализ дополнительно выявляет пять функций —

информационную, коммуникативную, развивающую, мотивационную и функцию контроля доступа — которые выполняет компетенция чтения в академическом и профессиональном контекстах. В заключение статьи предлагаются педагогические принципы интегрированного обучения чтению и намечаются направления для эмпирической проверки предложенной модели.

Ключевые слова: английский язык для специальных целей, развитие компетенции чтения, образование в области пищевых технологий, научно-технические тексты, интегрированное обучение

OZIQ-OVQAT TEXNOLOGIYASI TA'LIMIDA INGLIZ TILI ILMIY-TEXNIK O'QISH KOMPETSIYASINI RIVOJLANTIRISH: STRUKTURAL-FUNKSIONAL TAHLIL

Annotatsiya. Ushbu maqolada oziq-ovqat texnologiyalari dasturlarida professional tayyorgarlikning maqsadli natijasi sifatida ingliz tili ilmiy-texnik o'qish kompetensiyasining strukturaviy-funksional tahlili keltirilgan. Avvalgi tadqiqotlar ESP o'qishning individual jihatlari - lug'at bilimi, strategiyadan foydalanish yoki intizomiy mazmun - ko'rib chiqilgan bo'lsa-da, bu o'lehovlar qanday o'zaro bog'liqligini va ular oziq-ovqat texnologiyalari ta'limida qanday funktsiyalarni bajarishini aniqlaydigan integratsiyalashgan modelni kam odam bayon qilgan. ESP nazariyasi, kognitiv o'qish modellari va oziq-ovqat fanlari ta'limidagi empirik tadqiqotlarga tayanib, ushbu tadqiqot lingvistik, kognitiv-strategik, professional-mazmun va ijtimoiy-madaniy jihatlarni o'z ichiga olgan to'rt komponentli modelni ishlab chiqadi. Har bir komponent o'zining tarkibiy bilim va ko'nikmalari, rivojlanish traektoriyasi va umumiy kompetensiyaga qo'shgan hisssasi nuqtai nazaridan tahlil qilinadi. Tahlil shuningdek, o'qish kompetensiyasi akademik va professional kontekstlarda xizmat qiladigan beshta funktsiyani - axborot, kommunikativ, rivojlanish, motivatsion va darvozabonlik - aniqlaydi. Maqola integratsiyalashgan o'qish bo'yicha pedagogik tamoyillarni taklif qilish va taklif qilingan modelni empirik tasdiqlash bo'yicha ko'rsatmalarni bayon qilish bilan yakunlanadi.

Kalit so'zlar: Maxsus maqsadlar uchun ingliz tili, o'qish kompetentsiyasini rivojlantirish, oziq-ovqat texnologiyalari ta'limi, ilmiy-texnik matnlar, integratsiyalashgan o'qitish

INTRODUCTION

The globalization of the food industry has created unprecedented demands for English-language literacy among food technology professionals. Research articles, international standards, safety regulations, equipment manuals, and patent documentation are predominantly produced and disseminated in English, making reading competence a prerequisite for professional participation rather than a supplementary skill. For students preparing to enter this field, the ability to comprehend

English scientific-technical texts is thus not merely an academic requirement but a foundation for lifelong professional learning and international collaboration.

Despite widespread recognition of this need, food technology programs frequently treat English reading instruction as separate from disciplinary training, resulting in fragmented learning experiences that fail to develop the integrated competence students require. Needs analyses consistently reveal substantial gaps between the reading demands of professional practice and the preparation students receive in ESP courses. Vocabulary difficulty, syntactic complexity, unfamiliar rhetorical conventions, and insufficient background knowledge emerge as recurring obstacles across diverse educational contexts.

This article responds to these challenges by presenting a structural-functional analysis of English scientific-technical reading competence specifically situated within food technology education. The central argument is that this competence is best understood not as a collection of discrete skills but as an integrated system of interdependent components, each contributing distinct capabilities to the reading process while functioning collectively to enable professional communication. The analysis addresses three questions: What are the constituent components of this competence? How do these components function individually and collectively? What pedagogical principles follow from this structural-functional understanding?

The significance of this inquiry extends beyond theoretical clarification. By specifying what reading competence entails in this specific disciplinary context, the analysis provides a foundation for curriculum design, materials development, and assessment practices that are responsive to the actual demands food technology students will face in their professional lives.

METHODS

This study employs a theoretical-analytical design, synthesizing scholarship from three domains: ESP reading theory, cognitive models of reading comprehension, and

discipline-specific research in food technology education. The analytical procedure comprised four stages.

Stage One: Framework Identification. Foundational models of reading competence were examined, including cognitive processing models that delineate the mental operations involved in reading comprehension, component-skills frameworks that identify critical sub-skills for ESP reading development, and integrative models that emphasize the interaction of linguistic and content knowledge. These models provided the analytical vocabulary for describing competence components.

Stage Two: Empirical Synthesis. Research specific to food technology contexts was systematically reviewed, including needs analyses documenting reading demands and difficulties, studies of comprehension challenges in English for Food Technology courses, and analyses of authentic texts in food technology and engineering. This synthesis grounded the theoretical framework in empirically documented realities.

Stage Three: Component Specification. Components were derived through iterative comparison of theoretical categories and empirical findings, seeking convergence between what theory predicts should matter and what research documents as actually challenging for food technology students. Each component was specified in terms of its constituent knowledge domains and skills.

Stage Four: Functional Analysis. Functions were identified by analyzing how reading competence is deployed in academic study and professional practice as described in the literature. Particular attention was given to the purposes reading serves beyond immediate comprehension, including its role in professional identity formation and access to opportunity.

RESULTS

The analysis produced a four-component model of reading competence, each component exhibiting distinctive characteristics within the food technology context,

along with five functions that this competence serves in academic and professional settings.

Component One: Linguistic Knowledge

The linguistic component comprises the lexical, morphological, syntactic, and discourse-level knowledge systems that enable text processing. Within food technology, this component presents distinctive challenges arising from the lexical profile of the discipline.

At the lexical level, three categories of vocabulary operate simultaneously: high-frequency general words, academic vocabulary shared across disciplines, and technical terminology specific to food science. Technical vocabulary includes terms for preservation processes (*pasteurization, fermentation, lyophilization, irradiation*), food chemistry phenomena (*Maillard reaction, lipid oxidation, gelatinization*), microbiological concepts (*pathogenic microorganisms, spore-forming bacteria, colony-forming units*), and quality parameters (*water activity, organoleptic properties, shelf-life stability*). Research documents that unfamiliar technical vocabulary constitutes a primary comprehension obstacle, with 72.7% of food technology students reporting frequent difficulty and 81.8% citing insufficient background knowledge as a persistent challenge .

Beyond individual words, the linguistic component encompasses formulaic sequences characteristic of scientific discourse. Expressions such as "conduct a hazard analysis," "maintain cold chain integrity," and "achieve commercial sterility" function as lexical chunks processed as unified semantic units by proficient readers. The absence of such chunks from students' repertoires forces word-by-word processing, increasing cognitive load and reducing comprehension efficiency.

The morphological dimension offers a generative resource for managing unfamiliar terminology. Greek and Latin roots, prefixes, and suffixes—*thermo-* (heat), *hydro-* (water), *lipo-* (fat), *micro-* (small), combined with *-ation* (process), *-ity* (quality), *-genic* (producing)—allow readers to decompose novel terms and infer

meanings. Instruction in morphological analysis has been shown to improve students' ability to infer meanings of unfamiliar technical vocabulary in food science texts, indicating that this dimension is particularly amenable to pedagogical intervention.

Syntactic complexity presents a universal challenge, with 100% of respondents in one study reporting difficulties with the complex syntax characteristic of technical writing. Passive constructions ("the sample was subjected to thermal processing"), nominalizations ("the implementation of quality control procedures"), and extended noun phrases with multiple pre-modifiers create processing demands that exceed those of general English texts. Comprehension requires not only recognizing these structures but understanding their rhetorical functions—passives foregrounding processes rather than agents, nominalizations condensing information, and complex noun phrases encoding precise technical specifications.

Discourse-level knowledge encompasses understanding of cohesive devices that signal relationships among ideas. Scientific-technical writing in food technology employs transitional markers ("furthermore," "consequently," "in contrast"), lexical chains (repetition or synonymy of key terms), and parallel structures to organize information. Comprehending multi-step causal sequences—for example, how processing temperature affects microbial load, which influences product safety and shelf life—depends on accurately tracking these discourse signals.

Component Two: Cognitive-Strategic Knowledge

The cognitive-strategic component comprises the mental processes and deliberate strategies readers employ to construct meaning. This component operates at two levels: cognitive strategies engaged in text processing and metacognitive strategies that regulate comprehension.

Cognitive strategies include skimming for gist, scanning for specific information, identifying organizational patterns, making inferences, and predicting content. For food technology students, strategic competence involves navigating specific text types—

research articles, technical specifications, safety protocols, and regulatory documents — each presenting distinct comprehension demands. Research articles follow the IMRAD structure, requiring readers to locate information across sections; technical specifications present prescriptive requirements in standardized formats; safety protocols organize information according to hazard categories and control measures.

Metacognitive strategies involve planning reading approaches based on task purposes, monitoring comprehension, and evaluating comprehension success. Strategy instruction integrated with discipline-specific texts has produced substantial gains, with one study reporting 28% improvement in comprehension scores . Strategy deployment varies with text familiarity: reading specialized texts within their field, students rely on domain-specific strategies; encountering unfamiliar texts, they depend more heavily on linguistic-level strategies such as dictionary use and word analysis .

Detailed analysis of strategic behavior reveals patterns specific to food technology reading. When encountering research articles, successful readers demonstrate a consistent sequence: surveying abstract and graphical elements to establish a preliminary framework, reading the introduction to identify the research gap and objectives, navigating to results to examine data presentations, and finally engaging with the discussion. This non-linear approach reflects sophisticated understanding of scientific writing conventions. Students lacking structural awareness tend to read linearly, a strategy frequently resulting in cognitive overload when confronting dense technical content.

Inferential processing assumes particular importance because technical texts presuppose knowledge not explicitly stated. A text describing a novel preservation technique may assume familiarity with microbiological concepts; a discussion of packaging innovations may presuppose understanding of polymer chemistry. Competent readers deploy bridging inferences to connect new information with existing schemata, elaborative inferences to enrich understanding, and predictive inferences to

anticipate content. Research suggests inferential processing discriminates between more and less proficient ESP readers and that inferential abilities can be developed through activities requiring students to articulate the reasoning underlying interpretations .

Multimodal integration represents a further strategic dimension. Food technology texts routinely combine prose with tables, graphs, flow diagrams, and equations. Research on multimodal comprehension indicates students often struggle to integrate textual and graphical information, particularly when graphs employ unfamiliar conventions or when relationships between textual claims and graphical evidence are not explicit. Instruction addressing interpretation and integration of graphical information improves comprehension of scientific-technical texts.

Component Three: Professional-Content Knowledge

The professional-content component represents the intersection of linguistic and disciplinary knowledge. Reading competence cannot be separated from conceptual knowledge structures of the target discipline. Readers possessing well-developed schemata for food science—understanding thermal processing principles, microbial inactivation mechanisms, or food preservation chemistry—comprehend technical texts more efficiently because they integrate new information into existing frameworks.

This component includes knowledge of key concepts, processes, and relationships, plus familiarity with genres and discourse conventions through which knowledge is communicated. Authentic texts in food technology and engineering fall into three categories: informational texts for professionals (scientific articles, technical reports, product catalogues), pragmatically focused texts for broader audiences (operating instructions, labels, promotional materials), and educational texts from academic sources (textbooks, lecture materials) . Each genre presents distinct comprehension demands.

The depth of knowledge required extends beyond surface terminology familiarity to conceptual fluency—the ability to reason with and about disciplinary concepts. Reading a research article on high-pressure processing effects on protein structure

requires not merely understanding individual terms but possessing a working model of protein chemistry, understanding how pressure affects molecular bonds, and familiarity with analytical methods for assessing structural changes. This fluency enables readers to evaluate claim plausibility, identify methodological limitations, and assess finding significance—capacities distinguishing genuine comprehension from decoding.

Research documents significant correlation between disciplinary knowledge and reading comprehension performance. Students with stronger backgrounds in food chemistry, microbiology, and processing principles consistently demonstrate superior comprehension of English-language technical texts in these areas, even when general English proficiency is comparable to peers with weaker disciplinary preparation. This underscores the inseparability of content and language in ESP reading.

The quantitative dimension of professional-content knowledge warrants particular attention. Food technology texts frequently incorporate numerical data, statistical analyses, and mathematical formulas essential to understanding reported findings. A research article on thermal inactivation may present D-values, z-values, and activation energies interpretable only within established kinetic models. Studies on food rheology may employ mathematical models describing flow behavior. Research on sensory evaluation may report statistical significance tests and correlation coefficients. Comprehending such content requires quantitative literacy integral to disciplinary expertise. Students lacking this dimension may comprehend verbal text while failing to grasp quantitative evidence supporting its claims.

Methodological knowledge constitutes a further dimension. Articles in this field report experimental designs, sampling procedures, analytical methods, and statistical analyses requiring understanding for evaluating validity and reliability. Comprehension of methodological content requires familiarity with standard procedures (randomized controlled trials, factorial designs, response surface methodology) and ability to interpret descriptions of equipment, reagents, and procedures. Research indicates students

frequently experience difficulty with methodological sections, attributable not only to linguistic complexity but also to gaps in methodological knowledge.

Component Four: Socio-Cultural Knowledge

The socio-cultural component encompasses understanding of communicative norms, conventions, and cultural contexts shaping scientific-technical discourse. This includes recognition of how scientific arguments are constructed, conventions for citing and integrating sources, and pragmatic dimensions such as hedging claims, expressing certainty, and addressing audiences. For food technology students, this component involves understanding regulatory and standards frameworks governing international food production and trade, including discourse of Codex Alimentarius, the World Health Organization, and the International Organization for Standardization.

The component includes awareness of how cultural contexts influence food technology practices and their textual representations. Scientific-technical texts are not culturally neutral; they reflect assumptions about food safety, consumer expectations, and regulatory environments that may differ across contexts. Competent readers recognize and interpret these culturally embedded dimensions.

Understanding rhetorical purposes and audience expectations shaping different text types constitutes a further dimension. Research articles in food technology follow a distinctive argumentative structure moving from establishing a research territory through identifying a gap to occupying that gap. Technical standards employ a different rhetorical logic grounded in prescriptive authority and regulatory compliance. Product specifications and safety data sheets prioritize clarity, precision, and legal defensibility. Competent readers recognize these varied purposes and adjust comprehension strategies accordingly.

The ethical dimension of scientific-technical communication also falls within this component. Issues such as food safety, consumer protection, environmental sustainability, and equitable food access are embedded in technical texts and require

readers to recognize values and assumptions underlying them. A research article on novel preservation technology may implicitly weigh extended shelf life benefits against concerns about chemical additives or energy consumption. A regulatory document may reflect societal priorities regarding risk tolerance or consumer choice.

Interrelation of Components

While presented separately for analytical clarity, the four components function integratedly in actual reading. Linguistic knowledge provides the foundational code; cognitive-strategic abilities determine how effectively that code is deployed; professional-content knowledge supplies conceptual frameworks within which new information acquires significance; socio-cultural awareness situates texts within communicative contexts. Deficiency in any component impairs overall comprehension, while strength in one area may partially compensate for weakness in another.

Empirical research supports this interdependent model. Studies assessing multiple dimensions simultaneously report significant correlations among vocabulary knowledge, strategic awareness, disciplinary knowledge, and comprehension performance. Interventions addressing multiple components produce greater gains than single-dimension interventions. These findings suggest the four-component model serves not only as descriptive framework but also as guide for instructional design.

Functions of Reading Competence

The four components function collectively to serve five purposes within food technology education and practice.

The informational function enables access to current scientific knowledge, technological developments, and regulatory updates, predominantly disseminated in English. Reading competence facilitates extraction, processing, and integration of this information into professional practice, operating across text types from research articles to technical manuals.

The communicative function extends beyond reception to enable broader professional communication. Comprehending scientific-technical texts provides foundation for participating in discourse communities—engaging in discussions, preparing written responses, presenting findings, contributing to collaborative projects. The reading process involves internal dialogue with the text, developing communicative resources for active professional participation.

The developmental function fosters cognitive and professional growth. Reading scientific-technical texts develops critical thinking, analytical skills, and independent learning capacity essential for lifelong development in a rapidly evolving field. Through challenging texts, students develop tolerance for ambiguity, persistence in problem-solving, and metacognitive awareness for self-regulated learning.

The motivational function operates through reciprocal relationship between reading success and professional identity formation. Successful comprehension builds confidence and sense of belonging to the international professional community. Persistent difficulties undermine motivation and self-efficacy, highlighting the importance of appropriately scaffolded reading experiences.

The gatekeeping function operates within academic and professional contexts. Reading competence frequently serves as gatekeeper for advanced study, research opportunities, and career advancement. Students struggling with English-language reading may be excluded from international programs, research collaborations, and employment requiring English proficiency. Recognizing this function highlights equity dimensions of reading instruction.

DISCUSSION

The four-component model developed in this analysis offers several contributions to ESP theory and food technology education practice. First, it specifies the content of reading competence in terms relevant to a particular disciplinary context, moving beyond generic descriptions to articulate what food technology students specifically need to

know and be able to do. Second, it emphasizes the interdependence of components, challenging instructional approaches that treat vocabulary, strategies, content, and culture as separable. Third, it identifies functions that extend beyond immediate comprehension, highlighting the broader significance of reading competence for professional identity and opportunity.

The prominence of lexical and syntactic challenges documented in the research aligns with broader ESP findings while revealing discipline-specific characteristics. The lexical profile of food technology combines highly technical terminology with sub-technical academic vocabulary and formulaic sequences, creating demands that general English instruction inadequately addresses. The universal difficulty with syntactic complexity suggests instructional attention must extend beyond sentence-level grammar to address complex nominal and clausal structures prevalent in scientific-technical writing.

The cognitive-strategic component's importance is underscored by evidence that strategy instruction produces measurable gains. However, effectiveness depends on integration with authentic disciplinary texts and responsiveness to specific comprehension demands of different text types. Generic strategy instruction divorced from actual texts students will encounter professionally yields limited transfer.

The professional-content component highlights a fundamental tension: the relationship between language and content teaching. While ESP instructors are typically language specialists, effective reading instruction requires engagement with disciplinary content. This does not require language teachers to become content experts but to develop sufficient familiarity with food technology concepts and discourse to design meaningful tasks and anticipate conceptual difficulties. Collaborative approaches involving language and content instructors offer one response to this challenge.

The socio-cultural component, often overlooked in ESP reading instruction, is essential for preparing students to function in international professional contexts.

Understanding scientific argumentation conventions, technical communication pragmatics, and regulatory frameworks enables students to read texts as instances of professional discourse with which they engage as participants.

Several limitations warrant acknowledgment. The study is theoretical, synthesizing existing research rather than presenting new empirical data. The analysis draws primarily on research from Asian and Middle Eastern contexts where English functions as a foreign language; the model may manifest differently elsewhere. The proposed model requires empirical validation through studies operationalizing and measuring identified components in food technology populations.

Future research should examine relationships among components, developmental trajectories over professional training, and effectiveness of integrated instructional approaches. Longitudinal studies tracking students from undergraduate through professional practice would provide insights into long-term development and deployment of reading competence.

CONCLUSION

This article has presented a structural-functional analysis of English scientific-technical reading competence in food technology education. The four-component model—linguistic, cognitive-strategic, professional-content, and socio-cultural—specifies what this competence entails and how components interrelate. The five functions—informational, communicative, developmental, motivational, and gatekeeping—articulate why this competence matters beyond immediate comprehension.

Pedagogical implications point toward integrated instructional approaches addressing linguistic demands of specialized texts, developing strategic reading behaviors, activating and expanding disciplinary schemata, and cultivating understanding of scientific discourse conventions. The specific lexical and syntactic challenges identified warrant targeted attention within such approaches. The

motivational and gatekeeping functions underscore the importance of designing instructional experiences that build confidence and professional identity through successful engagement with authentic materials.

For food technology educators and ESP practitioners, the findings underscore the necessity of moving beyond generic reading instruction toward approaches responsive to specific communicative demands of the discipline. Developing reading comprehension competence in English should be recognized as integral to professional training, not supplementary. By understanding the structural nature of this competence and designing instruction accordingly, educators can better prepare food technology students for the demands of academic study and professional practice in an increasingly globalized field.

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