O‘ZBEKISTON MILLIY UNIVERSITETI XABARLARI, 2026, [15]
ISSN 2181-7324(Print)

IJTIMOIY FANLAR
http://journals.nuu.uz
ISSN 3093-8996(Onlayn)

UDK: 796.01:159.9:159

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Based on the review of Kh.Khakimov, associate professor of the Samarkand branch

THE IMPORTANCE OF TPACK AND STEM MODELS IN DEVELOPING ENGLISH WRITING AND SPEAKING SKILLS FOR STUDENTS OF NON-PHILOLOGICAL SPECIALTIES

Annotation

This article examines how Technological Pedagogical Content Knowledge (TPACK) and integrated Science, Technology, Engineering and Mathematics (STEM) education can be combined to support logistics students' productive skills in English, particularly speaking and writing. A focused narrative analysis of scholarship on technology integration, interdisciplinary problem solving, English for Specific Purposes, and communicative performance assessment informs the study. The principal outcome is a five-stage instructional framework that moves from a logistics problem through data interpretation and solution design to professional communication and reflective revision. Illustrative assignments include negotiating a delayed delivery, presenting a route recommendation, and drafting a written incident report. The article distinguishes what TPACK contributes to instructional decision-making from what STEM contributes to task content and reasoning.

Keywords: TPACK, integrated STEM, logistics education, English for Specific Purposes, speaking skills, writing skills, task-based learning.

NOFILOLOGIK TA’LIM YO‘NALISHI TALABALARINING INGLIZ TILIDA YOZISH VA GAPIRISH KO‘NIKMALARINI RIVOJLANTIRISHDA TPACK VA STEM MODELLARINING AHAMIYATI

Annotatsiya

Maqolada logistika yo‘nalishida tahsil olayotgan talabalarning ingliz tilida gapirish va yozish ko‘nikmalarini rivojlantirishda TPACK hamda STEM yondashuvlarini birgalikda qo‘llashning metodik imkoniyatlari tahlil qilinadi. Tadqiqot tegishli ilmiy adabiyotlar va til kompetensiyasini baholash mezonlarining maqsadli nazariy tahliliga asoslangan. Natijada logistika muammosini aniqlash, ma’lumotlarni tahlil qilish, yechimni asoslash, kasbiy muloqot va refleksiyadan iborat besh bosqichli o‘quv modeli ishlab chiqildi. Model asosida yuk tashishdagi kechikishlar, marshrut tanlash va ombor jarayonlari bo‘yicha og‘zaki taqdimotlar, muzokaralar hamda elektron xatlar yaratish taklif etiladi.

Kalit so‘zlar: TPACK, STEM, logistika ta’limi, ingliz tili, produktiv ko‘nikmalar, og‘zaki nutq, yozma nutq.

ЗНАЧЕНИЕ МОДЕЛЕЙ TPACK И STEM В РАЗВИТИИ НАВЫКОВ ПИСЬМА И ГОВОРЕНИЯ НА АНГЛИЙСКОМ ЯЗЫКЕ У СТУДЕНТОВ НЕФИЛОЛОГИЧЕСКИХ НАПРАВЛЕНИЙ

Аннотация

В статье рассматриваются методические возможности совместного применения моделей TPACK и STEM для развития навыков говорения и письма на английском языке у студентов направления «Логистика». Исследование основано на целевом теоретическом анализе научной литературы и критериев оценки языковой компетенции. Предложена пятиэтапная учебная модель, включающая постановку логистической проблемы, анализ данных, обоснование решения, профессиональную коммуникацию и рефлексию. На её основе предлагаются устные презентации, переговоры и деловая переписка по вопросам задержек поставок, выбора маршрутов и складских операций.

Ключевые слова: TPACK, STEM, логистическое образование, английский язык, продуктивные навыки, говорение, письмо.

Introduction. A logistics specialist rarely works with information that is complete, stable, or confined to a single language. A delayed shipment may require a phone call to a carrier, a short written explanation to a customer, and a revised delivery schedule prepared for management. In each interaction, English is used not simply to describe an event but to achieve a professional purpose. This distinction matters for university language courses: knowing transport terminology does not necessarily mean being able to justify a decision, negotiate an alternative, or document a problem accurately. In language pedagogy, speaking and writing are conventionally described as productive skills. For future logistics specialists, their value is best understood in relation to workplace actions: explaining the status of an order, requesting clarification, comparing shipping alternatives, documenting damage, and communicating operational risks. Such communication is often supported by tables, maps, schedules, tracking systems, and other forms of technical information. Students must therefore learn to convert numerical and operational evidence into language appropriate for a particular audience.

A needs-analysis study involving 156 logistics management students in Thailand identified the importance of all four language skills and vocabulary for logistics-related communication; participants particularly expressed a desire to improve speaking [4]. The findings cannot be transferred unchanged to another national or institutional context. Nevertheless, they illustrate why courses in English for Specific Purposes (ESP) should be designed around documented communicative needs rather than generic vocabulary lists alone. A recent discussion of logistics terminology in Uzbekistan similarly draws attention to context and the communicative purpose of specialized lexical items [8]. Two educational models provide a useful starting point for addressing this problem. The TPACK framework describes the relationships among technological, pedagogical, and content knowledge involved in meaningful technology integration [2]. Integrated STEM education, by contrast, emphasizes connections among disciplinary practices through authentic problem situations [3]. Although the models were developed for different purposes, their combination may help English instructors design tasks that are technically credible, linguistically demanding, and pedagogically manageable. The aim of this article is to formulate a theoretically grounded method for integrating TPACK and STEM principles into instruction aimed at developing logistics students' English speaking and writing.

Materials and methods. The study uses a focused narrative review and conceptual synthesis. It does not involve a

new questionnaire, classroom intervention, control group, or collection of individual student scores. The documentary base comprises foundational accounts of pedagogical content knowledge and TPACK, a conceptual framework for integrated STEM, research on project-based language learning, work on logistics-specific English needs, and the Common European Framework of Reference for Languages (CEFR) Companion Volume. These sources were selected for their direct relevance to the instructional problem and for the availability of identifiable publication details. This is a purposive selection rather than an exhaustive systematic review.

The analysis followed four steps. First, the principal concepts in each model were distinguished: disciplinary content, instructional methods, technology choice, authentic problem solving, and communicative output. Second, the communicative situations most closely connected to logistics training were identified, including explaining shipment status, evaluating alternatives, and producing customer-facing documents. Third, these elements were combined into a learning sequence that specifies the task, required reasoning, language product, and teacher support at each stage. Finally, the proposed outcomes were aligned with CEFR descriptors for reports, professional discussion, and goal-oriented cooperation [1], [1]. A distinction was maintained between source-based observations and author-developed proposals. Statements about previously published studies are treated as external evidence; the five-stage sequence, example scenario, and assessment rubric are methodological constructions derived from that evidence. Their practical value is plausible but remains to be verified through classroom implementation. This boundary is especially important when discussing a model’s 'effect': an effect measured through pre-and post-intervention assessment is not equivalent to a theoretically expected contribution.

Results. TPACK provides a perspective on the teacher’s instructional decisions. Knowledge of logistics content helps the teacher recognize why delivery lead time, shipment status, route constraints, and document accuracy matter. Pedagogical knowledge concerns how students learn to communicate: preparation, scaffolding, peer interaction, feedback, and revision. Technological knowledge concerns the affordances and limitations of tools such as shared documents, spreadsheets, interactive route maps, recording applications, and digital learning environments. TPACK becomes relevant when these three bodies of knowledge are coordinated rather than added together mechanically. Shulman’s earlier discussion of pedagogical content knowledge is a foundation for this emphasis on the transformation of subject matter into teachable forms [7, 4]; Mishra and Koehler extend the argument to teaching with technology [2, 1017].

STEM contributes a different organizing principle: learners investigate a consequential problem and use appropriate disciplinary reasoning to evaluate possible solutions. Kelley and Knowles situate integrated STEM learning at the intersection of inquiry, design, technological literacy, and mathematical thinking [3, 3]. In a logistics English classroom, an authentic problem may concern route reliability, storage conditions, delivery schedules, or resource use. The task does not require the language instructor to teach a full engineering course. It requires the English lesson to contain enough verified technical context for students to make and explain defensible choices. The language objective must remain explicit. The two approaches therefore meet at the point of task design. STEM supplies the problem, evidence, and reasoning demands. TPACK helps the teacher decide which tools and teaching moves will enable learners to communicate about that problem in English. Productive skills provide the observable output. If technology only makes a worksheet more attractive, its TPACK contribution is weak. Equally, if students perform calculations but do not present, discuss, or write about their conclusions, the activity has not met the language-learning objective.

The proposed sequence begins with a manageable operational difficulty and ends with a revised professional communication product. Each stage prepares a different form of language use. The sequence is presented in Table 1 and may be adapted to students’ proficiency levels, institutional resources, and modules within the logistics curriculum.

Table 1. Proposed instructional sequence for TPACK–STEM-integrated English tasks

Stage	Logistics/STEM activity	English output	TPACK-guided support
1. Identify the problem	Read a shipment brief; identify gaps and stakeholders	Questions, clarification requests	Digital/printed shipment brief; guided questions
2. Interpret evidence	Compare timeline, cost, and operational constraints	Notes explaining comparisons	Spreadsheet or comparison matrix; group analysis
3. Design a response	Choose a feasible action and state its limitations	Reasoned recommendation	Scenario card; problem-based discussion
4. Communicate	Negotiate, present and write for a defined audience	Meeting contribution; professional email	Role play, recording, collaborative drafting
5. Reflect and revise	Evaluate feedback and check factual consistency	Revised oral/written output	Rubric, peer review, revision record

The five stages should be understood as connected rather than rigidly linear. Students may return from a negotiation to the data table when a partner challenges their recommendation. They may also revise an email after discovering that a proposed delivery date is not supported by the schedule. These movements between evidence and expression are central to the model: English is used to test, refine, and communicate professional judgments.

Consider a simulated case in which a distributor expects a consignment on Friday, but a carrier reports that it will arrive two days later. Students receive an instructor-prepared shipment timeline, a short carrier message, and two possible response plans. One plan prioritizes earlier arrival but requires an additional transfer; the other reduces operational complexity but offers less flexibility. The figures and dates are teaching inputs created for the exercise, not observations from a real company or research dataset.

At the problem-analysis stage, groups identify information that is missing: whether the customer can accept partial delivery, whether storage conditions matter, and whether a transfer is feasible. In the design stage, each group prepares a comparison matrix with assumptions, advantages, constraints, and a recommended action. This activity introduces STEM-related practices such as interpreting a timeline, comparing operational constraints, and explaining a decision on the basis of evidence. It does not pretend that a simple comparison exercise fully represents every STEM discipline. The communication stage contains two complementary products. For speaking, students participate in a three-person meeting as logistics coordinator, carrier representative, and customer. They must explain the delay, ask precise questions, defend a recommendation, and reach a provisional agreement. For writing, each student drafts a 180–220-word professional email that summarizes the cause, proposed response, expected next update, and any outstanding uncertainty. Students are explicitly instructed not to claim certainty when information is incomplete. A spreadsheet can support analysis; a shared document can support collaborative drafting; and an audio recording can enable self-evaluation of oral fluency and clarity. These tools are selected because they serve identifiable learning functions. Where connectivity or equipment is limited, a printed table, paper draft, and face-to-face role play remain viable alternatives. The core outcome is not the number of platforms used. It is whether a learner can produce a coherent, accurate, and audience-sensitive message.

Evaluation should make the productive dimension visible. The CEFR Companion Volume distinguishes reports and essays, formal discussion, goal-oriented cooperation, and correspondence,

allowing an instructor to adapt general communicative descriptors to profession-specific performance [1]. A local rubric should distinguish the quality of language from the correctness of the professional recommendation; otherwise, technical knowledge may conceal weaknesses in communication, or grammatical accuracy may conceal a misleading operational explanation. The proposed rubric uses five criteria: (1) task completion and audience relevance; (2) precision of logistics vocabulary and factual information; (3) organization and coherence; (4) linguistic control, intelligibility, and appropriate register; and (5) interactive responsiveness for speaking or actionable completeness for writing. Each criterion may be scored on an explicitly defined scale, for example 0–4, with separate descriptors for oral and written tasks. The score range is an assessment design suggestion, not a reported research result. Teachers should calibrate scoring through shared examples before using the rubric in consequential evaluation. Three mechanisms may account for improvements if the approach is subsequently implemented well. First, realistic information gaps create a reason to ask questions and clarify meaning. Second, data-supported choices encourage learners to structure arguments rather than assemble unrelated sentences. Third, iterative production, feedback, and revision make errors visible in the context of purposeful communication. Research on project-based language learning supports the educational value of integrating language, subject matter, and higher-order skills, while also noting that learners need to understand the purpose of project activities [5]. Technology-supported language projects illustrate the possibilities of sustained, collaborative communication, although evidence obtained from different age groups and contexts should not be treated as direct proof of effectiveness for logistics undergraduates [6].

Discussion. This reorientation is consistent with the logic of ESP, where learning objectives should follow the communicative requirements of an identifiable field. Evidence about logistics students’ self-reported needs reinforces the importance of a balanced approach to receptive and productive language work [4]. Reading a tracking update or interpreting a schedule is often the input for a subsequent oral or written message. Accordingly, reading and listening should not be removed from instruction; they become purposeful preparation for speaking and writing. There are, however, important tensions. An elaborate STEM problem can overwhelm students whose language proficiency is still developing. The instructor may then spend so much time explaining technical facts that students have little opportunity to speak. Conversely, a visually engaging digital task may demand minimal reasoning or language. The solution is selective integration. Teachers should begin with a small, familiar logistics problem, provide relevant vocabulary and model genres, and increase complexity only as learners demonstrate independence. For lower-proficiency groups, structured prompts and short message templates may be appropriate. More advanced learners can negotiate competing constraints and justify uncertainty in fuller reports. The framework also requires collaboration across subject boundaries. An English instructor may possess strong expertise in instructional language design but limited experience with freight operations. A logistics lecturer can help check scenario realism, while the English instructor retains responsibility for linguistic goals and feedback. This division of work is more defensible than expecting every language teacher to become an expert in engineering or quantitative optimization. It also makes assessment clearer: domain accuracy and communicative effectiveness should be reviewed as related but distinguishable dimensions.

Digital access presents a further constraint. Shared spreadsheets or simulated tracking systems can make information visible and editable, but unequal device access, excessive cognitive load, and student use of automated text generation can obscure what learners themselves can produce. Therefore, the design should include short supervised speaking tasks, a visible revision history where feasible, and an individual writing component. Technology must remain subordinate to the learning objective. The integration of TPACK and STEM is not, by itself, evidence that a specific application, platform, or artificial-intelligence tool improves language proficiency. An empirical test of the framework should compare productive performance before and after instruction while accounting for initial English proficiency and prior logistics knowledge. A feasible study could combine analytic speaking and writing rubrics, equivalent task difficulty, independent scoring by trained raters, and student interviews about task authenticity. If a comparison group is used, instructional time and assessment conditions should be matched as closely as practical. The analysis should report effect sizes and uncertainty rather than relying solely on whether post-test averages are higher. None of these procedures has been conducted as part of the present conceptual article.

Conclusion. Integrating TPACK and STEM offers a coherent methodological direction for teaching productive English skills to logistics students, provided the models retain their distinct functions. TPACK guides the relationship among professional subject matter, pedagogy, and selected technologies. STEM contributes authentic problem contexts and evidence-based reasoning. Together, they can inform tasks in which learners interpret operational information and transform it into purposeful spoken or written communication. The article’s principal contribution is a five-stage instructional framework, accompanied by a simulated logistics case and assessable indicators of oral and written performance. These elements may help instructors design more authentic ESP lessons and clarify what students are expected to produce.

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