



**НАУЧНАЯ АРТЕЛЬ**  
**АКАДЕМИЧЕСКОЕ ИЗДАТЕЛЬСТВО**



ISSN (p) 2712-9489

ISSN (e) 2542-1026

№ 7/2025

**НАУЧНЫЙ ЖУРНАЛ  
«COGNITIO RERUM»**

Москва  
2025

# НАУЧНЫЙ ЖУРНАЛ «COGNITIO RERUM»

Учредитель:  
Общество с ограниченной ответственностью «Издательство  
«Научная артель»

ISSN (p) 2412-9489

ISSN (e) 2542-1026

Периодичность: 1 раз в месяц

Журнал размещается в Научной электронной библиотеке  
elibrary.ru по договору №511-08/2015 от 06.08.2015

Журнал размещен в международном каталоге  
периодических изданий Ulrich's Periodicals Directory.

Верстка: Мартиросян О.В.  
Редактор/корректор: Мартиросян Г.В.

Учредитель, издатель и редакция  
научного журнала «COGNITIO RERUM»  
Академическое издательство «Научная артель»:

+7 (495) 514 80 82

<https://sciartel.ru>

[info@sciartel.ru](mailto:info@sciartel.ru)

450057, ул. Салавата 15

Подписано в печать 15.07.2025 г.

Формат 60x90/8

Усл. печ. л. 9.2

Тираж 500.

Отпечатано  
в редакционно-издательском отделе академического издательства  
«Научная артель»  
<https://sciartel.ru>  
[info@sciartel.ru](mailto:info@sciartel.ru)  
+7 (495) 514 80 82

Цена свободная. Распространяется по подписке.

Все статьи проходят экспертную проверку. Точка зрения редакции не  
всегда совпадает с точкой зрения авторов публикуемых статей.

Авторы статей несут полную ответственность за содержание статей и за  
сам факт их публикации. Редакция не несет ответственности перед  
авторами и/или третьими лицами за возможный ущерб, вызванный  
публикацией статьи.

При использовании и заимствовании материалов, опубликованных в  
научном журнале, ссылка на журнал обязательна

## Главный редактор:

Сукиасян Асатур Альбертович, к.э.н.

## Редакционный совет:

Абидова Гулмира Шухратовна, д.т.н.

Авазов Сардоржон Эркин углы, д.с.-х.н.

Агафонов Юрий Алексеевич, д.м.н.

Алейникова Елена Владимировна, д.гос.упр.

Алиев Закир Гусейн оглы, д.фил.агр.н.

Ашрапов Баходурджон Пулотович, к.фил.н.

Бабаян Анжела Владиславовна, д.пед.н.

Баишева Зилия Вагизовна, д.фил.н.

Булатова Айсылу Ильдаровна, к.соц.н.

Бурак Леонид Чеславович, к.т.н., PhD

Ванесян Ашот Саркисович, д.м.н.

Васильев Федор Петрович, д.ю.н., член РАЮН

Вельчинская Елена Васильевна, д.фарм.н.

Виневская Анна Вячеславовна, к.пед.н.

Габрусь Андрей Александрович, к.э.н.

Галимова Гузалия Абкадировна, к.э.н.

Гетманская Елена Валентиновна, д.пед.н.

Гимранова Гузель Хамидулловна, к.э.н.

Григорьев Михаил Федосеевич, к.с.-х.н.

Грузинская Екатерина Игоревна, к.ю.н.

Гулиев Игбал Адилевич, д.м.н.

Датий Алексей Васильевич, к.э.н.

Долгов Дмитрий Иванович, к.э.н.

Дусматов Абдурахим Дусматович, к. т. н.

Ежкова Нина Сергеевна, д.пед.н.

Екшикеев Тагер Кадырович, к.э.н.

Епхиева Марина Константиновна, к.пед.н., проф. РАЕ

Ефременко Евгений Сергеевич, к.м.н.

Закиров Мунавир Закиевич, к.т.н.

Зарипов Хусан Баходирович, PhD.

Иванова Нионила Ивановна, д.с.-х.н.

Калужина Светлана Анатольевна, д.х.н.

Канарейкин Александр Иванович, к.т.н.

Касимова Дилара Фаритовна, к.э.н.

Кириасян Сусана Арсеновна, к.ю.н.

Киркимбаева Жумагуль Слямбековна, д.вет.н.

Кленина Елена Анатольевна, к.филос.н.

Клещина Марина Геннадьевна, к.э.н.,

Козлов Юрий Павлович, д.б.н., заслуженный эколог РФ

Кондрашихин Андрей Борисович, д.э.н.

Конопацкова Ольга Михайловна, д.м.н.

Куликова Татьяна Ивановна, к.псих.н.

Курбанаева Лилия Хамматовна, к.э.н.

Курманова Лилия Рашидовна, д.э.н.

Ларионов Максим Викторович, д.б.н.

Малышкина Елена Владимировна, к.и. н.

Маркова Надежда Григорьевна, д.пед.н.

Мещерякова Алла Брониславовна, к.э.н.

Мухамадеева Зинфира Фанисовна, к.соц.н.

Мухамедова Гулчехра Рихсибаевна, к.пед.н.

Набиев Тухтамурод Сахобович, д.т.н.

Песков Аркадий Евгеньевич, к.полит.н.

Половения Сергей Иванович, к.т.н.

Пономарева Лариса Николаевна, к.э.н.

Почивалов Александр Владимирович, д.м.н.

Прошин Иван Александрович, д.т.н.

Саттарова Рано Кадыровна, к.биол.н.

Сафина Зилия Забировна, к.э.н.

Симонович Николай Евгеньевич, д.псих. н., академик РАЕН

Сирик Марина Сергеевна, к.ю.н.

Смирнов Павел Геннадьевич, к.пед.н.

Старцев Андрей Васильевич, д.т.н.

Танаева Замфира Рафисовна, д.пед.н.

Терзиев Венелин Кръстев, д.э.н., член РАЕ

Умаров Бехзод Тургунпулатович, д.т.н.

Хайров Расим Золимхон углы, к.пед.н.

Хамзаев Иномжон Хамзаевич, к. т. н.

Хасанов Сайдинаби Сайдидалиевич, д.с.-х.н.

Чернышев Андрей Валентинович, д.э.н.

Чиладзе Георгий Бидзиневич, д.э.н., д.ю.н., член РАЕ

Шилкина Елена Леонидовна, д.соц.н.

Шкирмонтов Александр Прокопьевич, д.т.н., член-РАЕ

Шляхов Станислав Михайлович, д.физ.-мат.н.

Шошин Сергей Владимирович, к.ю.н.

Юсупов Рахимьян Галимьянович, д.и. н.

Яковишина Татьяна Федоровна, д.т.н.

Янгиров Азат Вазирович, д.э.н.

Яруллин Рауль Рафаэллович, д.э.н., член РАЕ

## СОДЕРЖАНИЕ

### ФИЗИКА

- Львов О.С.** 6  
ЗАМЕЧАНИЯ К СТАТЬЕ “ТЕНЗОР ЭНЕРГИИ-ИМПУЛЬСА И УРАВНЕНИЯ ЭЛЕКТРОМАГНИТНОГО ПОЛЯ В ОДНОРОДНОЙ СРЕДЕ”

- Пономарев Д.В.** 8  
ВЗАИМОСВЯЗЬ ГРАВИТАЦИОННОЙ ПОСТОЯННОЙ И СКОРОСТИ СВЕТА

### ХИМИЯ

- Akmadov N., Agageldiyeva J.** 15  
THE ROLE OF AGRICULTURAL TECHNOLOGY IN EDUCATION

- Charyberdiyev K., Yoldashov G., Hojamberdiyev H.** 16  
VETERINARY AND SANITARY EXPERTISE: SCIENTIFIC FOUNDATIONS FOR HEALTH, SAFETY, AND ENVIRONMENTAL CONTROL

- Ovezgeldiyeva E., Yoldashov G., Rejepov T.** 19  
THE ROLE OF AGRICULTURAL EDUCATION IN SUSTAINABLE DEVELOPMENT: GLOBAL PERSPECTIVES

### ТЕХНИКА И ТЕХНОЛОГИЯ

- Азиев Я.Г., Мамедов Ф.И.** 22  
ВЛИЯНИЕ ЦИФРОВЫХ ПЛАТФОРМ НА ОПТИМИЗАЦИЮ МАРШРУТОВ, ПРЕДОТВРАЩЕНИЕ ПРОБОК И СНИЖЕНИЕ ВЫБРОСОВ

- Bui Thi Thuy** 25  
CALCULATING LINEAR VIBRATIONAL DIFFERENTIAL EQUATION OF CAR WITH FRACTIONAL DAMPING

- Tran Thi Tram** 29  
CALCULATION OF CRANE ROBOT KINEMATICS

### СЕЛЬСКОЕ ХОЗЯЙСТВО

- Seydiyeva J. Garyagdyev M.** 35  
WORLD EXPERIENCE IN FEEDING RACEHORSES: A MODERN PERSPECTIVE ON OPTIMIZING PERFORMANCE AND HEALTH

### ФИЛОЛОГИЯ

- Mammedov M., Atjykova O.** 38  
SUCCESSFULLY FOREIGN LANGUAGES LEARNING

- Matmuradova L., Kurbanowa A.** 39  
LEARNING ENGLISH - A TRANSFORMATIVE JOURNEY THAT BROADENS HORIZONS, BUILDS CONFIDENCE

- Myratdurdyev N., Bayramgeldiyev V., Akmadov N.** 41  
LEARNING WORLD LANGUAGES IN THE CONTEXT OF BIOLOGICAL SCIENCES

- Nguyen Thi Thu Phuc** 43  
ATTITUDES TOWARDS THE USE OF ENGLISH - VIETNAMESE CODE-SWITCHING IN CONVERSATIONS  
OF VIETNAMESE ENGINEERS

#### ПЕДАГОГИКА

- Seydiyeva J., Gurdov N.** 51  
THE INDISPENSABLE ROLE OF INNOVATIVE TECHNOLOGIES IN MODERN EDUCATION

- Truong Thi Thanh Thuy** 53  
USING ENGLISH STORIES ON YOUTUBE IN LANGUAGE TEACHING AND LEARNING

- Vu Huu Tuyen** 57  
DEVELOPING STUDENTS' SELF-LEARNING ABILITY IN ENGINEERING THROUGH THE USE OF  
TECHNOLOGY IN TECHNICAL DRAWING

- Мухидинов М.Г.,** 60  
ПСИХОЛОГИЧЕСКИЕ ПРОБЛЕМЫ ИНФОРМАЦИОННОЙ ТРАНСФОРМАЦИИ ОБРАЗОВАНИЯ

#### МЕДИЦИНА

- Atayeva A.** 65  
THE INTEGRATED IMPERATIVE: MEDICAL ECOLOGY AND HYGIENE SCIENCE FOR GLOBAL HEALTH

#### ВЕТЕРИНАРИЯ

- Гостев Д.** 69  
ПРАВОВАЯ И НОРМАТИВНО-ТЕХНИЧЕСКАЯ БАЗА ОБЕСПЕЧЕНИЯ БЕЗОПАСНОСТИ  
СУБПРОДУКТОВ

#### ГЕОГРАФИЯ

- Seydiyeva J. Annayeva L.** 72  
CHARACTERISTICS OF TOURISM GEOGRAPHY: A SPATIAL LENS ON A GLOBAL PHENOMENON

- Seydiyeva J. Shamyradova G.** 75  
TOURIST DESTINATIONS OF THE WORLD AND THEIR ENDURING CHARMS

#### АРХИТЕКТУРА

- Charyyev S., Agayev B.** 79  
THE MODERN SCIENTIFIC FOUNDATIONS OF BUILDING MATERIALS: ENGINEERING A SUSTAINABLE  
FUTURE



# ФИЗИКА

УДК 537.871

Львов Олег Сергеевич  
НПО «Рубин», пенсионер  
г. Пенза, РФ

**ЗАМЕЧАНИЯ К СТАТЬЕ “ТЕНЗОР ЭНЕРГИИ-ИМПУЛЬСА И УРАВНЕНИЯ  
ЭЛЕКТРОМАГНИТНОГО ПОЛЯ В ОДНОРОДНОЙ СРЕДЕ”**

**Аннотация**

В июньском номере 2025 г. научного журнала "COGNITIO RERUM" была опубликована статья Львова О.С. “Тензор энергии-импульса и уравнения электромагнитного поля в однородной среде”. Автор статьи предлагает вариант решения наболевшего вопроса о тензоре энергии-импульса в однородной среде, а также новое уравнение электромагнитного поля (ЭМП) в подвижной среде. К сожалению, в статье обнаружилось несколько серьезных ошибок и недостаточно строгих обоснований некоторых положений. Учитывая важность затронутой проблемы, автор предлагает корректировку отдельных фрагментов статьи с целью устранения выявленных недостатков.

**Ключевые слова:**

тензор энергии-импульса, электромагнитное поле, однородная среда.

Lvov Oleg Sergeevich  
SPO “Rubin”, retiree

**COMMENTS ON THE ARTICLE “ENERGY-MOMENTUM TENSOR AND ELECTROMAGNETIC FIELD  
EQUATIONS IN A HOMOGENEOUS MEDIUM”**

**Annotation**

In the June 2025 issue of the journal "COGNITIO RERUM", an article by O.S. Lvov was published. «The energy-impulse tensor and the electromagnetic field equation in a homogeneous medium». The author of the article proposes a solution to the pressing question of the energy-impulse tensor in a homogeneous medium, as well as a new equation of the electromagnetic field in a moving medium. Unfortunately, the article revealed several serious errors and insufficiently strong justifications for some of the provisions. Given the importance of the problem, the author proposes to correct the separate fragments of the article in order to eliminate the identified shortcomings.

**Keywords:**

energy-momentum tensor, electromagnetic field, homogeneous medium.

**Введение**

В июньском номере 2025 г. журнала "COGNITIO RERUM" была опубликована статья Львова О.С. “Тензор энергии-импульса и уравнения электромагнитного поля в однородной среде” [1]. Автор статьи предлагает вариант решения наболевшего вопроса о тензоре энергии-импульса в однородной среде, а также новое уравнение электромагнитного поля (ЭМП) в подвижной среде. К сожалению, в статье было обнаружено несколько серьезных ошибок и недостаточно строгих обоснований некоторых положений. Учитывая важность затронутой проблемы, автор предлагает корректировку отдельных фрагментов статьи с целью устранения выявленных недостатков.

### Обнаруженные ошибки автора статьи

1. Ниже формулы (2) написано:

“Релятивистские уравнения (1) при добавлении токовых членов считаются справедливыми как для неподвижной, так и для движущейся среды. Однако такая ситуация имеет место лишь в случае детального *микроскопического* описания среды. При *макроскопическом* описании среды, когда рассматриваемая среда характеризуется лишь показателями диэлектрической и магнитной проницаемости... использование релятивистских уравнений (1) не правомерно”.

Это утверждение неверно. Фактически уравнения (1) (уравнения Максвелла) представляют *макроскопическое* описание ЭМП в диэлектрической среде. С целью обоснования неправомерности уравнений (1) представляется разумным указать в конце раздела следующее:

“Уравнения ЭМП (1) считаются справедливыми как для неподвижной, так и для движущейся среды [2, с. 363]. Однако такая ситуация вызывает сомнения ввиду записи нерелятивистских уравнений ЭМП в среде в явной релятивистской форме, а также ввиду проблемы получения в этом случае корректного ТЭИ. Ниже предлагаются другие формы уравнений ЭМП и ТЭИ, не обладающих отмеченными недостатками”.

2. В формулах (20g) значение плотности импульса ЭМ волны получается умножением компонент ТЭИ ЭМП на фактическую скорость ЭМ волн

$$S_1 = \frac{c}{n} T^{01} = \frac{c}{4\pi n} E_2 H_3 = \frac{\omega^2}{4\pi c n^2},$$

$$S'_1 = v'_1 T'^{01} = \frac{v_1}{4\pi} E'_2 H'_3 = \frac{\gamma^2 \omega^2 (1 - \beta n)^3}{4\pi c n - \beta}.$$

Это неверно. В принятой вариационной методике импульсные компоненты ТЭИ умножаются на скорость света  $c$ . На это обстоятельство следует указать в начальной части **Приложения А** такой фразой:

“Согласно ТЭИ Минковского (3g) при покоящейся среде вектор плотности потока энергии  $\mathbf{S} = \frac{c}{4\pi} (\mathbf{E} \times \mathbf{H})$  и вектор плотности импульса  $\mathbf{g} = \frac{n^2}{4\pi c} (\mathbf{E} \times \mathbf{H})$  [3]. В компонентной записи  $S^\alpha = c T^{0\alpha}$  и  $g^\alpha = \frac{1}{c} T^{\alpha 0}$ ”.

Две конечные формулы (20g) следует записать в следующей форме:

$$S^1 = c T^{01} = \frac{c}{4\pi} E_2 H_3 = \frac{c}{4\pi} \frac{\omega}{c\sqrt{\epsilon}} \frac{\omega}{\sqrt{\mu} c} = \frac{\omega^2}{4\pi c n},$$

$$S'^1 = c T'^{01} = \frac{c}{4\pi} E'_2 H'_3 = \frac{\omega^2}{4\pi c n} \frac{(1 - \beta n)^2}{1 - \beta^2}.$$

3. В конце раздела “Уравнения и тензор энергии-импульса свободного ЭМП в однородной магнитно-диэлектрической среде” фразу “Заметим, что сохранение энергии и импульса в некоторой ИСО имеет место также в любой другой ИСО, в частности в подвижной ИСО, в силу равенства нулю истоков указанных величин” предлагается заменить более строгим утверждением:

“Заметим, что сохранение энергии и импульса в некоторой ИСО имеет место также в любой другой ИСО, в частности в подвижной ИСО, в силу равенства нулю всех компонент 4-вектора истоков указанных величин”.

### Заключение

Обнаруженные ошибки вызывают сомнения в правильности освещенных в статье новых положений. Однако, справедливости ради, следует отметить, что выявленные две серьезные ошибки касаются лишь критических замечаний в адрес некоторых известных в настоящее время положений теории ЭМП в среде.

Эти ошибки не влияют на правильность полученных результатов, что подтверждается повторной проверкой автором всех имеющихся расчетов.

Поправленный вариант статьи можно посмотреть по ссылке  
<http://lvov-articles.ru>tensorEMF/TEM EMF.pdf>.

**Список использованной литературы:**

1. Львов О.С. Тензор энергии-импульса и уравнения электромагнитного поля в однородной среде // Научный журнал «COGNITIO RERUM» № 6/2025, с. 10-19.
2. Ландау Л.Д., Лифшиц Е.М. Теоретическая физика, том VIII. Электродинамика сплошных сред // М. Наука, 1982, 621 с.
3. Веселаго В.Г., Щавлев В.В. О релятивистской инвариантности тензоров энергии-импульса в форме Минковского и форме Абрагама // УФН, №3, 2010, т. 180, с. 331,332.

© Львов О.С., 2025

**Пономарев Дмитрий Валерьевич**

Независимый исследователь  
г. Санкт-Петербург, РФ

**ВЗАИМОСВЯЗЬ ГРАВИТАЦИОННОЙ ПОСТОЯННОЙ И СКОРОСТИ СВЕТА**

**Аннотация**

В статье рассматривается взаимосвязь значения гравитационной постоянной и скорости света через связь полной внутренней энергии покоя материального тела и энергии его гравитационного поля. Целью работы является математический вывод формулы определения гравитационной постоянной через скорость света.

**Ключевые слова:**

гравитационная постоянная, скорость света, тензор энергии-импульса, тензор напряжений.

**Dmitry Ponomarev V.**

Independent researcher  
Saint-Petersburg, Russia

**THE RELATIONSHIP BETWEEN THE GRAVITATIONAL CONSTANT AND THE SPEED OF LIGHT**

**Abstract**

The article examines the relationship between the value of the gravitational constant and the speed of light through the relationship between the total internal energy of rest of a material body and the energy of its gravitational field. The purpose of the work is to mathematically derive a formula for determining the gravitational constant through the speed of light.

**Keywords:**

gravitational constant, speed of light, energy-momentum tensor, stress tensor.

Гравитационная постоянная – это одна из основных фундаментальных физических констант и ее, пожалуй, знают или слышали о ней буквально все. Гравитационная постоянная присутствует в знаменитом уравнении определения силы гравитационного притяжения, которое имеет вид [1]:

$$F = G \frac{m_1 m_2}{r^2}, \quad (1)$$

где:  $F$  – гравитационная сила между двумя материальными телами с массами  $m_1$  и  $m_2$ , находящимися на расстоянии  $r$  между друг другом;  $G$  – гравитационная постоянная.

До сих пор гравитационная постоянная является физической величиной, значение которой определяют экспериментально. В настоящей работе показано, что гравитационную постоянную можно определить математически из закона сохранения энергии и она представляет из себя определенную часть другой фундаментальной константы – скорости света. Это дает возможность точно определить значение гравитационной постоянной, которое будет зависеть только от того на сколько точно определено значение скорости света в вакууме.

Настоящая статья является кратким содержанием работы Пономарева Д.В. «Гравитационная постоянная – это физическая величина, имеющая числовое выражение в 0,02 части обратной величины скорости света ( $G = 0,02/c$ )» [2] и содержит только базовые тезисы без детализации математических выкладок и обоснований.

Рекомендованное Комитетом данных для науки и техники (CODATA) на 2024 год значение гравитационной постоянной, если округлить до 5 знаков после запятой, равно [1]:

$$G = 6,67430 \cdot 10^{-11} \text{ м}^3 \cdot \text{с}^{-2} \cdot \text{кг}^{-1}, \text{ или } \text{Н} \cdot \text{м}^2 \cdot \text{кг}^{-2} \quad (2)$$

Из определения гравитационной постоянной следует, что численно она равна модулю силы тяготения, действующей на точечное тело единичной массы со стороны другого такого же тела, находящегося от него на единичном расстоянии [1]. Из этого определения понятно, что гравитационная постоянная сама из себя представляет единичную (элементарную) силу  $F_e$ , т.е.:

$$F_e = G \quad (3)$$

Любое материальное тело создает гравитационное поле и основной энергетической характеристикой этого поля является его гравитационный потенциал. Производная гравитационного потенциала по расстоянию, как раз и является гравитационной силой. Поэтому, если единичное (элементарное) значение потенциала гравитационного поля обозначить через  $\varphi_e$ , то его можно представить следующим уравнением:

$$\varphi_e = -G \quad (4)$$

Любое материальное тело обладает так называемой полной внутренней энергией покоя, знаменитая формула которой в собственной системе отсчета следующая:

$$E = mc^2, \quad (5)$$

где:  $E$  – полная внутренняя энергия покоя материального тела массой покоя  $m$ ;  $c$  – скорость света в вакууме.

В уравнении (5) масса покоя  $m$  является неким коэффициентом, который выражает реальную массу материального тела и, если ее взять за единичную (элементарную), т.е.  $m = 1$ , то получаем уравнение единичной (элементарной) полной энергии  $E_e$ :

$$E_e = c^2 \quad (6)$$

Для дальнейшего удобства запишем два уравнения (4) и (6) рядом (знак «-» перед гравитационной постоянной  $G$  убираем, т.к. вектор гравитационной силы не рассматривается):

$$\begin{aligned} E_e &= c^2; \\ \varphi_e &= G \end{aligned} \quad (7)$$

Из уравнения (7) следует, что с одной стороны мы имеем полную единичную (элементарную)

энергию покоя материального тела единичной (элементарной) массы, а с другой стороны энергию гравитационного поля, создаваемого этим материальным телом, которое характеризуется единичным (элементарным) потенциалом гравитационного поля. Наглядное (схематичное) изображение массы тела и его гравитационного поля (искривления пространства-времени) представлено на рисунке 1 (основой рисунка является изображение из источника [3], на который добавлены отметки энергий  $E$  и  $\varphi$ ).

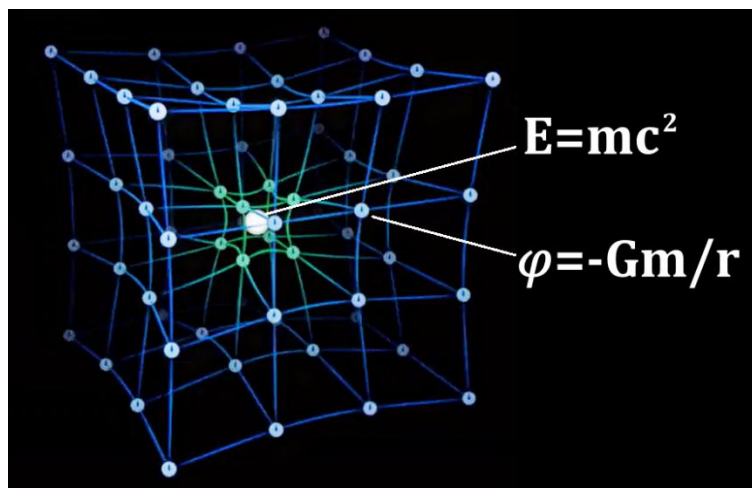


Рисунок 1 – Схематичное изображение массы тела и его гравитационного поля (искривления пространства-времени)

В уравнении (7) энергии  $E_e$  и  $\varphi_e$  следует считать функциями ( $E_e(c)$  и  $\varphi_e(G)$ ), а сам показатель  $c$  является не постоянной, а тоже функцией. Именно при таком подходе можно будет связать  $c$  и  $G$  между собой. Тогда уравнение (7) перепишем в следующий вид:

$$\begin{aligned} E_e(c) &= c^2; \\ \varphi_e(G) &= G \end{aligned} \quad (8)$$

Отметим, что энергия  $E_e(c)$  – это энергия, сосредоточенная в объемном материальном теле, т.е. в данном случае в единичном (элементарном) объеме, а энергия  $\varphi_e(G)$  – это энергетическая характеристика безразмерной точки гравитационного поля. Далее рассмотрим, что из себя представляет единичная (элементарная) энергия, выраженная «скоростью света», и разложим ее до безразмерной точки.

Очевидно, что полная энергия покоя материального тела  $E$ , которая зависит от скорости света  $c$  порождает гравитационное поле с энергетической характеристикой  $\varphi$ , зависящей от гравитационной постоянной  $G$ . По закону сохранения энергии для замкнутой физической системы можно сказать, что и через гравитационное поле с энергетической характеристикой  $\varphi$ , зависящей от гравитационной постоянной  $G$  можно выйти на значение полной энергии покоя материального тела  $E$ , зависящей от скорости света  $c$ . Иными словами, полная энергия тела порождает потенциал гравитационного поля и/или наоборот. Таким образом, функции  $E_e(c)$  и  $\varphi_e(G)$  можно считать обратными по отношению друг к другу, если между величинами  $c$  и  $G$  ввести определенный коэффициент пропорциональности  $k$ , а беря во внимание уравнение (8) можно сказать, что должно выполняться следующее равенство:

$$\begin{aligned} \varphi_e(G) &= k_p \cdot (E_e^{-1}(c))' \Rightarrow \\ G &= k_p \cdot ((c^2)^{-1})', \end{aligned} \quad (9)$$

где:  $(E_e^{-1}(c))'$  – производная обратной функции единичной (элементарной) полной энергии (производная функции является пределом отношения приращения функции к приращению ее

аргумента и в нашем случае приводит значение функции к безразмерной точке);  $kp$  – коэффициент пропорциональности между функциями  $\varphi e(G)$  и  $(Ee-1(c))'$ ;  $((c2)-1)'$  – производная обратной функции от функции  $c2$  (она же равна функции  $(Ee-1(c))'$ ).

Из уравнения (9) однозначно можно сделать вывод, что вся энергия гравитационного поля материального тела, которое распространяется в четырехмерном (бесконечном) пространстве-времени равна полной внутренней энергии этого материального тела. И это очень важное заключение.

Согласно современной теории тяготения гравитацию создает энергия, а точнее поле так называемого тензора энергии-импульса. В свою очередь с точки зрения теории относительности, девять пространственных компонентов тензора энергии-импульса являются компонентами тензора напряжений. Рассмотрим подробнее тензор напряжений, схематичное представление которого изображено на рисунке 2 из источника [4].

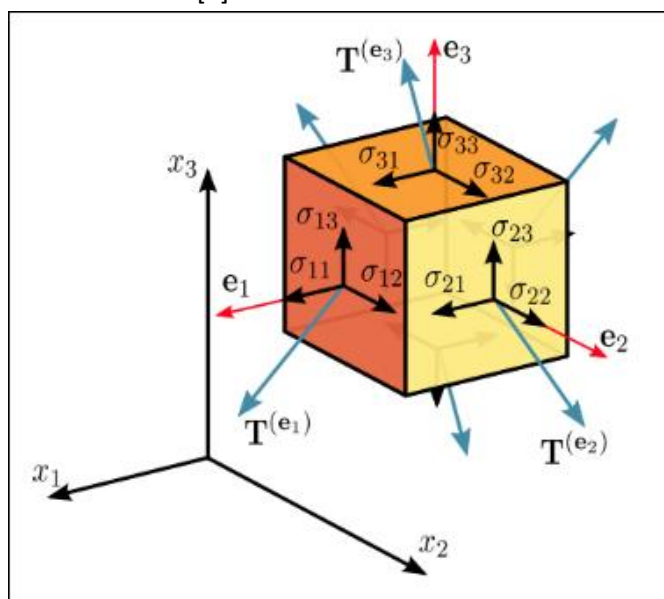


Рисунок 2 – Тензор механического напряжения элементарного объема тела

Тензор напряжений – это тензор второго ранга, описывающий механические напряжения в произвольной точке тела. В случае объемного тела тензор напряжений часто записывается в виде матрицы  $3 \times 3$  [4]:

$$\sigma = \begin{bmatrix} T^{(e_1)} \\ T^{(e_2)} \\ T^{(e_3)} \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix}, \quad (10)$$

где:  $\sigma$  – тензор напряжений;  $T^{(e_1)}$  – вектор механического напряжения, действующий на поверхность  $en$ ;  $\sigma_{ij}$  – компоненты тензора напряжений.

Как мы видим, тензор напряжений представлен (состоит) своими девятью компонентами  $\sigma_{ij}$ . Отметим, что окружающий нас мир описывается четырьмя измерениями – это три измерения пространства и одно временное. Таким образом, источник единичной (элементарной) энергии (функция «скорость света» в уравнении (8), которая равна  $\sqrt{c^2}$ ) материального тела единичного (элементарного) объема распределен по этим девяти пространственным компонентам тензора напряжений и одной временной компоненте (измерению), а т.к. все измерения равнозначны, то это распределение источника энергии между всеми представленными десятью компонентами ( $9+1=10$ ) является равномерным. Таким образом, из уравнения (8) можно получить следующее уравнение для

определения обратной функции полной энергии материального тела, приходящейся на одну из десяти компонент:

$$E_1(c) = \left( \frac{\sqrt{E_e^{-1}(c)}}{10} \right)^2 = \frac{(c^2)^{-1}}{100} \quad (11)$$

Любое число (значение)  $a$  можно представить (выразить), как:

$$a = e^x, \quad (12)$$

где:  $e$  – (число  $e$ ) основание натурального логарифма, математическая константа, иррациональное и трансцендентное число;  $x$  – вещественное число.

Натуральный логарифм  $\ln(a)$  есть обратная функция для экспоненты  $a = e^x$ . Тогда обратная функция от функции  $c^2$  (она же функция  $(c^2)^{-1}$  в уравнении (11)) будет иметь вид:

$$(c^2)^{-1} = \ln c^2 \quad (13)$$

Уравнение (11) с учетом определенной обратной функции от функции  $c^2$  можно записать в следующем виде:

$$E_1(c) = \frac{\ln c^2}{100} \quad (14)$$

Так как в уравнении (14) мы пришли к энергии в расчете на одну компоненту, а она (компонента тензора напряжений и временная компонента) имеет размерность (пространственную и временную соответственно), то для того, чтобы перейти к энергии безразмерной точки необходимо еще взять производную от функции  $E_1(c)$  по скорости света  $c$ . Тогда получаем:

$$(E_1(c))' = \left( \frac{\ln c^2}{100} \right)' = \frac{2}{100 \cdot c} \quad (15)$$

Таким образом, из уравнения (9) и уравнения (15), где полная внутренняя энергия приведена к энергии безразмерной точки значение гравитационной постоянной  $G$  будет равно:

$$G = \frac{2}{100 \cdot c} = 0,02 \cdot c^{-1} = 0,02/c \quad (16)$$

Уравнение (16) следует трактовать так, что числовое значение гравитационной постоянной равно числовому значению 0,02 части обратной величины скорости света. Если скорость света в вакууме равна 299 792 458 м/с, то расчетное значение гравитационной постоянной равно:

$$G = 0,02/299792458 = 6,671281903963041 \cdot 10^{-11} \quad (17)$$

Представленное выше значение гравитационной постоянной  $G$  является наиболее точным на момент публикации настоящей статьи и ее корректировка будет осуществляться, если наукой будет установлено более точное значение скорости света в вакууме.

Из проведенного исследования также можно сделать следующие основные выводы:

1. Полная внутренняя энергия покоя материального тела связана с энергией гравитационного поля. Их функциональная зависимость между собой обратная;
2. Энергию замкнутой системы, где существует материальное тело и его гравитационное поле нужно определять либо по полной внутренней энергии покоя материального тела, либо по энергии его гравитационного поля, т.е. энергия этой системы равна не сумме двух энергий (энергия замкнутой системы  $\neq$  полная внутренняя энергия покоя материального тела + энергия гравитационного поля), а она равна одной из двух (на любой выбор) обозначенных энергий (полной внутренней энергии материального тела или энергии гравитационного поля);
3. Числовое значение всей энергии гравитационного поля материального тела, которое

распространяется в четырехмерном (бесконечном) пространстве-времени равна числовому значению полной внутренней энергии покоя этого материального тела.

Выведенная в настоящей работе взаимосвязь полной внутренней энергии покоя материального тела с энергией его гравитационного поля доказывает, что гравитацию действительно создает энергия. Отклонение теоретически выведенного в настоящей работе расчетного значения гравитационной постоянной от рекомендованного Комитетом данных для науки и техники (CODATA) на 2024 год и других экспериментально полученных ее значений составляет от  $0,003 \cdot 10^{-11}$  Дж до  $0,0006 \cdot 10^{-11}$  Дж, что говорит о высокой точности полученных результатов и выводов, сделанных в статье.

**Список использованной литературы:**

1. Гравитационная постоянная; официальный сайт; URL: [https://ru.wikipedia.org/wiki/ Гравитационная постоянная](https://ru.wikipedia.org/wiki/Гравитационная_постоянная) (дата обращения: 02.07.2025).
2. Пономарев Д.В. Гравитационная постоянная – это физическая величина, имеющая числовое выражение в 0,02 части обратной величины скорости света ( $G = 0,02/c$ ); официальный сайт; URL: <https://antigravity-theory.ru/гравитационная-постоянная> (дата обращения: 02.07.2025).
3. Наглядная демонстрация искажения пространства-времени массой объекта; официальный сайт; URL: [https://pikabu.ru/story/naglyadnaya\\_demonstratsiya\\_iskazheniya\\_prostranstvavremeni\\_massoy\\_obekta\\_4183885](https://pikabu.ru/story/naglyadnaya_demonstratsiya_iskazheniya_prostranstvavremeni_massoy_obekta_4183885) (дата обращения: 02.07.2025).
4. Тензор напряжений; официальный сайт; URL: [https://ru.wikipedia.org/wiki/Тензор\\_напряжений](https://ru.wikipedia.org/wiki/Тензор_напряжений) (дата обращения: 02.07.2025).

© Пономарев Д.В., 2025



# ХИМИЯ

**Akmadov Nurberdi**, student.

Turkmen Agricultural University named after S.A. Niyazov.

Ashgabat, Turkmenistan

**Agageldiyeva Jemile**, student.

International Horse Breeding Academy named after Aba Annaev

Arkadag, Turkmenistan

## THE ROLE OF AGRICULTURAL TECHNOLOGY IN EDUCATION

### Abstract

Agricultural technology is rapidly transforming the farming landscape, introducing new tools and methodologies that significantly improve productivity, efficiency, and sustainability. To ensure that future generations of farmers are prepared to navigate this technological revolution, agricultural education must evolve and integrate technology into its curricula. This article explores the role of agricultural technology in education and how it can be used to equip students with the skills needed to thrive in a technology-driven agricultural sector. The article discusses various technological innovations, such as precision agriculture, automation, and data analytics, and their potential impact on agricultural education and the future workforce.

### Keywords:

agricultural technology, precision agriculture, automation, agricultural education, data analytics, innovation, sustainable farming, smart farming.

### 1. Introduction

The integration of technology in agriculture has reshaped the industry, enabling farmers to produce more with fewer resources, reduce waste, and minimize environmental impacts. From precision agriculture that uses GPS and sensors to drones that monitor crop health, technology is transforming farming practices globally. However, for these innovations to reach their full potential, the next generation of farmers must be well-versed in these technologies and their applications.

Agricultural education has a critical role to play in preparing future agricultural professionals to utilize these tools effectively. By incorporating agricultural technology into educational curricula, agricultural institutions can ensure that students are not only aware of the technological advances available but also equipped with the skills to apply them in real-world settings. This article examines the importance of agricultural technology in education and how it can help create a workforce capable of navigating the challenges and opportunities presented by modern agriculture.

### 2. The Role of Agricultural Technology in Modernizing Farming

Agricultural technology encompasses a broad range of innovations designed to improve farming practices. These technologies are central to the future of agriculture, especially in the context of increasing global food demand, climate change, and the need for more sustainable farming methods. By integrating technology into education, agricultural institutions can empower students to understand and apply cutting-edge solutions to these challenges.

#### Precision Agriculture: Using Data to Optimize Farming Practices

Precision agriculture (PA) involves the use of advanced technologies such as GPS, remote sensing, and geographic information systems (GIS) to monitor and manage field variability. PA enables farmers to make more informed decisions regarding planting, irrigation, fertilization, and pest management, all of which contribute to increased productivity and reduced environmental impact.

In agricultural education, incorporating PA technologies into the curriculum allows students to understand how data can be used to optimize farm management. Students can learn how to use GPS-guided tractors for precise planting, sensors for monitoring soil health, and drones to track crop conditions in real-time. By incorporating these tools into education, future farmers will be equipped to use data-driven insights for better decision-making.

- **Benefits for Education:**

- o Introduces students to data-driven decision-making in farming.
- o Provides hands-on experience with cutting-edge farming technologies.
- o Improves understanding of sustainability in farm management.

**Conclusion**

Agricultural technology is transforming the farming industry and reshaping the future of food production. To ensure that future generations of farmers are prepared to thrive in this new technological landscape, agricultural education must evolve to incorporate these innovations. By integrating technologies such as precision agriculture, automation, and data analytics into curricula, educational institutions can equip students with the skills needed to succeed in a technology-driven agricultural world.

The challenge lies in overcoming barriers such as limited infrastructure, resistance to change, and the rapid pace of technological innovation. However, with the right investments in education, training, and resources, agricultural institutions can prepare students to navigate and lead the future of farming, ensuring a sustainable and productive agricultural system for years to come.

**References:**

1. Pretty, J., et al. (2006). Sustainable Agriculture in the 21st Century: The Role of Education. *International Journal of Agricultural Sustainability*, 4(1), 13-24.
2. FAO. (2018). *The State of the World's Biodiversity for Food and Agriculture*. Food and Agriculture Organization of the United Nations.
3. Altieri, M. A., & Nicholls, C. I. (2012). Agroecology: A Global Movement for Food Security and Sustainability. *Agroecology and Sustainable Food Systems*, 36(2), 49-67.
4. Baker, B., & Hodges, A. (2019). Bridging the Gap: Connecting Agricultural Education with Sustainable Farming Practices. *Journal of Agricultural Education*, 56(3), 12-26.

© Akmadov N., Agageldiyeva J., 2025

**Charyberdiyev Kakageldi**, lecturer

**Yoldashov Guvanch**, student

International horse breeding academy named after Aba Annayev

Arkadag, Turkmenistan

**Hojamberdiyev Hojamberdi**, lecturer

Turkmen Agricultural University

Ashgabat, Turkmenistan

**VETERINARY AND SANITARY EXPERTISE: SCIENTIFIC FOUNDATIONS FOR HEALTH,  
SAFETY, AND ENVIRONMENTAL CONTROL**

**Abstract**

Sanitary expertise plays a critical role in protecting public health and ensuring environmental safety

through the control of hygiene, food quality, water purity, and industrial sanitation. At the core of this interdisciplinary field lies chemistry, which provides the analytical tools, scientific understanding, and technological basis for detecting hazards, assessing risks, and maintaining sanitary standards. This article explores the fundamental relationship between chemistry and sanitary expertise, highlighting how chemical principles underpin routine inspection, laboratory diagnostics, food safety evaluation, and pollution control. It also addresses the role of chemical education in training sanitary experts and the importance of chemistry in the development of international sanitary regulations.

**Keywords:**

sanitary expertise, analytical chemistry, hygiene, food safety, water quality, toxicology, chemical control, environmental sanitation.

Sanitary expertise is a key element of public health systems and regulatory frameworks that aim to prevent the spread of disease, ensure food and water safety, and protect environmental quality. Whether in the field of veterinary hygiene, food inspection, environmental monitoring, or industrial sanitation, the scientific foundation of sanitary expertise is grounded in chemistry. Chemical knowledge is not only necessary for identifying contamination and evaluating hygienic conditions, but it also guides the interpretation of laboratory results, formulation of safety recommendations, and implementation of health regulations.

One of the primary roles of chemistry in sanitary expertise is in the field of analytical chemistry. Sanitary experts rely on chemical analysis to detect harmful substances in food, water, air, and consumer products. Analytical techniques such as titration, spectrophotometry, chromatography, and mass spectrometry are essential for measuring concentrations of microbial toxins, heavy metals (e.g., lead, mercury, arsenic), pesticides, nitrates, and other contaminants. These methods help establish whether levels are within permissible limits defined by health authorities and international standards such as those of the WHO, FAO, or Codex Alimentarius.

In food safety, chemistry is indispensable for assessing nutritional value, authenticity, and contamination of food products. Sanitary experts use chemical methods to detect food additives, preservatives, colorants, antibiotics, and residues from processing. For example, chromatographic techniques are applied to detect illegal additives or allergens, while titration and pH analysis determine acidity levels in dairy or meat products. The chemical structure and behavior of spoilage indicators, such as peroxide values in fats or ammonia in decomposing fish, also fall under chemical examination.

Water quality monitoring, another pillar of sanitary expertise, relies heavily on inorganic and organic chemistry. Experts evaluate physical and chemical parameters such as pH, turbidity, dissolved oxygen, hardness, and the presence of ions like chlorides, sulfates, and phosphates. Toxicological assessments often involve detection of pollutants such as phenols, oil residues, detergents, and microbial byproducts using colorimetric and spectroscopic methods. Chlorine levels and disinfectant byproducts must be carefully controlled and analyzed to ensure both safety and effectiveness in drinking water systems.

In environmental sanitation, chemistry supports the detection and remediation of pollution in soil, air, and industrial waste. Sanitary experts use chemical indicators to assess the impact of factory emissions, agricultural runoff, or urban sewage. Air quality is assessed by analyzing concentrations of carbon monoxide, sulfur dioxide, nitrogen oxides, and volatile organic compounds (VOCs). Soil contamination is monitored

through chemical testing of heavy metals, pesticides, and persistent organic pollutants (POPs). These assessments are critical for regulatory compliance and public health protection.

Toxicology, a subfield of chemistry, plays a central role in evaluating the risks of chemical exposure. Sanitary specialists must understand the dose-response relationships, mechanisms of toxicity, metabolism of xenobiotics, and threshold limit values (TLVs) for chemicals encountered in the environment or workplace. Knowledge of chemical interactions within the human or animal body allows sanitary experts to assess the danger posed by contaminants and advise on prevention or treatment strategies.

Chemical principles also guide the use of disinfectants and sterilizing agents in medical, food processing, and industrial environments. Understanding the mode of action of chlorine, ozone, alcohols, aldehydes, and quaternary ammonium compounds helps experts apply these agents effectively without causing harm to users or damaging equipment. Proper chemical selection, concentration adjustment, and contact time determination are all based on sound chemical knowledge.

The training of sanitary experts must therefore include a strong foundation in general, inorganic, organic, analytical, and environmental chemistry. Practical laboratory skills, chemical safety, and interpretation of test results are crucial components of this education. In many countries, curricula in sanitary-veterinary or public health programs include specialized chemistry courses tailored to hygienic control and inspection. These prepare students to apply chemical tools in real-world sanitary investigations and decision-making.

International sanitary regulations and control systems also depend on standardized chemical methods. Agencies like the World Organisation for Animal Health (WOAH), the European Food Safety Authority (EFSA), and national bodies establish protocols for chemical testing in inspection procedures. Sanitary experts must be familiar with Good Laboratory Practices (GLP), Hazard Analysis and Critical Control Points (HACCP), and ISO laboratory standards that ensure the reliability and reproducibility of chemical analyses used in sanitary assessments.

### **Conclusion**

Chemistry is an indispensable component of sanitary expertise, providing the scientific backbone for detecting hazards, controlling quality, and safeguarding public health. Whether in food safety, water monitoring, air quality, or environmental hygiene, chemical knowledge allows sanitary experts to make evidence-based decisions and enforce health regulations. As the challenges of modern hygiene grow in complexity—due to industrialization, climate change, and global trade—the integration of advanced chemical methods and education becomes even more critical. Strengthening the link between chemistry and sanitary practice ensures a safer, healthier future for communities worldwide.

### **References:**

1. WHO. (2017). Guidelines for Drinking-Water Quality. World Health Organization.
2. Codex Alimentarius Commission. (2020). General Standard for Contaminants and Toxins in Food and Feed. FAO/WHO.
3. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2018). Principles of Instrumental Analysis (7th ed.). Cengage Learning.
4. Tietz, N. W. (2012). Clinical Guide to Laboratory Tests (4th ed.). Saunders.
5. Harrison, R. M., & Hester, R. E. (Eds.). (2000). Chemistry in the Environment. Royal Society of Chemistry.

© Charyberdiyev K., Yoldashov G., Hojamberdiyev H., 2025

**Ovezgeldiyeva Ejegul**, senior lecturer.

International Horse Breeding Academy named after Aba Annaev

**Yoldashov Guvanch**, student.

Arkadag, Turkmenistan

**Rejepov Toyly**, lecturer.

Turkmen Agricultural University named after S.A. Niyazov.

Ashgabat, Turkmenistan

## THE ROLE OF AGRICULTURAL EDUCATION IN SUSTAINABLE DEVELOPMENT: GLOBAL PERSPECTIVES

### Abstract

Agricultural education plays a critical role in addressing global challenges related to sustainable development. As the world grapples with issues such as climate change, food security, and resource depletion, agricultural education has emerged as a key component in preparing future generations to meet these challenges. This article explores how agricultural education can promote sustainable farming practices worldwide, highlighting the importance of integrating environmental sustainability into agricultural curricula. The article examines successful models from different countries, detailing how educational systems can equip students with the knowledge, skills, and attitudes needed to drive sustainable agricultural practices that balance productivity with environmental conservation.

### Ключевые слова:

agricultural education, sustainable development, food security, climate change, sustainable farming, pedagogy, global case studies.

### 1. Introduction

Agricultural education is the cornerstone of global efforts to address sustainability challenges in the agricultural sector. As the world faces growing pressures from population growth, climate change, land degradation, and water scarcity, the need for sustainable agricultural practices has never been more urgent. Agricultural education equips future farmers, researchers, policymakers, and entrepreneurs with the tools they need to develop innovative and environmentally friendly solutions.

The shift toward sustainable development in agriculture requires a rethinking of traditional farming practices. Sustainability in agriculture means meeting the food needs of the present generation without compromising the ability of future generations to meet their own needs. Agricultural education can drive this transition by preparing individuals to not only understand but also apply principles of sustainability in practical ways. By integrating environmental, social, and economic factors into agricultural curricula, educators can shape a new generation of leaders in the agricultural field.

### 2. The Importance of Agricultural Education in Promoting Sustainability

Agricultural education encompasses a range of topics, including plant science, animal husbandry, agronomy, economics, and rural development. Integrating sustainability into these disciplines is crucial for addressing the pressing challenges of our time. In the context of climate change and resource depletion, agricultural education must foster the knowledge and skills that support more resilient, sustainable farming practices.

#### 2.1. Knowledge and Skills for Sustainable Farming Practices

Agricultural education must equip students with practical knowledge that fosters sustainable farming. This includes:

Soil health management: Teaching students how to maintain soil fertility and prevent soil erosion

through methods like crop rotation, cover cropping, and reduced tillage.

Water conservation: Training in efficient irrigation systems, rainwater harvesting, and technologies like drip irrigation can significantly improve water use efficiency.

Biodiversity preservation: Promoting agroforestry, integrated pest management (IPM), and organic farming methods that protect biodiversity and reduce the need for chemical inputs.

Climate adaptation: Educating students on climate-smart agriculture, which includes practices that mitigate climate change impacts and enhance agricultural productivity, such as drought-tolerant crops and heat-resistant varieties.

By providing students with this foundational knowledge, agricultural education plays a critical role in ensuring that farmers can adapt to changing environmental conditions while maintaining productivity.

**Список использованной литературы:**

1. FAO. (2018). The State of Food and Agriculture 2018: Migration, Agriculture, and Rural Development. Food and Agriculture Organization of the United Nations.
2. KALRO. (2017). Agroecology and Sustainable Farming Systems in Kenya: Teaching Methods and Approaches. Kenya Agricultural and Livestock Research Organization.
3. PRONAF. (2021). Family Farming in Brazil: Education for Sustainable Agriculture. National Program for Strengthening Family Farming.
4. IAASTD. (2009). Agriculture at a Crossroads: Global Report. International Assessment of Agricultural Knowledge, Science and Technology for Development.

© Ovezgeldiyeva E., Yoldashov G, Rejepov T., 2025



# ТЕХНИКА И ТЕХНОЛОГИЯ

УДК 656.1

**Азиев Ядулла Гасан оглы**

Старший преподаватель

Нахчыванский Государственный Университет

Азербайджанская Республика, город Нахчыван

yadohazi@gmail.com

**Мамедов Фарахим Ильхам оглы**

Преподаватель

Нахчыванский государственный университет

Азербайджанская Республика, город Нахчыван

ferahimm35@gmail.com

**ВЛИЯНИЕ ЦИФРОВЫХ ПЛАТФОРМ НА ОПТИМИЗАЦИЮ МАРШРУТОВ,  
ПРЕДОТВРАЩЕНИЕ ПРОБОК И СНИЖЕНИЕ ВЫБРОСОВ**

**Аннотация**

Влияние цифровых платформ на оптимизацию маршрутов, предотвращение пробок и снижение выбросов становится все более значимым фактором в улучшении городской мобильности и устойчивого развития транспортной инфраструктуры. Внедрение цифровых технологий и платформ, таких как системы навигации, аналитика трафика и предиктивное моделирование, позволяет улучшить маршрутизацию, избегать перегруженных участков и тем самым минимизировать задержки. Кроме того, платформы способствуют снижению выбросов за счет сокращения времени, проведенного в пробках, и использования альтернативных, более экологических маршрутов. В совокупности эти решения улучшают общую экологическую обстановку, уменьшают затраты на топливо и повышают эффективность использования транспортных средств.

**Ключевые слова:**

цифровые платформы, общественный транспорт, муниципальные службы,  
оптимизация маршрутов, экологичные маршруты.

**Haziyev Yadulla Hasan**

head teacher

Nakhchivan State University

Azerbaijan Republic, Nakhchivan city

**Mammadov Farahim İlham**

teacher

Nakhchivan State University

Azerbaijan Republic, Nakhchivan city

**THE IMPACT OF DIGITAL PLATFORMS ON ROUTE OPTIMIZATION, TRAFFIC CONGESTION  
PREVENTION AND EMISSION REDUCTION**

**Abstract**

The impact of digital platforms on route optimization, congestion avoidance, and emission reduction

is becoming an increasingly important factor in improving urban mobility and sustainable transport infrastructure. The implementation of digital technologies and platforms such as navigation systems, traffic analytics, and predictive modeling improve routing, avoid congested areas, and thus minimize delays. In addition, platforms help reduce emissions by reducing the time spent in traffic jams and using alternative, greener routes. Together, these solutions improve the overall environmental situation, reduce fuel costs, and increase vehicle efficiency.

**Keywords:**

digital platforms, public transport, municipal services, route optimization, eco-routes.

**Введение.**

Цифровые платформы играют ключевую роль в трансформации транспортной отрасли, позволяя улучшать управление движением и минимизировать воздействие на окружающую среду. Благодаря использованию данных в реальном времени, алгоритмов искусственного интеллекта и передовых аналитических инструментов, такие платформы помогают водителям, операторам общественного транспорта и муниципальным службам делать передвижение более эффективным и экологичным. [1].

**Методы исследования.**

Современные цифровые платформы обрабатывают данные от миллионов пользователей, включая информацию о дорожной ситуации, погодных условиях и плотности трафика. Эти данные помогают платформам рассчитывать наиболее оптимальные маршруты, избегая загруженных участков и учитывая изменяющуюся обстановку на дорогах.

Платформы, такие как Google Maps и Яндекс. Навигатор, активно используют алгоритмы, которые на основе данных о пробках и заторах предлагают альтернативные маршруты. Это позволяет пользователям избегать плотного трафика и добираться до пункта назначения быстрее, с меньшим расходом топлива.

Благодаря анализу исторических данных о трафике и использованию машинного обучения, платформы могут предсказывать, в какое время на определенных дорогах возникнут заторы. Пользователи могут планировать поездки с учетом таких прогнозов, избегая перегруженных дорог в часы пик.

Платформы для общественного транспорта, такие как Moovit, интегрируют данные о движении автобусов, трамваев и поездов, помогая пользователям выбирать удобные маршруты и минимизировать время ожидания. Это улучшает эффективность общественного транспорта и помогает людям реже использовать личные автомобили. [2].

Муниципальные службы и операторы транспортных сетей используют платформы для координации транспортных потоков, перенаправляя движение, когда на определенных дорогах возникает перегрузка. Это помогает снизить вероятность образования пробок и оптимизировать загрузку дорог в зависимости от времени суток и дорожной обстановки.

Платформы, использующие Vehicle-to-Vehicle (V2V) и Vehicle-to-Infrastructure (V2X) технологии, помогают транспортным средствам обмениваться данными друг с другом и с элементами инфраструктуры, такими как светофоры и дорожные знаки. Это позволяет заранее предупреждать водителей о предстоящих заторах и улучшает координацию движения.

Системы управления светофорами на основе искусственного интеллекта могут адаптировать их работу в зависимости от трафика, уменьшая время простоя автомобилей и предотвращая заторы на

перекрестках. Такие системы помогают распределять потоки более равномерно, что особенно эффективно на оживленных улицах. [3].

Цифровые платформы, такие как Uber Freight и Convoу, позволяют компаниям планировать маршруты грузовых автомобилей с учетом загруженности дорог, выбирая оптимальные временные интервалы для поездок. Это сокращает количество грузовиков на дорогах в часы пик и снижает вероятность пробок.

Оптимизация маршрутов и предотвращение пробок позволяют транспортным средствам сократить время простоя на холостом ходу, что снижает расход топлива и выбросы углекислого газа. Платформы помогают водителям избегать долгих простоев, которые являются одной из основных причин повышения уровня выбросов в городах. [4].

Платформы для управления электромобилями, такие как ChargePoint и Electrify America, помогают водителям планировать маршруты с учетом станций зарядки и уровня заряда аккумулятора, предотвращая риски остановок и оптимизируя потребление энергии.

Некоторые платформы предлагают пользователям выбрать экологичные маршруты, которые минимизируют количество выбросов за счет плавного движения и избегания перегруженных дорог. Например, Google Maps ввела функцию выбора маршрута с минимальным расходом топлива, что помогает пользователям снижать углеродный след.

Платформы для совместных поездок, такие как BlaBlaCar, и каршеринговые сервисы, такие как Zipcar, снижают количество автомобилей на дорогах, предоставляя возможность использовать одно транспортное средство несколькими людьми. Это сокращает потребность в личном транспорте, снижает нагрузку на дороги и уменьшает количество выбросов. [5].

#### **Заключение.**

Цифровые платформы оказывают значительное влияние на оптимизацию маршрутов, предотвращение пробок и снижение выбросов, что способствует развитию более экологически чистых и эффективных транспортных систем. Применение таких технологий, как анализ данных в реальном времени, предсказание загруженности дорог и управление маршрутами, позволяет не только улучшить мобильность, но и сократить затраты на топливо и уменьшить вредные выбросы в атмосферу. Внедрение цифровых решений в транспортной инфраструктуре, делает транспортные потоки более управляемыми и снижает экологическую нагрузку на окружающую среду.

#### **Список использованной литературы:**

1. Иванов П.В. и Сидоров К.А. (2021). Цифровизация транспортной системы и ее влияние на оптимизацию маршрутов. Журнал транспортных исследований, 14(3), с.45-58.
2. Петров Л.М. и Смирнова И.В. (2020). Применение цифровых платформ для управления транспортными потоками. Вопросы транспортной логистики, 12(5), с.102-118.
3. Кузнецов А.И. (2022). Современные цифровые технологии в управлении городским движением. Городской транспорт и цифровизация, 10(4), с.23-35.
4. Захаров В.П. и Павлова Е.Н. (2023). Эффективность применения цифровых платформ для снижения выбросов и оптимизации маршрутов. Экология и транспорт, 7(2), с.50-67.
5. Соловьев М.Г. и Петрова Н.Д. (2021). Программные решения для управления трафиком и их влияние на экологическую ситуацию. Транспорт и экология, 9(3), с.72-85.

©Азиев Я.Г., Мамедов Ф.И., 2025

Bui Thi Thuy

Hanoi University of Mining and Geology, Vietnam

## CALCULATING LINEAR VIBRATIONAL DIFFERENTIAL EQUATION OF CAR WITH FRACTIONAL DAMPING

### Abstract

Based on the theory of fractional derivative, Newton's second law of motion and some transformation, the present study aims to establish linear vibrational differential equation of car with fractional damping. Using the Liouville-Rieman's definition of fractional derivatives, a numerical algorithm is developed on base of the well-known Newmark integration method to calculate dynamic response of fractional order systems. Then, we apply this method to calculate linear vibrations of car containing fractional derivatives.

### Keywords:

vibration, nonlinear, car, fractional order, damping

### 1. Introduction

In recent years Fractional Calculus has been a fruitful field of research in science and engineering [1–5]. In fact, many scientific areas are currently paying attention to the Fractional Calculus concepts and we can refer its adoption in viscoelasticity and damping, diffusion and wave propagation, electromagnetism, chaos and fractals, heat transfer, biology, electronics, signal processing, robotics, system identification, traffic systems, genetic algorithms, percolation, modeling and identification, telecommunications, chemistry, irreversibility, physics, control systems as well as economy, and finance...

Cars are a means of transport that play a very important role in the national economy and are currently widely used in all fields of economy and life. Car vibrations not only affect people (drivers and passengers), transported goods, durability, and safety of movement of cars, but also affect the life of the road. One of the important tasks of car's vibration research is to establish and solve differential equations to determine vibration parameters.

### 2. Establishing linear vibrational differential equation of car with fractional damping

Let  $x$  and  $u$  be the displacements of the object and the wheel. It is assumed that the stiffness of the shaft lining can be represented by a spring equivalent to stiffness  $k$  with the displacement denoted by  $z$ .

We have Newton's second law of motion

$$m\ddot{x} = -R(t), \quad (1)$$

Where  $m$  is the mass of the object,  $x(t)$  is the displacement, and  $R(t)$  is the internal force generated inside the viscoelastic object.

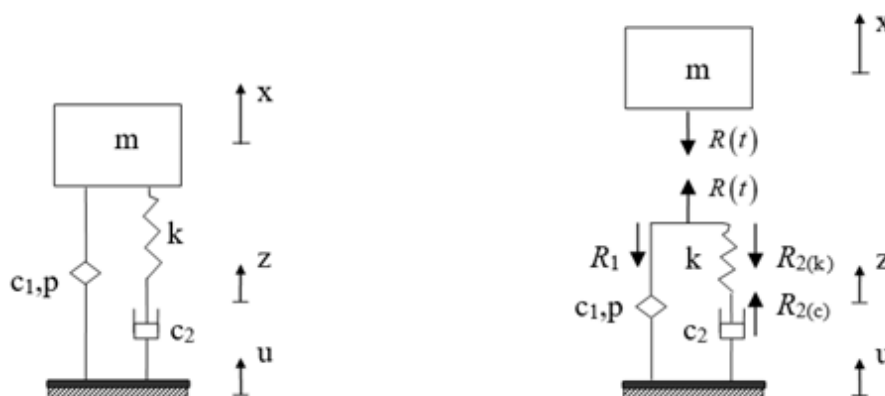


Figure 1 – Fractional derivative model

Figure – Force analysis

The force value  $R(t)$  is equal to the total value of the force  $R_1$  acting on the damping  $c_1$  and the force  $R_2$  acting on spring  $k_2$  or damping  $c_2$

$$R(t) = R_1 + R_2, \quad (2)$$

$$R_2 = R_{2(k)} = R_{2(c)}, \quad (3)$$

Where

$$R_1 = c_1 D_t^p (x - u), \quad R_{2(k)} = k(x - z), \quad R_{2(c)} = c_2 (\dot{z} - \dot{u}), \quad (4)$$

$$\Rightarrow R(t) = c_1 D_t^p (x - u) + k(x - z), \quad (5)$$

$$\text{From equations (3) and (4) we have} \quad k(x - z) = c_2 (\dot{z} - \dot{u}) \quad (6)$$

We have the differential equation of vibration from equation (1), (5) and (6)

$$\ddot{x} + \frac{k}{c_2} \ddot{x} + \frac{c_1}{m} D_t^{p+1} x + \frac{k}{m} \dot{x} + \frac{kc_1}{mc_2} D_t^p x = \frac{c_1}{m} D_t^{p+1} u + \frac{k}{m} \dot{u} + \frac{kc_1}{mc_2} D_t^p u. \quad (7)$$

### 3. Using the Newmark method to calculate linear vibration of car involving fractional operators

We have the vibration differential equation of car

$$\ddot{x} + \frac{k}{c_2} \ddot{x} + \frac{c_1}{m} D_t^{p+1} x + \frac{k}{m} \dot{x} + \frac{kc_1}{mc_2} D_t^p x = \frac{c_1}{m} D_t^{p+1} u + \frac{k}{m} \dot{u} + \frac{kc_1}{mc_2} D_t^p u, \quad (0 < p < 1). \quad (8)$$

We denote  $\frac{k}{c_2} = a$ ,  $\frac{c_1}{m} = b$ ,  $\frac{k}{m} = c \rightarrow \frac{kc_1}{mc_2} = ab$ , the differential equation of vibration (8) has following

form

$$\ddot{x} + a\ddot{x} + bD_t^{p+1} x + c\dot{x} + abD_t^p x = bD_t^{p+1} u + c\dot{u} + abD_t^p u \quad (9)$$

Using the Newmark method to solve the above differential equation.

We apply the composition rule to  $D^p x(t)$  [3, 4, 5], that is

$$D^p x(t) = D[D^{-\nu} x(t)] = \frac{1}{\Gamma(\nu)} \frac{d}{dt} \int_0^t \frac{x(\tau)}{(t-\tau)^{1-\nu}} d\tau = \frac{x(0)}{\Gamma(\nu)} t^{\nu-1} + D^{-\nu} \dot{x}(t), \quad (10)$$

$$\nu = 1 - p, \quad 0 < \nu < 1.$$

The numerical algorithm to calculate the fractional derivative at  $t = t_n$  of Eq. (10) is

$$D^p x(t_n) = \frac{1}{\Gamma(1-p)} \frac{x(0)}{t_n^p} + \frac{1}{\Gamma(1-p)} \left[ \int_0^{t_{n-1}} \frac{\dot{x}(\tau)}{(t_n - \tau)^p} d\tau + \int_{t_{n-1}}^{t_n} \frac{\dot{x}(\tau)}{(t_n - \tau)^p} d\tau \right], \quad (11)$$

We denote

$$I_0 = \frac{x(0)}{t_n^p}, \quad I_{n-1} = \int_0^{t_{n-1}} \frac{\dot{x}(\tau)}{(t_n - \tau)^p} d\tau, \quad \Delta I_n = \int_{t_{n-1}}^{t_n} \frac{\dot{x}(\tau)}{(t_n - \tau)^p} d\tau \quad (12)$$

By substituting relationships (12) into (11) we become the following equation

$$D^p x(t_n) = \frac{1}{\Gamma(1-p)} (I_0 + I_{n-1} + \Delta I_n) \quad (13)$$

We approximate the ordinary definite integral  $I_{n-1}$  by trapezoid numerical integration as

$$I_{n-1} \approx \frac{h}{2} \left[ \frac{\dot{x}_0}{t_n^p} + \frac{\dot{x}_{n-1}}{h^p} + 2 \sum_{i=1}^{n-2} \frac{\dot{x}(ih)}{(t_n - ih)^p} \right], \quad h = t_n - t_{n-1}, \quad n \geq 2. \quad (14)$$

Now we note the integrals  $\Delta I_n$  of equation (12). We must define  $\ddot{x}(\tau)$  under integral sign to calculate that integral. With  $t_{n-1} \leq \tau \leq t_n$ , we use the Taylor expansion and omit high order terms because the interval  $\tau - t_{n-1}$  could be taken very small.

$$\begin{aligned} \Delta I_n &= \int_{t_{n-1}}^{t_n} \frac{\dot{x}_{n-1}}{(t_n - \tau)^p} d\tau + \int_{t_{n-1}}^{t_n} \frac{\dot{x}_n - \dot{x}_{n-1}}{h} \cdot \frac{\tau - t_{n-1}}{(t_n - \tau)^p} d\tau \\ &= \frac{h^{1-p}}{1-p} \dot{x}_{n-1} + \frac{h^{1-p}}{(1-p)(2-p)} (\dot{x}_n - \dot{x}_{n-1}). \end{aligned} \quad (15)$$

We have the Newmark approximation of  $\ddot{x}_n, \ddot{x}_n, \dot{x}_n$  as follows

$$\dot{x}_n = \frac{\gamma}{\beta h} (x_n - x_{n-1}) + \left(1 - \frac{\gamma}{\beta}\right) \dot{x}_{n-1} + \left(1 - \frac{\gamma}{2\beta}\right) h \ddot{x}_{n-1} + \left(\frac{1}{2} - \frac{\gamma}{6\beta}\right) h^2 \ddot{\ddot{x}}_{n-1}, \quad (16)$$

$$\ddot{x}_n = \frac{\alpha}{\beta h^2} (x_n - x_{n-1}) - \frac{\alpha}{\beta h} \dot{x}_{n-1} + \left(1 - \frac{\alpha}{2\beta}\right) \ddot{x}_{n-1} + \left(1 - \frac{\alpha}{6\beta}\right) h \ddot{\ddot{x}}_{n-1}, \quad (17)$$

$$\ddot{\ddot{x}}_n = \frac{1}{\beta h^3} (x_n - x_{n-1}) - \frac{1}{\beta h^2} \dot{x}_{n-1} - \frac{1}{2\beta h} \ddot{x}_{n-1} - \left(\frac{1}{6\beta} - 1\right) \ddot{\ddot{x}}_{n-1}, \quad (18)$$

From equation (15) and (16), we yield

$$\begin{aligned} \Delta I_n &= \frac{h^{1-p}}{(1-p)(2-p)} \left[ \frac{\gamma}{\beta h} (x_n - x_{n-1}) + \left(2 - p - \frac{\gamma}{\beta}\right) \dot{x}_{n-1} \right. \\ &\quad \left. + \left(1 - \frac{\gamma}{2\beta}\right) h \ddot{x}_{n-1} + \left(\frac{1}{2} - \frac{\gamma}{6\beta}\right) h^2 \ddot{\ddot{x}}_{n-1} \right] \end{aligned} \quad (19)$$

We also apply for  $D^{p+1}x(t)$  at  $t = t_n$

$$D^{p+1}x(t_n) = \frac{1}{\Gamma(1-p)} [\bar{I}_0 + \bar{I}_{n-1} + \Delta \bar{I}_n]. \quad (20)$$

Where

$$\bar{I}_0 = -p \frac{x(0)}{t_n^{p+1}} + \frac{\dot{x}(0)}{t_n^p}, \quad (21)$$

$$\bar{I}_{n-1} = \int_0^{t_{n-1}} \frac{\ddot{x}(\tau)}{(t_n - \tau)^p} d\tau \approx \frac{h}{2} \left[ \frac{\ddot{x}_0}{t_n^p} + \frac{\ddot{x}_{n-1}}{h^p} + 2 \sum_{i=1}^{n-2} \frac{\ddot{x}(ih)}{(t_n - ih)^p} \right], \quad (22)$$

$$\begin{aligned} \Delta \bar{I}_n &= \int_{t_{n-1}}^{t_n} \frac{\ddot{x}(\tau)}{(t_n - \tau)^p} d\tau = \frac{h^{1-p}}{(1-p)(2-p)} \left[ \frac{\alpha}{\beta h^2} (x_n - x_{n-1}) - \frac{\alpha}{\beta h} \dot{x}_{n-1} \right. \\ &\quad \left. + \left(2 - p - \frac{\alpha}{2\beta}\right) \ddot{x}_{n-1} + \left(1 - \frac{\alpha}{6\beta}\right) h \ddot{\ddot{x}}_{n-1} \right] \end{aligned} \quad (23)$$

Suppose the road surface excitation  $u$  is represented by a harmonic function  $u = U \sin(\omega t + \varphi)$  (24)

With  $U, \omega, \varphi$  are constants. We have

$$\dot{u} = U \omega \cos(\omega t + \varphi), \quad (25)$$

$$D^p u = U \omega^p \sin\left(\omega t + \varphi + p \frac{\pi}{2}\right), \quad (26)$$

$$D^{p+1}u = D[D^p u] = U\omega^{p+1} \cos\left(\omega t + \varphi + p \frac{\pi}{2}\right), \quad (27)$$

Substituting equation (13), (17), (18) and (20) into (9) at  $t = t_n$  we obtain

$$\begin{aligned} & \ddot{x}_n + a\ddot{x}_n + \frac{b}{\Gamma(1-p)}\Delta\bar{I}_n + c\dot{x}_n + \frac{ab}{\Gamma(1-p)}\Delta I_n \\ & = bD^{p+1}u_n + c\dot{u}_n + abD^p u_n - \frac{b}{\Gamma(1-p)}[\bar{I}_0 + \bar{I}_{n-1}] - \frac{ab}{\Gamma(1-p)}[I_0 + I_{n-1}], \end{aligned} \quad (28)$$

Substituting equations (16 - 18) and (25 - 27) into (28) we have

$$\begin{aligned} & \left[ \frac{1}{\beta h^3} + a \frac{\alpha}{\beta h^2} + b \frac{h^{1-p}}{\Gamma(3-p)} \frac{\alpha}{\beta} + c \frac{\gamma}{\beta h} + ab \frac{h^{-p}}{\Gamma(3-p)} \frac{\gamma}{\beta} \right] x_n \\ & = bU\omega^{p+1} \cos\left(\omega t_n + \varphi + p \frac{\pi}{2}\right) + cU\omega \cos(\omega t_n + \varphi) + abU\omega^p \sin\left(\omega t_n + \varphi + p \frac{\pi}{2}\right) \\ & - \frac{b}{\Gamma(1-p)}[\bar{I}_0 + \bar{I}_{n-1}] - \frac{ab}{\Gamma(1-p)}[I_0 + I_{n-1}] \\ & + \left[ \frac{1}{\beta h^3} x_{n-1} + \frac{1}{\beta h^2} \dot{x}_{n-1} + \frac{1}{2\beta h} \ddot{x}_{n-1} + \left(\frac{1}{6\beta} - 1\right) \ddot{x}_{n-1} \right] \\ & + a \left[ \frac{\alpha}{\beta h^2} x_{n-1} + \frac{\alpha}{\beta h} \dot{x}_{n-1} + \left(\frac{\alpha}{2\beta} - 1\right) \ddot{x}_{n-1} + \left(\frac{\alpha}{6\beta} - 1\right) h \ddot{x}_{n-1} \right] \\ & + b \frac{h^{1-p}}{\Gamma(3-p)} \left[ \frac{\alpha}{\beta h^2} x_{n-1} + \frac{\alpha}{\beta h} \dot{x}_{n-1} + \left(p - 2 + \frac{\alpha}{2\beta}\right) \ddot{x}_{n-1} + \left(\frac{\alpha}{6\beta} - 1\right) h \ddot{x}_{n-1} \right] \\ & + c \left[ \frac{\gamma}{\beta h} x_{n-1} + \left(\frac{\gamma}{\beta} - 1\right) \dot{x}_{n-1} + \left(\frac{\gamma}{2\beta} - 1\right) h \ddot{x}_{n-1} + \left(\frac{\gamma}{6\beta} - \frac{1}{2}\right) h^2 \ddot{x}_{n-1} \right] \\ & + ab \frac{h^{1-p}}{\Gamma(3-p)} \left[ \frac{\gamma}{\beta h} x_{n-1} + \left(p - 2 + \frac{\gamma}{\beta}\right) \dot{x}_{n-1} + \left(\frac{\gamma}{2\beta} - 1\right) h \ddot{x}_{n-1} + \left(\frac{\gamma}{6\beta} - \frac{1}{2}\right) h^2 \ddot{x}_{n-1} \right] \end{aligned} \quad (29)$$

We finally obtain numerical solution  $x_n$  of the differential equation of motion (8) through the values of  $x_{n-1}, \dot{x}_{n-1}, \ddot{x}_{n-1}, \ddot{x}_{n-1}$  where  $\dot{x}_{n-1}, \ddot{x}_{n-1}$  and  $\ddot{x}_{n-1}$  are calculated as follows

$$\begin{cases} \ddot{x}_n = \frac{1}{\beta h^3}(x_n - x_{n-1}) - \frac{1}{\beta h^2} \dot{x}_{n-1} - \frac{1}{2\beta h} \ddot{x}_{n-1} - \left(\frac{1}{6\beta} - 1\right) \ddot{x}_{n-1}, \\ \ddot{x}_n = \ddot{x}_{n-1} + (1 - \alpha) h \ddot{x}_{n-1} + \alpha h \ddot{x}_n, \\ \dot{x}_n = \dot{x}_{n-1} + h \ddot{x}_{n-1} + \left(\frac{1}{2} - \gamma\right) h^2 \ddot{x}_{n-1} + \gamma h^2 \ddot{x}_n. \end{cases} \quad (30)$$

We suppose that initial conditions to above formulas  $x(0), \dot{x}(0)$  and  $\ddot{x}(0)$  are given.

### 3. Conclusions

The linear vibrational differential equation takes the form of a third-order differential equation in the case of integer damping. The linear vibrational differential equation contains the third-order and fractional order derivatives in the case of fractional damping.

In this paper, the approximation formulas for the third order dynamic systems are developed which based on idea of the Newmark integration method. Then, using the Liouville-Rieman's definition of fractional derivatives and the Newmark integration scheme, we find solutions of established differential equations in subsequent studies. It is possible to survey the vibrations of car, contributing to setting directions and measures to improve the quality of produced cars.

**References:**

1. N.M. Newmark, "A Method of Computation for structural Dynamics", ASCE Journal of Engineering Mechanics Division, Vol. 85, pp 67 – 94, 1959.
2. K. B. Oldham and J. Spanier, The Fractional Calculus: Theory and Applications of Differentiation and Integration to Arbitrary Order, vol. 11 of Mathematics in Science and Engineering, Academic Press, New York, NY, USA, 1974.
3. K. S. Miller and B. Ross, An Introduction to the Fractional Calculus and Fractional Differential Equations, A Wiley-Interscience Publication, John Wiley & Sons, New York, NY, USA, 1993.
4. I. Podlubny, Fractional Differential Equations, vol. 198 of Mathematics in Science and Engineering, Academic Press, San Diego, Calif, USA, 1999.
5. R. Hilfer, Ed., Applications of Fractional Calculus in Physics, World Scientific Publishing, Singapore, 2000.

©Bui Thi Thuy, 2025

**Tran Thi Tram**

Master at University of Mining and Geology, Hanoi, Vietnam

**CALCULATION OF CRANE ROBOT KINEMATICS****Annotation**

The paper introduces the general of crane robot and the application of parallel control mechanics. Some main subjects are studied: Position Analysis, Kinematics Analysis, Dynamics Analysis.

**Keywords:**

robot, mechatronic.

**1. Introduction**

Cranes are widely used in large-scale manufacturing but are not widely used in areas requiring high precision. To overcome this, a new type of crane has been created, which is controlled by a computer to control all six degrees of freedom. That crane is called a crane robot.

Crane robot is designed based on the idea of parallel linkage manipulators of Stewart Platform using cables as parallel connections and a winch as the operating part. The working platform is suspended and held taut by six cables, the load is the forcing force.



Figure 1 – Crane robot transports goods

## 2. Location Analysis

### 2.1 Determine the degrees of freedom of the structure

One end of each of the six cables of the crane robot is connected to the moving plate, which is considered a ball joint. The other end of the cable is connected to the rack via pulleys, which are also considered ball joints. The length of each cable is changed by the motors. With different lengths of each cable, we can create any position and direction of the moving plate in space. There are a total of 14 links (6 cables, 6 pulleys, the rack and the moving plate), 18 joints, 6 redundant degrees of freedom.

Number of degrees of freedom of the structure:

$$F = \lambda(n - j - 1) + \sum f_i - f_p \quad (1)$$

$\lambda$  : is the degree of freedom of any link in space ( $\lambda = 6$ )

$n$  : is the total number of links in the mechanism

$j$  : is the total number of joints in the mechanism

$f_i$  : is the total number of degrees of freedom of the joints in the mechanism

$f_p$  : is the total number of excess degrees of freedom of the mechanism

$$\text{So } F = 6(14 - 18 - 1) + (12 \times 3 + 6 \times 1) - 6 = 6$$

Thus, the degree of freedom of crane robot is 6, which means that it can perform translational movements in the x, y, z directions, rotation, folding, and shaking (rotation around the x, y, z axes). However, within the scope of this article, crane robot is built according to the requirement that the moving plate below always moves in a plane parallel to the Oxy plane. From that requirement, we determine the mathematical model of crane robot (Figure 2).

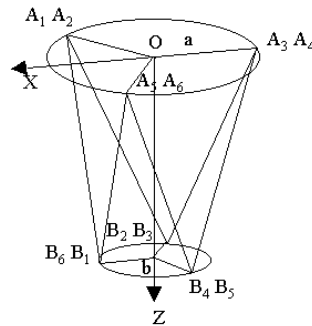


Figure 2 – Crane robot schematic diagram

### 2.2 Crane robot's rotation matrix

With the model and working requirements of crane robot, we get the rotation matrix to convert the coordinates between the moving plate and the rack. The rotation matrix is obtained from rotating around the Oz axis by an angle  $\theta$ .

Then

$${}^A R_B = \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \quad (2)$$

## 3. Inverse kinematics problem

For the inverse kinematics problem, the displacement  $\Delta$ ,  ${}^A R_B$  matrix and initial position  $p_0$  are

known. We have to find the length of the cable segments at the analysis point. From the crane robot model, we determine the coordinates of the legs at the working position as follows:

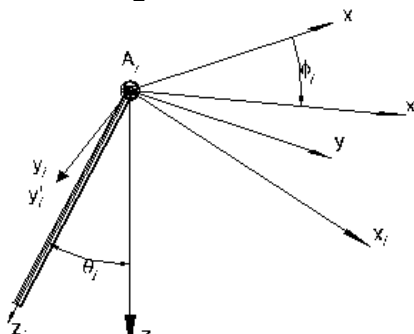
$$\begin{aligned}
 d_1 &= \begin{bmatrix} p_x \cos \theta - p_y \sin \theta + b \cos \theta - \frac{a}{2} \\ p_x \sin \theta + p_y \cos \theta + b \sin \theta - \frac{a\sqrt{3}}{2} \\ h + p_z \end{bmatrix} & d_4 &= \begin{bmatrix} p_x \cos \theta - p_y \sin \theta - \frac{b}{2} \cos \theta + \frac{b\sqrt{3}}{2} \sin \theta + a \\ p_x \sin \theta + p_y \cos \theta - \frac{b}{2} \sin \theta - \frac{b\sqrt{3}}{2} \cos \theta \\ h + p_z \end{bmatrix} \\
 d_2 &= \begin{bmatrix} p_x \cos \theta - p_y \sin \theta - \frac{b}{2} \cos \theta - \frac{b\sqrt{3}}{2} \sin \theta - \frac{a}{2} \\ p_x \sin \theta + p_y \cos \theta - \frac{b}{2} \sin \theta + \frac{b\sqrt{3}}{2} \cos \theta - \frac{a\sqrt{3}}{2} \\ h + p_z \end{bmatrix} & d_5 &= \begin{bmatrix} p_x \cos \theta - p_y \sin \theta - \frac{b}{2} \cos \theta + \frac{b\sqrt{3}}{2} \sin \theta - \frac{a}{2} \\ p_x \sin \theta + p_y \cos \theta - \frac{b}{2} \sin \theta - \frac{b\sqrt{3}}{2} \cos \theta + \frac{a\sqrt{3}}{2} \\ h + p_z \end{bmatrix} \\
 d_3 &= \begin{bmatrix} p_x \cos \theta - p_y \sin \theta - \frac{b}{2} \cos \theta - \frac{b\sqrt{3}}{2} \sin \theta + a \\ p_x \sin \theta + p_y \cos \theta - \frac{b}{2} \sin \theta + \frac{b\sqrt{3}}{2} \cos \theta \\ h + p_z \end{bmatrix} & d_6 &= \begin{bmatrix} p_x \cos \theta - p_y \sin \theta + b \cos \theta - \frac{a}{2} \\ p_x \sin \theta + p_y \cos \theta + b \sin \theta - \frac{a\sqrt{3}}{2} \\ h + p_z \end{bmatrix}
 \end{aligned}$$

#### 4. Forward kinematics problem

For the forward kinematics problem, the length of the moving cables is known, we must determine the position of the moving plate corresponding to the length of the moving cables (which is the displacement  $\Delta$  and the  ${}^A R_B$  rotation matrix).

The direction of leg  $i$  can be represented by two Euler angles, which are rotation around the  $Z_i$  axis by angle  $\phi_i$ , then rotation around the  $Y_i$  axis by angle  $\theta_i$  as shown in the figure below. Therefore, the rotation matrix of leg  $i$  can be written as  ${}^A R_i = R_{Z\phi_i} \cdot R_{Y\theta_i}$

$$\begin{aligned}
 &= \begin{bmatrix} \cos \phi_i & -\sin \phi_i & 0 \\ \sin \phi_i & \cos \phi_i & 0 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} \cos \theta_i & 0 & \sin \theta_i \\ 0 & 1 & 0 \\ -\sin \theta_i & 0 & \cos \theta_i \end{bmatrix} \\
 &= \begin{bmatrix} \cos \phi_i \cos \theta_i & -\sin \phi_i & \cos \phi_i \sin \theta_i \\ \sin \phi_i \cos \theta_i & \cos \phi_i & \sin \phi_i \sin \theta_i \\ -\sin \theta_i & 0 & \cos \theta_i \end{bmatrix}
 \end{aligned}$$



The unit vector  ${}^i S_i$  in the coordinate system of foot  $i$  is given by  ${}^i S_i = [0, 0, 1]^T$

The coordinate  $S_i$  in the fixed coordinate system is calculated  $S_i = {}^A R_i \cdot {}^i S_i$

$$S_i = \begin{bmatrix} \cos\phi_i \sin\theta_i \\ \sin\phi_i \sin\theta_i \\ \cos\theta_i \end{bmatrix}$$

Solving the above equation gives us the following results for angles  $\phi_i$  and  $\theta_i$ :

$$\cos\theta_i = S_{iz}$$

$$\sin\theta_i = \sqrt{S_{ix}^2 + S_{iy}^2} \quad (0 \leq \theta \leq \pi)$$

$$\sin\phi_i = \frac{S_{iy}}{\sin\theta_i}$$

$$\cos\phi_i = \frac{S_{ix}}{\sin\theta_i}$$

From this the Euler angles of the  $i$ -th leg were determined.

### 5. Dynamic analysis

Attach coordinate system  $A(x, y, z)$  to the basket and coordinate system  $B(u, v, w)$  to the moving plate,  $xy$  plane contains ball joint  $A_i$ ,  $uv$  plane contains ball joint  $B_i$ . The origin of the moving coordinate system  $B$  is located at the center  $P$  of the moving plate, the origin of the fixed coordinate system  $A$  is located at the center  $O$  of the basket. The legs (fibers) are represented by vector  $d_i$ . In addition, attach the coordinate system of leg  $i$  with the origin at  $A_i$ , the  $z_i$  axis is directed from  $A_i$  to  $B_i$ , the  $y_i$  axis is the vector product of the two vectors  $Z_i$  and  $Z$  and the  $x_i$  axis is determined by the right-hand rule.

The velocity and angular acceleration of leg  $i$  in the coordinate system of leg  $i$  are given as follows:

$${}^i \omega_i = \frac{1}{d_i} ({}^i S_i \times {}^i v_{bi}) = \frac{1}{d_i} \begin{bmatrix} -{}^i v_{biy} \\ {}^i v_{bix} \\ 0 \end{bmatrix}$$

$${}^i \dot{\omega}_i = \frac{1}{d_i} \cdot {}^i S_i \times {}^i \dot{v}_{bi} - \frac{2\dot{d}_i}{d_i} \cdot {}^i \omega_i = \frac{1}{d_i} \begin{bmatrix} -{}^i \dot{v}_{biy} + \frac{2 \cdot {}^i v_{biz} \cdot {}^i v_{biy}}{d_i} \\ {}^i \dot{v}_{bix} - \frac{2 \cdot {}^i v_{biz} \cdot {}^i v_{bix}}{d_i} \\ 0 \end{bmatrix}$$

$$\omega_i = {}^A R_i \cdot {}^i \omega_i, \quad \xi_i = {}^A R_i \cdot {}^i \xi_i$$

## 6. Conclusion

We have analyzed position, kinematics, and dynamics to come up with a solution to control the actuators in parallel.

## References

1. K.S.Fu, R.C.Gonzalez, C.S.G.Lee (1987). Robotics. International Edition.
2. T. D. Burtonm (1994). Introduction to Dynamic Systems Analysis. McGraw-Hill.

©Tran Thi Tram, 2025



# СЕЛЬСКОЕ ХОЗЯЙСТВО

Seydiyeva Jennet Charyyargulyyevna  
Garyagdyev Maksat Annamyradovich

Lecturer

International horse breeding academy named after Aba Annayev  
Arkadag, Turkmenistan

## **WORLD EXPERIENCE IN FEEDING RACEHORSES: A MODERN PERSPECTIVE ON OPTIMIZING PERFORMANCE AND HEALTH**

### **Abstract**

The field of racehorse nutrition is undergoing a significant transformation, moving beyond traditional high-starch diets to embrace a more scientific, holistic, and customized approach. This article provides an updated overview of global feeding practices, incorporating recent advances in research. While the fundamental need for high energy remains, modern strategies prioritize the intricate balance of the equine digestive system, particularly the gut microbiome. Emerging research highlights the critical link between gut health and athletic performance, advocating for diets that support a diverse and stable microbial population. Furthermore, there is a growing trend towards precision feeding, utilizing a broader range of energy sources—from "super fibers" to strategic fat inclusion—to meet individual metabolic needs and mitigate the risks of metabolic and gastrointestinal disorders. This evolution in feeding philosophy aims to enhance not only the short-term performance of these equine athletes but also their long-term health, soundness, and career longevity.

### **Keywords:**

racehorse, nutrition, feeding, performance, health, gut microbiome, precision feeding,  
super fibers, forage, energy sources, supplements.

### **Introduction**

In the high-stakes world of thoroughbred racing, a horse's diet is the cornerstone of its performance, dictating its energy, recovery, and overall well-being. For decades, the global standard for fueling these elite athletes has been the energy-dense, high-starch grain ration, designed to provide the explosive power needed for a race. However, recent scientific breakthroughs have exposed the limitations and potential health risks of this traditional approach, sparking a profound shift in feeding philosophies across major racing jurisdictions worldwide.

The most significant paradigm change centers on a deeper understanding of the equine gut microbiome—the complex ecosystem of bacteria, fungi, and protozoa residing in the hindgut. Groundbreaking studies have established a direct link between a horse's gut microbial diversity and its athletic potential and long-term health. For instance, research from the University of Surrey has shown that the gut bacterial community of a one-month-old foal can predict its future performance and susceptibility to disease. Specific microbial byproducts, such as butyrate, are now understood to be key players in the "gut-muscle axis," acting as a direct energy source and influencing muscle function. This has led to a re-evaluation of feed ingredients, with a greater emphasis on components that nourish and stabilize this delicate ecosystem, such as fermentable fibers and prebiotics.

The racehorse stands as the epitome of an equine athlete, demanding a precise and highly specialized nutritional program to meet the extraordinary energy demands of training and competition. Across the globe, trainers, veterinarians, and nutritionists continually strive to refine feeding strategies to optimize speed, stamina, and recovery, all while safeguarding the horse's overall well-being. Historically, racehorse diets have

heavily relied on high-starch grains to provide the explosive energy required for intense bursts of speed. However, a deeper understanding of equine digestive physiology and the potential health consequences of imbalanced rations has led to a paradigm shift in feeding philosophies.

The equine digestive system, designed for continuous grazing of fibrous plant material, is a delicate balance. Unlike ruminants, horses are hindgut fermenters, meaning that a significant portion of fiber digestion occurs in the cecum and large colon. While high-intensity exercise necessitates concentrated energy sources, an over-reliance on non-structural carbohydrates (starches and sugars found in grains) can overwhelm the foregut's digestive capacity. This can lead to undigested starch reaching the hindgut, causing microbial imbalances, acidosis, and a cascade of problems including colic, laminitis, and equine gastric ulcer syndrome (EGUS).

Beyond the microbiome, the modern approach to racehorse nutrition is increasingly defined by precision and customization. Trainers and nutritionists are moving away from "one-size-fits-all" rations, opting instead for data-driven feeding programs tailored to a horse's individual metabolic profile, training intensity, and genetic predispositions. This has popularized the use of alternative, "cool" energy sources, such as fats and "super fibers" like sugar beet pulp and soybean hulls. These ingredients provide highly digestible energy without the high glycemic response of starches, helping to prevent behavioral issues and reduce the risk of conditions like tying-up (exertional rhabdomyolysis) and gastric ulcers. The processing of grains has also been refined, with techniques like steam flaking and micronization now standard practice to improve pre-cecal starch digestion, thereby reducing the burden on the hindgut.

Ultimately, the world of racehorse feeding has evolved from a simple practice of providing fuel to a sophisticated science aimed at optimizing physiological function from the cellular level up. The focus is now on a synergy of high-quality forage, balanced energy from multiple sources, and targeted supplementation, all guided by the latest research to build a robust, resilient, and high-performing equine athlete.

#### References:

1. Geor, R. J., Harris, P., & Coenen, M. (Eds.). (2013). *Equine Applied and Clinical Nutrition*. Saunders.
2. Lewis, L. D. (1995). *Equine Clinical Nutrition: Feeding and Care*. Williams & Wilkins.
3. Kentucky Equine Research (KER). (2025). *Alternative Energy Sources for Performance Horses*. EquiNews. Retrieved from <https://ker.com/equinews/alternative-energy-sources-performance-horses/>
4. University of Surrey. (2024). *Bacterial gut diversity improves the athletic performance of racehorses*. News and Press Releases. Retrieved from <https://www.surrey.ac.uk/news/bacterial-gut-diversity-improves-athletic-performance-racehorses>
5. Martin, J. (2021). *Racehorse nutrition*. Johnston Racing. Retrieved from [https://www.johnston.racing/wp-content/uploads/2021\\_04\\_Vet-John-Martin-discusses-racehorse-nutrition.pdf](https://www.johnston.racing/wp-content/uploads/2021_04_Vet-John-Martin-discusses-racehorse-nutrition.pdf)

© Seydiyeva J. Garyagdyev M., 2025



# ФИЛОЛОГИЯ

**Mammedov Mekan**, student.

Turkmen National Institute of World Languages named after Dovletmamet Azadi.

**Atjykova Ogulhan**, student.

Turkmen Agricultural University

Ashgabat, Turkmenistan

## SUCCESSFULLY FOREIGN LANGUAGES LEARNING

### Abstract

In an increasingly interconnected world, mastering foreign languages has become a vital skill that opens up numerous personal, academic, and professional opportunities. This article explores the significance of learning foreign languages, effective strategies for acquiring new languages, common challenges faced by learners, and the benefits of multilingualism. Emphasizing the role of technology, cultural exposure, and motivation, the discussion highlights how language learning fosters cross-cultural understanding, cognitive development, and career advancement. While recognizing the hurdles, the article advocates for adopting innovative approaches and a proactive mindset to succeed in mastering multiple languages.

### Introduction

The globalization of economies, expansion of international travel, and the rise of digital communication have made proficiency in foreign languages more important than ever. Learning additional languages beyond one's native tongue not only enriches cultural awareness but also enhances cognitive abilities, improves employability, and facilitates meaningful connections across borders. However, acquiring new languages presents challenges such as grammatical complexity, pronunciation difficulties, and maintaining motivation over time. The modern learner benefits from a wide array of tools and strategies—ranging from traditional classroom instruction to digital platforms—that can make language acquisition more effective, engaging, and accessible. Embracing multilingualism is no longer just a cultural asset but a crucial competency in today's globalized society.

Successful language learning hinges on a combination of immersive exposure, active practice, and consistent effort. Immersion techniques—such as engaging with films, music, books, and conversations in the target language—help develop listening and comprehension skills while fostering cultural understanding. Digital tools like language learning apps (e.g., Duolingo, Babbel), online courses, and virtual exchanges offer personalized, flexible learning pathways suitable for various proficiency levels. Incorporating speaking practice through language tandems, group discussions, and pronunciation exercises boosts fluency and confidence. Setting clear, achievable goals, maintaining regular practice routines, and seeking feedback are critical to progress. Moreover, learning a language in context—by understanding its cultural nuances and real-life usage—makes the process more meaningful and memorable.

Learning a new language often involves overcoming numerous obstacles. Pronunciation nuances, especially in tonal or phonologically different languages, can be difficult. Grammar rules and syntax may seem complex and inconsistent, leading to frustration. Maintaining motivation over long periods is challenging, especially when progress appears slow or when learners lack opportunities for authentic practice. Psychological barriers such as fear of making mistakes and lack of confidence can also impede speaking and active participation. Additionally, limited access to qualified teachers, resources, or immersive environments can hinder progress, particularly in regions where the target language is less prevalent. Overcoming these hurdles requires perseverance, adaptive learning strategies, and a supportive environment that encourages experimentation and resilience.

The advantages of multilingualism extend well beyond basic communication. Learning foreign

languages enhances cognitive skills such as problem-solving, multitasking, and memory. It broadens cultural horizons, fostering empathy and intercultural competence, which are essential in today's diverse societies. Professionally, multilingual individuals have a competitive edge in global job markets, with increased opportunities for international careers, diplomacy, and business negotiations. Educationally, knowing multiple languages facilitates access to diverse academic resources and research. Personally, acquiring new languages builds confidence, enriches travel experiences, and nurtures a lifelong curiosity about the world. Overall, mastering foreign languages empowers individuals to participate more fully in global conversations and communities.

The future of language learning is increasingly intertwined with technological innovation. Artificial intelligence, virtual reality, and machine learning are creating immersive, adaptive, and interactive learning environments that cater to individual needs. Online communities and social media enable learners to practice with native speakers worldwide, breaking down geographical barriers. To maximize success, learners should adopt a proactive attitude, embrace cultural diversity, and seek out authentic language experiences. Educational institutions and policymakers must prioritize multilingual education, invest in teacher training, and develop accessible resources, especially in underserved regions. Encouraging early language exposure and fostering a positive attitude toward mistakes as part of the learning process are also crucial. Ultimately, embracing a lifelong learning mindset and leveraging technological advancements will be key to mastering multiple foreign languages.

### Conclusion

Learning foreign languages is a powerful tool for personal growth, cultural exchange, and professional development. While challenges exist, modern methodologies, technological tools, and a motivated mindset make language acquisition more attainable than ever. Multilingualism not only enriches individual lives but also promotes understanding and cooperation across nations, fostering a more connected and inclusive world. By adopting effective strategies and staying committed, learners can unlock the myriad opportunities that mastering foreign languages offers, paving the way for a brighter, more interculturally fluent future.

### References:

1. Crystal, D. (2010). *\*The Cambridge Encyclopedia of Language\**. Cambridge University Press.
2. Gardner, R. C., & Lambert, W. E. (1972). *\*Attitudes and Motivation in Second-Language Learning\**. Newbury House.
3. Godwin-Jones, R. (2018). Using Mobile Technology to Develop Language Skills and Cultural Understanding. *\*Language Learning & Technology\**, 22(2), 3–13.

© Mammedov M., Atyjkova O., 2025

**Matmuradova Leyli**, student.

Turkmen National Institute of World Languages named after Dovletmamet Azadi.

**Kurbanowa Arzuw**, student.

Turkmen Agricultural University  
Ashgabat, Turkmenistan

## LEARNING ENGLISH - A TRANSFORMATIVE JOURNEY THAT BROADENS HORIZONS, BUILDS CONFIDENCE

### Abstract

English has become the global lingua franca, opening doors to international communication,

education, and business. As more learners around the world seek to acquire proficiency in English, understanding effective learning strategies, common challenges, and the vast opportunities that come with mastery of the language becomes essential. This article explores the key aspects of learning English, including innovative approaches, obstacles faced by learners, and the benefits gained from achieving fluency. Emphasizing the importance of motivation, immersive experiences, and technological tools, the discussion highlights how individuals can overcome difficulties and harness the potential of English as a gateway to global engagement.

Learning English has gained unprecedented importance in the 21st century due to globalization, technological advancement, and economic integration. For many non-native speakers, acquiring fluency is not only a personal goal but also a professional necessity, enabling access to world-class education, international careers, and cross-cultural understanding. However, mastering English presents unique challenges, particularly for learners with different native languages, educational backgrounds, and access to resources. Innovative teaching methods, digital platforms, and immersive experiences have transformed traditional language learning, making it more accessible and engaging than ever before. Recognizing these developments, learners must adopt strategic approaches, stay motivated, and leverage available technologies to succeed.

### **Effective Strategies for Learning English**

Successful English acquisition relies on a combination of structured learning and real-world practice. Immersive methods, such as engaging with English media—movies, podcasts, books, and social media—enhance listening and comprehension skills while familiarizing learners with various accents, idioms, and cultural contexts. Interactive language apps and online courses offer personalized, flexible learning options, enabling learners to practice vocabulary, grammar, and pronunciation at their own pace. Participating in conversation clubs, language exchanges, and immersion programs further develops speaking and listening skills, fostering confidence and fluency. Additionally, setting clear goals, maintaining consistent practice routines, and actively seeking feedback are critical for steady progress. Emphasizing communicative competence over rote memorization encourages learners to use English in authentic situations, making their learning experience more meaningful and effective.

Despite the availability of numerous resources, learners encounter multiple obstacles in mastering English. Pronunciation and intonation often prove difficult, especially for those whose native languages have different phonetic systems. Grammar complexities, such as tense usage and sentence structure, can cause confusion and errors. Limited exposure to native speakers and authentic language environments hampers fluency development. Furthermore, psychological barriers, including fear of making mistakes and lack of confidence, hinder active participation in conversations. Socioeconomic factors also play a role, as access to quality education, technology, and language learning opportunities varies widely across regions. Overcoming these challenges requires patience, perseverance, and the adoption of adaptive learning techniques tailored to individual needs.

Proficiency in English offers numerous advantages in today's interconnected world. It facilitates access to higher education in prestigious universities, many of which use English as the medium of instruction. In the job market, English fluency enhances employability and opens doors to international companies and collaborations. On a cultural level, understanding English allows learners to engage with diverse perspectives, literature, and entertainment, fostering global awareness and empathy. Additionally, bilingual or multilingual individuals often experience cognitive benefits, such as improved problem-solving skills and better multitasking abilities. For many, learning English is a transformative journey that broadens horizons, builds confidence, and creates pathways for personal and professional growth.

The future of learning English lies in leveraging technology and fostering immersive experiences. Virtual reality (VR) and artificial intelligence (AI) enable realistic language practice environments and personalized feedback, accelerating learning outcomes. Mobile learning platforms and social media provide opportunities for informal practice and cultural exchange. To maximize success, learners should combine formal education with informal exposure, maintain a positive attitude, and cultivate a growth mindset. Governments and educational institutions must invest in accessible language programs, especially in underserved regions, to bridge existing gaps. Encouraging intercultural communication and promoting language diversity within multilingual environments can also enhance motivation and contextual understanding. Ultimately, embracing innovation and fostering a supportive learning community are key to unlocking the full potential of English learners worldwide.

### Conclusion

Learning English remains a vital pursuit for millions seeking to participate fully in our interconnected world. While challenges exist, advances in technology, innovative teaching methods, and a global emphasis on immersive learning provide unprecedented opportunities for success. By adopting strategic approaches, maintaining motivation, and utilizing diverse resources, learners can overcome obstacles and achieve fluency. English proficiency not only broadens individual horizons but also fosters cross-cultural understanding and collaboration, contributing to a more open and interconnected global society.

### References

1. Crystal, D. (2012). *English as a Global Language*. Cambridge University Press.
2. Richards, J. C., & Rodgers, T. S. (2014). *Approaches and Methods in Language Teaching*. Cambridge University Press.
3. Liu, M. (2020). The Impact of Technology on English Language Learning. *Journal of Language Education*, 15(3), 45-60.

© Matmuradova L., Kurbanowa A., 2025

**Myratdurdyev Novruz**, lecturer.

**Bayramgeldiyev Vepa**, student.

International horse breeding academy named after Aba Annayev  
Arkadag, Turkmenistan

**Akmadov Nurberdi**, student.

Turkmen Agricultural University named after S.A. Niyazov.  
Ashgabat, Turkmenistan

## LEARNING WORLD LANGUAGES IN THE CONTEXT OF BIOLOGICAL SCIENCES

### Abstract

In an increasingly globalized scientific community, the ability to communicate across languages has become essential—particularly in interdisciplinary fields like biological sciences. This article explores the value and impact of learning world languages for students and professionals in biology-related fields. It analyzes the importance of multilingualism in international collaboration, scientific publishing, field research, and academic mobility. The article also examines pedagogical strategies to integrate language learning with scientific education and discusses how language competence enriches both knowledge production and cultural understanding in the global life sciences.

**Keywords:**

world languages, biological sciences, scientific communication, multilingualism, academic collaboration, interdisciplinary education, research mobility, global science.

In today's interconnected world, the biological sciences no longer operate within national or linguistic borders. Collaboration among scientists from diverse linguistic and cultural backgrounds is the norm rather than the exception. Whether studying climate change, conducting epidemiological research, or participating in global conservation efforts, biologists are required to communicate, publish, and cooperate across languages and regions. In this context, the integration of world language learning into biology education is not just an asset—it is a necessity.

Learning world languages also enhances access to non-English scientific literature. While English-language journals dominate global indexing systems, a wealth of valuable research continues to be published in regional languages. Studies on biodiversity, traditional medicine, endemic species, and agricultural practices often appear in local academic or government publications. Language competence allows researchers to broaden their knowledge base, validate local expertise, and avoid duplication of existing work.

To address these needs, interdisciplinary educational models are emerging that integrate language learning into science curricula. For example, English for Specific Purposes (ESP) programs tailored for biology students teach scientific terminology, writing research papers, giving presentations, and reading journal articles. Similar initiatives exist for French, German, and Spanish in regions where these languages are dominant. Language modules can be embedded in biology degrees, offering students both linguistic competence and scientific communication skills.

Classroom strategies may include reading scientific texts in multiple languages, comparing international case studies, conducting bilingual lab reports, or simulating multilingual conferences. Technology also facilitates this integration—students can use translation software, online glossaries, and collaborative platforms to practice science communication in real-world contexts.

Importantly, the benefits of learning world languages in the biological sciences go beyond academic or professional advancement. They contribute to ethical and inclusive science, where researchers engage with diverse perspectives, respect local knowledge systems, and practice responsible communication. Multilingual scientists are more likely to collaborate equitably, navigate cross-cultural challenges, and represent the global nature of biological research.

**Conclusion**

Learning world languages in the context of biological sciences is a strategic and humanistic investment. It prepares future scientists to operate effectively in a globalized, multilingual world, enriches the quality of research through broader access to knowledge and collaboration, and fosters respect for cultural and linguistic diversity. As the biological sciences continue to address global challenges—from pandemics to biodiversity loss—language competence will remain an indispensable tool for global scientific progress and ethical engagement.

**References:**

1. Montgomery, S. L. (2013). *Does Science Need a Global Language? English and the Future of Research*. University of Chicago Press.
2. Swales, J. M. (1990). *Genre Analysis: English in Academic and Research Settings*. Cambridge University Press.
3. Canagarajah, A. S. (2002). *A Geopolitics of Academic Writing*. University of Pittsburgh Press.
4. Flowerdew, J. (2015). Some Thoughts on English for Research Publication Purposes (ERPP) and Related Issues. *Language Teaching*, 48(2), 250–262.

5. Ammon, U. (2010). The Dominance of English as a Language of Science: Effects on Other Languages and Language Communities. de Gruyter Mouton.
  6. UNESCO. (2022). Multilingualism in Scientific Research and Global Knowledge Sharing. Paris: UNESCO.
- © Myratdurdyev N., Bayramgeldiyev V., Akmadov N., 2025

Nguyen Thi Thu Phuc

Hanoi University of Mining and Geology, Vietnam

## ATTITUDES TOWARDS THE USE OF ENGLISH - VIETNAMESE CODE-SWITCHING IN CONVERSATIONS OF VIETNAMESE ENGINEERS

### Abstract

**Code-switching** is a common phenomenon in bilingual communication that has attracted the attention of many scholars, including Gumperz (1972), Poplack (1980), Grosjean (1982), Malik (1994), Auer (1995), Appel & Muysken (2006), Ho-Dac-Tuc (2003), and Kim (2006). This study investigates attitudes toward English-Vietnamese code-switching in workplace conversations among a group of engineers. A mixed-methods approach was used, combining questionnaires and analysis of recorded conversations, based on the theoretical frameworks of Eagley & Chaiken (1993), Myers-Scotton (1993), and Hidalgo (1998).

The findings reveal generally open and positive attitudes: most participants understood, felt comfortable with, and preferred code-switched conversations. Factors such as age, occupation, English proficiency, and frequency of use had limited influence overall, though specific aspects like work experience, field of expertise, and English ability did play a role. While code-switching may slightly affect the purity of Vietnamese, its positive impact on English acquisition—especially vocabulary and technical terms—is undeniable. Therefore, code-switching should be encouraged in English teaching and learning, particularly in specialized contexts.

### Key word:

code-switching, attitudes to code-switching of engineers in a company, Vietnam.

### 1. Introduction

**Code-switching**, a sociolinguistic phenomenon common in bilingual communities, occurs when speakers alternate between their native language (L1) and a second language (L2) across different domains (Kim, 2006). With English becoming a global language (Crystal, 2003), English expressions have become widespread in online platforms and daily speech, particularly among youth—for example: “*ok nhé*,” “*hello bạn*,” “*lướt web*,” “*search mạng*,” “*check lại*,” etc. This practice is generally accepted in society.

Code-switching has drawn significant scholarly attention (Poplack, 1980; Grosjean, 1982; Malik, 1994; Appel & Muysken, 2006; Ho, 2003; Kim, 2006). In Vietnam, many professionals, especially engineers, frequently use English-Vietnamese code-switching at work despite living in a predominantly Vietnamese-speaking environment.

This study examines the **attitudes toward code-switching** among engineers at an oil and gas company in southern Vietnam. Although they are not linguists or English teachers, most of them are proficient in English. The main research question is:

1. *What are the attitudes toward English-Vietnamese code-switching in workplace conversations among Vietnamese engineers?*

The study aims to explore how highly qualified professionals perceive the integration of code-switching into their daily work life, contributing insights into the behavior of bilingual speech communities in Vietnam.

## 2. Theoretical basis and methodology

### 2.1. Theories

**Sociolinguistics** examines the relationship between language and society, including how language use reflects and shapes social structures. Within this field, **bilingualism** refers to the ability to communicate in two or more languages (Spolsky, 1998). A key phenomenon in bilingual speech is **code-switching**, defined as the alternating use of two or more languages within a conversation (Grosjean, 1982; Poplack, 1980). It often occurs without changes in topic or interlocutor and serves important social functions (Myers-Scotton, 1993).

The concept of **attitude** is complex and multifaceted. Gardner (1980) sees it as a general disposition, while Ajzen (1988) focuses on its evaluative nature. Eagley & Chaiken (1993) define attitude as a psychological tendency expressed by degrees of favor or disfavor toward an entity, reflected in responses such as approval/disapproval, liking/disliking, or attraction/aversion.

Studies on attitudes toward code-switching explore various influencing factors. Myers-Scotton (1993) highlights **age** and **language proficiency** as key variables, while Hidalgo (1998) found that some bilinguals view code-switching negatively in terms of **understandability**, **attractiveness**, and **correctness**.

This study investigates participants' **attitudes toward code-switching** through a questionnaire addressing elements such as comprehension, emotional response (favor/disfavor), linguistic preferences, and perceived impact on English learning. It also examines how factors like **age**, **occupation**, **English proficiency**, and **frequency of use** influence these attitudes.

### 2.2. Methods

To address the research question, a survey was conducted with fifteen engineers at PVC-PT Company, who were involved in preparing international bidding documents and contracts. With the company's permission, their natural workplace conversations were recorded and transcribed. The code-switched excerpts were then distributed to employees in other companies to gather broader feedback. A structured questionnaire titled *"Attitudes of the Community towards Code-Switching"* was designed and distributed to 120 respondents. The questionnaire included close-ended items, aiming to assess participants' frequency of code-switching, comprehension, comfort level, preference, perceived attractiveness, and views on whether factors such as age, profession, work field, or English proficiency influence code-switching. It also examined perceptions of code-switching's effect on the purity of Vietnamese and its impact—positive or negative—on English language acquisition, particularly in teaching and learning contexts such as ESL and ESP. The collected data were then analyzed to draw conclusions for the study.

## 3. Findings and discussion

The questionnaire, consisting of various item types, was distributed to 120 respondents. Their answers were collected and systematically grouped according to the thematic focus of each section for quantitative analysis and interpretation.

### 3.1. Part 1: Frequency of code-switching in everyday conversations

Figure 1 shows that 120 people participated in the survey and answered this questionnaire in which two people (1.66%) "always" code-switch, forty six (38.33%) people "usually" do it, sixty one (50.83%) choose "sometimes" whereas only seven (5.83%) choose "rarely" and four (3.33%) say "never". Clearly that most of the respondents in the questionnaire are used to code-switching in their everyday conversations. This acquaintance may make them easier to understand code-switching and give the correct reply to the survey.

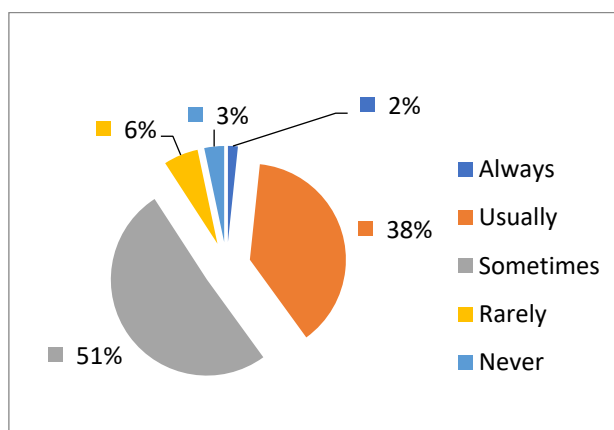


Figure 1 – Frequency of codes-switching in everyday conversations

### 3.2. Part 2: Attitudes of respondents towards code-switching in conversations at workplace

A total of 120 participants responded to nine survey items related to attitudes toward code-switching. The results, summarized in Table 1, show that a large majority (90%) reported understanding conversations involving code-switching, while only 10% did not. Approximately 67.5% felt comfortable with such conversations, and 63.33% expressed a preference for them. Additionally, 64.16% found code-switching to be attention-catching. Regarding comprehension difficulty, 74.16% stated that code-switching did not cause confusion, while 25.83% thought it did.

As for influencing factors, only 30% believed English proficiency affects understanding and use of code-switching, while 70% disagreed. Similarly, 25.83% acknowledged age as a factor, whereas 74.16% did not. When asked about occupation or field of work, 39.16% saw it as influential, compared to 60.83% who did not. Lastly, opinions were nearly split on whether code-switching harms the purity of Vietnamese: 52.5% agreed, while 47.5% disagreed.

Table 1

Attitudes to code-switching in conversations at workplace

|                                                                                                                            | Yes              |        | No               |        |
|----------------------------------------------------------------------------------------------------------------------------|------------------|--------|------------------|--------|
|                                                                                                                            | Number of choice | %      | Number of choice | %      |
| <b>Q1:</b> Do you understand the conversations with code-switching ?                                                       | 108              | 90%    | 12               | 10%    |
| <b>Q2:</b> Do you feel comfortable when facing conversations with code-switching ?                                         | 81               | 67.5%  | 39               | 32.5%  |
| <b>Q3:</b> Do you prefer conversations with code-switching ?                                                               | 76               | 63.33% | 44               | 36.66% |
| <b>Q4:</b> Do the conversations with code-switching draw your attention?                                                   | 77               | 64.16% | 43               | 35.83% |
| <b>Q5:</b> Do you find words in conversations with code-switching make you difficult to understand them?                   | 31               | 25.83% | 89               | 74.16% |
| <b>Q6:</b> Do you think your proficiency of English affects the understanding and using codes-witching in conversations?   | 36               | 30%    | 84               | 70%    |
| <b>Q7:</b> Do you think your age affects the understanding and using codes-witching in conversations?                      | 31               | 25.83% | 89               | 74.16% |
| <b>Q8:</b> Do you think your occupation or work field affects the understanding and using codes-witching in conversations? | 47               | 39.16% | 73               | 60.83% |
| <b>Q9:</b> Do you think code-switching destroys Vietnamese impurity?                                                       | 63               | 52.50% | 57               | 47.50% |

In summary, although the respondents vary in age, occupation, and English proficiency, nearly all

understand workplace conversations involving code-switching. About two-thirds feel comfortable with and prefer such conversations, finding them engaging and generally easy to follow. Most do not believe that English proficiency, age, or occupation significantly affects their ability to understand or use code-switching. However, opinions are divided on its impact on the purity of Vietnamese: slightly more than half view it as potentially harmful, while the rest disagree. Overall, attitudes toward code-switching are open and mostly positive, though respondents suggest it should be used selectively to avoid possible negative effects on Vietnamese language proficiency.

### 3.3. Part 3: Further findings about the impacts of age, occupation, proficiency of English and frequency of English using on code-switching.

Part 3 of the questionnaire with four small items is providing more details referred to age, occupation, proficiency and frequency of using English at work. With the support from Part 2, there are some findings on the impacts of those mentioned factors described later on.

#### 3.3.1. Impact of age on understanding and using of code-switching

There are only eight (8 of 120) respondents working for 2-5 years and four of them (50%) agree that age affects the understanding and using of code-switching, four disagree. Most of the respondents have been working for 5-10 years (73 of 120) in which only fourteen people (19.17%) choose “Yes”, fifty nine people (80.82%) choose “No”. Thirty nine (39 of 120) respondents have over ten years working at company, fifteen of them say “Yes” and twenty four say “No”.

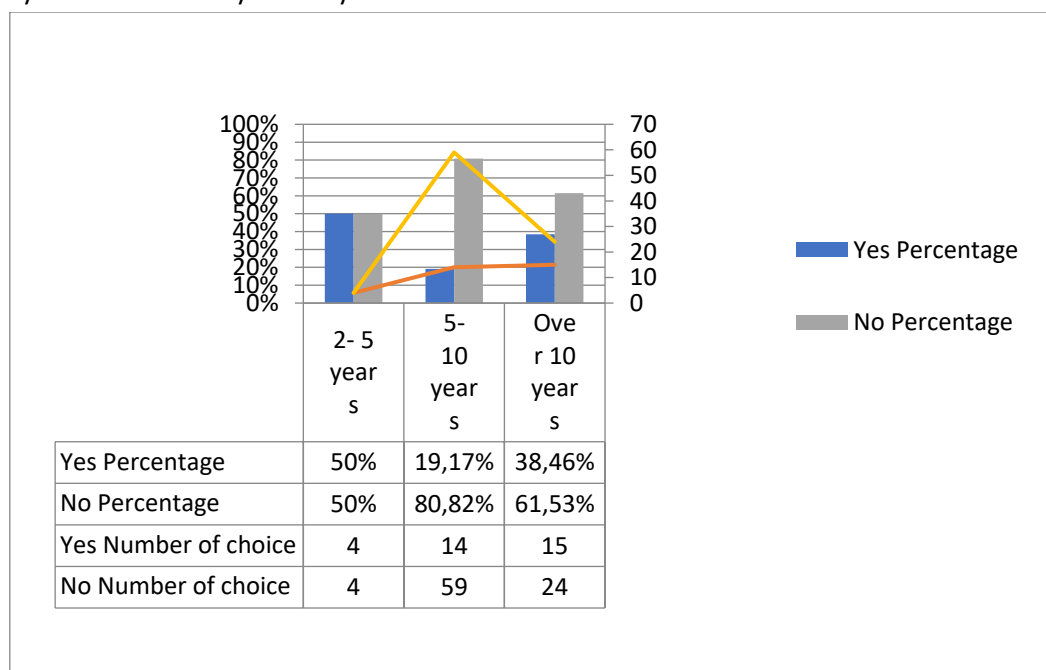


Figure 2 – Impact of age on understanding and using of code-switching  
(Breakdown of Q7 in Part 2 and Q1 in Part 3)

The largest group of respondents had 5–10 years of work experience, and most of them reported no difficulty in understanding or using code-switching. The second-largest group, those with over 10 years of experience, also largely believed that age does not affect code-switching. The smallest group consisted of those with only 2–5 years of experience. These results suggest that in the workplace, experience may contribute to greater familiarity and ease with code-switching, particularly among young but experienced professionals.

There may also be differences in attitudes toward code-switching depending on context. In professional settings, such as meetings, the use of code-switching often involves specific, technical terms

relevant to the job, making it more meaningful and acceptable among experienced employees. Outside of work—at home, in cafés, or on social media—code-switching tends to reflect casual habits, modernity, or social style, and is more prevalent among younger generations. This implies that **working age** may influence code-switching differently than **biological age**, particularly in how it shapes exposure to and purpose of code-switching across different contexts.

### 3.3.2. Impact of occupation on understanding and using of code-switching

To further clarify the impact of occupation on the understanding and use of code-switching, the 120 respondents were divided into four groups: Engineers (66), Workers (22), Marketing and Sales (17), and Administrative and Personnel staff (15). Based on responses to Question 8 (Part 2) and Questions 2 and 3 (Part 3), the results are shown in Table 1 and Figure 2. A majority of engineers (71.21%) believed that occupation does not affect code-switching comprehension or usage, and over half of the workers (54.54%) shared this view. In contrast, more than half of the Marketing and Sales group (58.82%) and Administrative and Personnel staff (53.33%) believed that occupation does have an influence.

Overall, engineers and workers—those engaged in technical and high-tech services—tend to have a more open view toward code-switching, likely due to their frequent exposure to specialized English terminology. Meanwhile, staff in marketing, sales, and administrative roles may find such code-switching more challenging, possibly due to unfamiliarity with technical vocabulary commonly used in code-switched conversations.

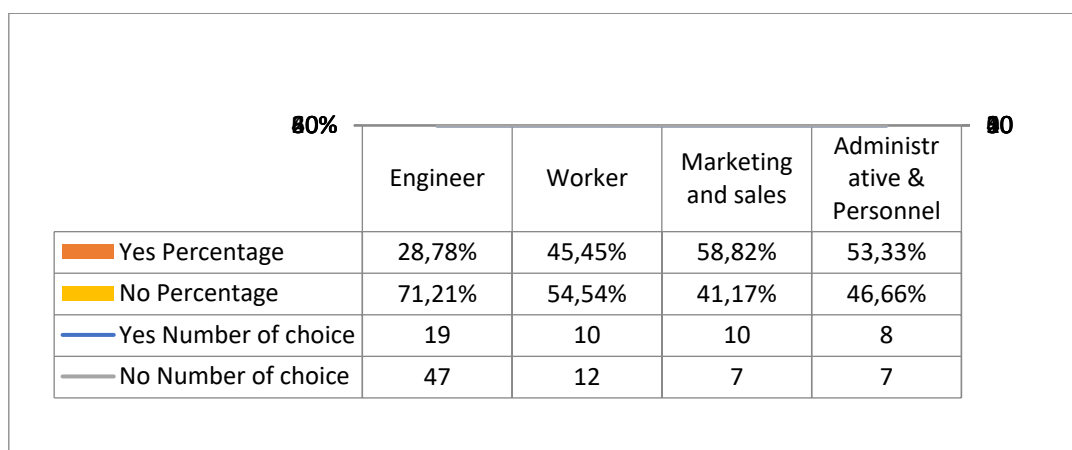


Figure 3 – Impact of occupation on understanding and using of code-switching  
(Breakdown of Q8 in Part 2 and Q2, 3 in Part 3)

### 3.3.3. Impact of proficiency of English on understanding and using of code-switching

Respondents were divided into four groups based on English proficiency: Excellent (5), Very Good (62), Good (45), and Poor (7). According to responses to Question 6 (Part 2) and Question 4 (Part 3), the results shown in Figure 4 indicate that none of the respondents with excellent English believed proficiency affects code-switching comprehension. Similarly, 85% of those at the very good level, 48% at the good level, and 43% at the poor level shared this view. The proportion of agreement declines as proficiency decreases.

These findings suggest that higher English proficiency correlates with greater confidence and competence in understanding and using code-switching, particularly in professional contexts where accuracy and specialized vocabulary are required. Those with lower proficiency may struggle with unfamiliar terms or pronunciation, leading to hesitation or reduced comprehension. Thus, while the majority believe that proficiency has little impact, the data indicate that it does play a moderate role—those more fluent in English tend to understand and use code-switching more effectively.

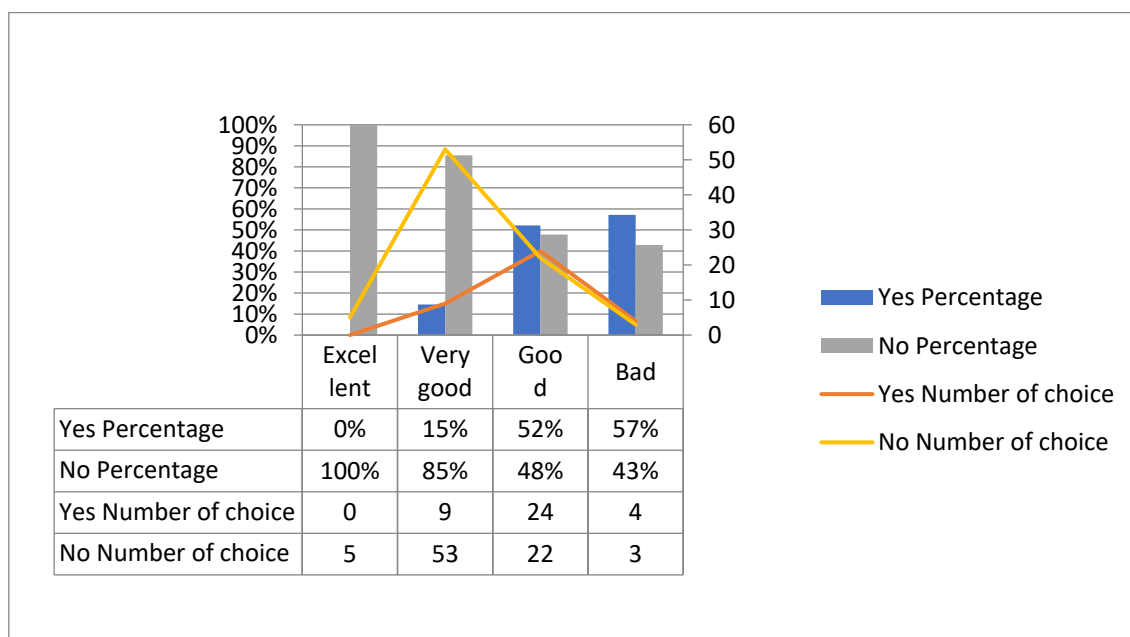


Figure 4 – Impact of proficiency of English on understanding and using of code-switching  
(Breakdown of Q6 in Part 2 and Q4 in Part 3)

### 3.3.4. Impact of frequency of using English at work on favor and disfavor of code-switching

Respondents were categorized into three groups based on their frequency of using English at work: frequent use (57 people), occasional use (60), and no use (3). As shown in Figure 5, 75.43% of those who frequently use English reported liking code-switching, while just over half of the occasional users expressed the same preference. None of the respondents who never use English reported a liking for code-switching.

These findings suggest that attitudes toward code-switching are closely tied to the frequency of English use in daily work. The more frequently respondents use English, the more favorable their view of code-switching. Conversely, those with little or no exposure to English at work tend to be less supportive or indifferent to the phenomenon.

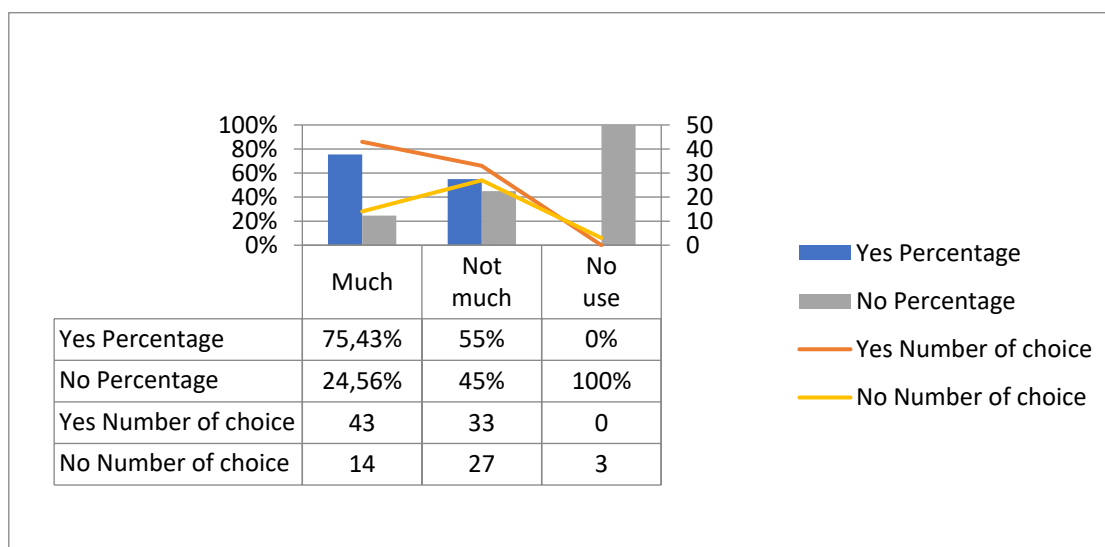


Figure 5 – Impact of frequency of using English at work on favor and disfavor of code-switching  
(Breakdown of Q3 in Part 2 and Q5 in Part 3)

### 3.4. Part 4: Positive or negative impacts of code-switching on English acquisition

When asked about the impact of code-switching on English acquisition, 79 respondents (63.83%) viewed it positively, while 41 (34.16%) expressed a negative opinion. As shown in Figure 6, positive perceptions were nearly twice as common as negative ones, indicating a shift in attitudes. Historically, code-switching was seen as a sign of communicative incompetence (Hamer & Blanc, 2000), but contemporary perspectives, such as Grosjean's (2010), emphasize that it reflects a high level of bilingual competence rather than linguistic deficiency.

Although around half of the respondents believe code-switching may harm the purity of Vietnamese, a majority still recognize its positive role in English learning and do not reject its educational value. In practice, when teachers lack appropriate equivalents in Vietnamese, code-switching can be an effective tool for explanation or clarification. As Weinreich (1953) and later Kim (2006) noted, earlier negative views on code-switching may have contributed to bilingual speakers feeling excluded from both linguistic and cultural groups. Therefore, while the benefits are acknowledged, educators should apply code-switching purposefully and with clear pedagogical intent.

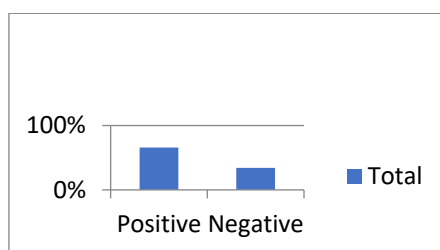


Figure 6: Impacts of code-switching on English acquisition

## 4. Conclusion

When encountering code-switching in workplace conversations, most respondents express open and positive attitudes. They generally understand these conversations, feel comfortable with them, and prefer this form of communication. The majority also believe that code-switched words are not difficult to comprehend. While most do not perceive age, occupation, English proficiency, or frequency of English use as major influences, detailed analysis reveals more nuanced insights. Those with 5–10 years of work experience tend to be more familiar and confident with code-switching than less experienced colleagues. Individuals in technical fields, such as engineers and workers, who regularly deal with specialized vocabulary, are also more comfortable using code-switching. Higher English proficiency and more frequent use of English at work correlate with greater acceptance and understanding of this phenomenon.

Today, code-switching is more widely accepted, with increasing recognition of its benefits in bilingual communication and education. However, when applied in language teaching, educators should use code-switching deliberately and with clear objectives to support effective English acquisition and avoid potential confusion or overdependence.

## References

1. Appel, R. & Muysken, P. (2006) *Language contacts and bilingualism*. Amsterdam University Press.
- 2Crystal, D (2003). *English as a Global Language*. (2nd ed) Cambridge University Press.
3. Eagley, A.H., Chaiken, S. (1993) *The Psychology of Attitudes*. London: Harcourt Brace College Publishers
- 4Grosjean, F. (1982). *Life with two languages: An introduction to bilingualism*. Cambridge, MA: Harvard University Press.
5. Garrett, P. (2007) 'Language Attitudes'. In Llamas, C., Mullany, L., Stockwell, P. (eds.) *The Routledge Companion to Sociolinguistics*. Abindgdon, Oxon: Routledge.



# ПЕДАГОГИКА

**Seydiyeva Jennet Charyyargulyyevna**  
**Gurdov Novruzalem Gurtgeldiyevich**

Lecturer

International horse breeding academy named after Aba Annayev  
 Arkadag, Turkmenistan

## THE INDISPENSABLE ROLE OF INNOVATIVE TECHNOLOGIES IN MODERN EDUCATION

### Abstract

Innovative technologies are fundamentally reshaping the landscape of modern education, moving beyond traditional pedagogical models to create dynamic, personalized, and globally connected learning experiences. This article explores the critical importance of these advancements, highlighting their capacity to enhance student engagement, foster critical 21st-century skills, promote accessibility, and facilitate data-driven instructional strategies. From Artificial Intelligence and Virtual Reality to adaptive learning platforms and robust Learning Management Systems, these technologies are pivotal in preparing students for a rapidly evolving world and empowering educators with unprecedented tools for effective teaching. The integration of innovative tech is no longer an option but a necessity for providing a truly modern, relevant, and impactful education.

### Keywords:

educational technology, edtech, personalized learning, artificial intelligence, virtual reality, augmented reality, blended learning, student engagement, digital literacy, future skills.

### Introduction

The classroom of today is vastly different from that of even a decade ago, and the pace of transformation is only accelerating. We are living in an era defined by rapid technological advancement, where digital fluency is becoming as crucial as traditional literacy. In this context, the integration of innovative technologies into education is not merely an enhancement but an imperative for equipping students with the competencies needed to thrive in the 21st century. The COVID-19 pandemic, while challenging, served as a global accelerator, thrusting digital learning solutions into the mainstream and undeniably demonstrating technology's vital role in ensuring educational continuity and accessibility.

However, the importance of innovative technologies extends far beyond remote learning capabilities. The current educational paradigm is shifting towards a more student-centered, personalized, and experiential approach. Learners today expect dynamic, interactive content that mirrors their daily digital interactions, and they require skills that prepare them for jobs that may not even exist yet. Technologies like Artificial Intelligence (AI) are moving beyond theoretical discussions to practical classroom applications, offering real-time feedback, automating administrative tasks, and even generating customized learning paths. Similarly, Virtual Reality (VR) and Augmented Reality (AR) are transforming abstract concepts into tangible, immersive experiences, breaking down geographical barriers and making learning truly global. This article will delve into the multifaceted importance of these technological innovations in delivering a modern education that is relevant, engaging, and prepares students not just for examinations, but for life.

### The Importance of Innovative Technologies

The impact of innovative technologies on modern education can be categorized into several critical areas:

1. **Personalized Learning Experiences:** One of the most transformative benefits of educational technology (EdTech) is its ability to cater to individual learning styles and paces. Adaptive learning platforms,

powered by AI, analyze student performance in real-time, identifying strengths, weaknesses, and preferred learning modalities. They then adjust content difficulty, provide targeted resources, and recommend personalized learning paths. This ensures that every student receives instruction tailored to their unique needs, maximizing comprehension and engagement, and preventing students from being left behind or held back by a uniform curriculum.

2. Enhanced Engagement and Motivation: Traditional lecture-based learning can often lead to passive student participation. Innovative technologies introduce interactive, multimedia-rich content that captures and sustains student attention. Gamification, for instance, incorporates game-like elements (points, badges, leaderboards, challenges) into learning activities, fostering healthy competition and intrinsic motivation. Virtual and Augmented Reality transport students to historical sites, inside the human body, or even to distant galaxies, making abstract concepts tangible and fostering a deeper, more memorable understanding.

3. Accessibility and Inclusivity: Technology significantly breaks down barriers to education. Online learning platforms and digital resources provide access to high-quality education for students in remote areas, those with disabilities (e.g., text-to-speech, speech-to-text, visual aids), or those who cannot attend traditional schools. This democratization of knowledge ensures that geographical location, physical limitations, or socio-economic status do not hinder a student's ability to learn and thrive.

4. Development of 21st-Century Skills: Beyond academic content, modern education must cultivate skills essential for future success:

- Digital Literacy: Students learn to navigate, evaluate, and create digital content responsibly and ethically.
- Critical Thinking and Problem-Solving: Interactive simulations, coding platforms, and data analysis tools challenge students to think critically and solve complex problems.
- Collaboration and Communication: Online collaboration tools (e.g., shared documents, video conferencing, discussion forums) enable seamless group work and foster effective communication skills, preparing students for collaborative professional environments.
- Creativity and Innovation: Multimedia creation tools, coding, and design software empower students to express their creativity and innovate.

5. Data-Driven Instruction and Feedback: Learning Management Systems (LMS) and other EdTech tools collect vast amounts of data on student performance, engagement, and progress. This data provides educators with invaluable insights, allowing them to identify learning gaps, track individual student development, and adjust their teaching strategies in real-time. Automated grading and instant feedback mechanisms (e.g., from AI tutors or quiz apps) allow students to quickly understand their mistakes and learn from them, while freeing up valuable teacher time for more personalized interaction.

6. Preparation for a Digital Future: The job market is increasingly digital. By integrating technology into daily learning, students become adept at using various digital tools and platforms, gaining a competitive edge in their future careers. From coding and data science to digital marketing and virtual collaboration, skills honed through technology in education are directly transferable to the modern workforce.

#### Conclusion

The integration of innovative technologies is no longer an optional add-on but a foundational pillar of modern education. These technologies empower educators to move beyond the limitations of traditional classrooms, fostering environments that are more engaging, personalized, and accessible. They are instrumental in cultivating the critical thinking, creativity, collaboration, and digital literacy skills that students need to navigate a rapidly evolving global landscape. As we look to the future, continuous investment in and thoughtful implementation of cutting-edge educational technologies will be paramount to ensuring that every student receives a high-quality, relevant education that prepares them not just for the challenges of tomorrow, but for the opportunities of a lifetime.

**References:**

1. Paniagua, A., & Liu, F. (2018). Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills. UNESCO.
2. Prensky, M. (2010). Teaching Digital Natives: Partnering for Real Learning. Corwin Press.
3. Siemens, G. (2005). Connectivism: A Learning Theory for the Digital Age. International Journal of Instructional Technology and Distance Learning, 2(1).
4. UNESCO - Education Sector: <https://www.unesco.org/education>

© Seydiyeva J., Gurdov N., 2025

**Truong Thi Thanh Thuy**

Hanoi University of Mining and Geology

**USING ENGLISH STORIES ON YOUTUBE IN LANGUAGE TEACHING AND LEARNING****Abstract**

To take advantage of the benefits of audiobooks in English teaching and learning, the author used document analysis to explore English short stories on YouTube, selected suitable stories based on students' proficiency, and integrated them into tasks that support language skills. This study employs a descriptive research approach, using a survey questionnaire to evaluate the impact of audiobook use during the English learning process of non-English major students at Hanoi University of Mining and Geology. The results showed a great number of students agreed that reading and listening to stories on YouTube had a positive impact on their English learning. Specifically, students became more interested, revised and expanded their vocabulary and grammar, and improved listening, reading, and pronunciation skills and most of them wished to continue this learning method.

**Keywords:**

Youtube, impact, stories, technology.

**1. Introduction**

Nowadays, with the explosive development of information technology, the teaching and learning of English has become more convenient than ever. Learners are no longer limited to knowledge delivered by the teacher or textbooks—they now have access to a vast open resource of learning materials online. Teachers can also take advantage of rich educational materials to help learners gradually master the target language. Along that journey, books have always been both a teacher and a friend, nurturing knowledge and enriching the soul. Learning English through reading books and stories has been proven effective for learners (Pardede, 2011), and the exploitation of English stories on YouTube has been applied by the author in teaching English to first-year university students at Hanoi University of Mining and Geology. In this article, the author wishes to share practical experiences as well as learner feedback regarding their experience learning a foreign language by reading and listening to English stories on YouTube.

By surveying the students' ideas on the effects of using stories on Youtube in learning English, this article offers recommendations for English study outside the classroom at a technical university with a strong belief that with patience, motion, and a suitable method, any student would be able to use English in their work and life, creating a community of fluent English users.

## 2. Content

### 2.1. Theoretical background and methodology

According to Serafini (2004), audiobooks should be used in all reading comprehension programs. Educators who overlook this resource are missing out on an effective strategy for learners with both strong and weak reading comprehension skills. Chang (2011) states that reading comprehension is most effective when learners read and listen to audiobooks simultaneously.

In Rufino's opinion (2024), there are five methods for using Youtube in teaching and learning the English language. They are horizontal method, intersecting method, vertical method, parallel method and spiral method.

To take advantage of the benefits of audiobooks in English teaching and learning, the author used document analysis to explore English short stories on YouTube, selected suitable stories based on students' proficiency and content, and integrated them into exercises that support language skills. The way that the author used is somewhat like the parallel method classified by Rufino (2024).

This report employs a descriptive research approach, using a survey questionnaire to evaluate the impact of audiobook use during the English learning process of non-English major students at the University of Mining and Geology. The survey includes 9 questions, utilizing a 5-point Likert scale ranging from "completely untrue for me" to "completely true for me." A total of 37 full-time students enrolled in English 1 course during the second semester of the 2024-2025 academic year participated in the survey from April 11, 2025, to April 30, 2025. To ensure objective information, students were not required to provide personal information such as names or email addresses on the survey. They were also informed that there were no right or wrong answers, encouraging them to answer the survey confidently. The authors used descriptive statistics through SPSS version 20, including mean (M) and standard deviation (SD), to analyze the quantitative data collected from the questionnaire.

In conducting this study, the authors posed two research questions:

1. What are the benefits of learning English through stories on Youtube?
2. How did the students feel about this way of learning?

### 2.2. Research results and discussion

#### 2.2.1. Selecting a suitable Youtube channel

The first step in the research process was to explore and analyze YouTube channels that offer English stories. The channel *Learn English Through Story* was chosen because it is specifically designed for English learners. Stories are read clearly and slowly, suitable for listening comprehension. They are categorized by level, genre, and length, ranging from short fairy tales like *"The Three Little Pigs"* to novels such as *"Pride and Prejudice"*. For those interested in nonfiction, the channel also offers stories about places, customs, traditions, or real historical figures. While listening, learners can also follow the text on the screen, synchronized with the audio.

#### 2.2.2. Designing tasks for learners

During the teaching of Group 9 in English 1 (second semester, 2024–2025), the author selected several stories from *Learn English Through Story* with a duration of 5–7 minutes or longer stories divided into chapters. Stories were chosen at Level 1 to suit the students' proficiency. After each English lesson, the teacher would share a story link in the class's Zalo group. Students were required to listen multiple times, then read aloud and record a video of themselves reading the story. The videos were uploaded to a Google Drive link set up by the teacher. The teacher then reviewed the videos and provided feedback on reading, pronunciation, etc. At the end of the course, students were asked to retell a story or a part of one and answer some questions from the teacher and classmates about its content.

#### 2.2.3. Surveying student's feedback

Below is the summary of the survey results:

| Questions                                                                     | N  | Min | Max | Mean   | Standard Dev |
|-------------------------------------------------------------------------------|----|-----|-----|--------|--------------|
| 1. I feel more interested in learning English through YouTube stories         | 37 | 1   | 5   | 3.0270 | 1.04047      |
| 2. I revised and improved my vocabulary through listening and reading stories | 37 | 1   | 5   | 3.2703 | 0.96173      |
| 3. I remembered and reinforced grammar more easily                            | 37 | 1   | 5   | 3.1351 | 0.94757      |
| 4. My listening and reading comprehension improved                            | 37 | 1   | 5   | 3.0811 | 1.03758      |
| 5. My pronunciation improved through reading aloud                            | 37 | 1   | 5   | 3.1081 | 0.99398      |
| 6. I felt more confident recording myself reading stories                     | 37 | 1   | 4   | 2.8378 | 1.06754      |
| 7. I could retell a story without subtitles by the end of the course          | 37 | 1   | 4   | 2.8378 | 1.06754      |
| 8. I would like to continue learning English this way                         | 37 | 1   | 4   | 3.1081 | 0.90627      |
| 9. Learning English through YouTube stories is truly effective                | 37 | 1   | 5   | 3.3243 | 0.88362      |

The first five questions show average scores above 3 and standard deviations around 1, indicating that a great number of students agreed that reading and listening to stories on YouTube had a positive impact on their English learning. Specifically, students became more interested, revised and expanded their vocabulary and grammar, and improved listening, reading, and pronunciation skills.

Questions 6 and 7 show average scores slightly above 2.8, with standard deviations greater than 1, indicating that while more students felt confident recording and retelling stories, a significant portion still lacked confidence.

Question 8 had a mean score above 3 and a standard deviation below 1, indicating that most students wished to continue this learning method.

Question 9 had the highest average (above 3.3) and the lowest standard deviation (0.88), suggesting strong agreement that learning English through YouTube stories is truly effective.

The results are compatible with Rufino's research (2024) in which he stated that "using Youtube is said to polish English skills. These are speaking, pronunciation, listening, self-learning, comprehension, grammar, reading and writing."

### **2.3. Recommendations for teachers and students**

Based on the findings of the study, both teachers and students can benefit significantly from incorporating English stories on YouTube into their teaching and learning practices. However, to maximize the effectiveness of this method, certain strategies and best practices should be followed.

#### **2.3.1. For teachers**

It is highly recommended that the teachers should:

- **Carefully select appropriate content:** Teachers should choose YouTube channels that are specifically designed for English learners, such as *Learn English Through Story*. Stories should be categorized by language level (e.g., beginner, intermediate) and genre. Choosing content that aligns with students' proficiency levels ensures that they are challenged but not overwhelmed.

- **Design structured assignments:** Simply recommending a video is not enough. Teachers should accompany each story with clear tasks, such as vocabulary pre-teaching, comprehension questions, or pronunciation-focused exercises. Weekly tasks could include listening, reading aloud, and retelling the story to develop a range of language skills.

- **Incorporate speaking and pronunciation practice:** Encouraging students to record themselves

reading stories can be a powerful tool to improve fluency and confidence. Teachers should provide constructive feedback on pronunciation, intonation, and pacing.

- **Foster a reflective learning environment:** In addition to quizzes or comprehension checks, teachers can ask students to reflect on what they learned, how they felt during the listening and reading process, and how it helped their language development.

- **Create a supportive online community:** Platforms like Zalo, Google Classroom, or Facebook groups can be used to share videos, offer feedback, and build a sense of learning community. Teachers should be active in these groups to guide and motivate students consistently.

- **Encourage voluntary participation and autonomy:** To promote long-term learning habits, teachers should gradually allow students to choose their own stories based on personal interests, helping them develop independent learning strategies.

#### 2.3.2. For students

On the part of the students, they should:

- **Be consistent and active:** Regular practice is key to improvement. Students should make it a habit to listen to at least one English story each week, ideally more than once, to enhance both comprehension and pronunciation.

- **Use both listening and reading modes:** Listening alone may not be enough. Students should follow along with subtitles or transcripts while listening, then try reading the story aloud to reinforce vocabulary and structure.

- **Record and reflect:** Recording oneself reading a story helps identify pronunciation issues and build speaking confidence. Reviewing these recordings and comparing them over time can also track progress.

- **Engage with a variety of genres:** Students should explore different types of stories—fiction, nonfiction, fairy tales, and biographies—to expand their vocabulary and cultural understanding.

- **Participate actively in class activities:** Engaging in story retelling, discussions, and group reflections improves not only language skills but also builds confidence in using English for communication.

- **Stay curious and self-motivated:** Finally, students should view story-based learning not as homework, but as a fun and enriching way to immerse themselves in the language. Choosing stories that spark curiosity can turn learning into a habit rather than a task.

### 3. Conclusion

Based on these practical experiences of using English stories from YouTube in teaching, the author finds this method helps learners actively practice and improve their language skills outside of the classroom. A major advantage of using YouTube audiobooks is that learners become more engaged and develop a habit of reading/listening to books. However, to ensure effectiveness, instructors should encourage participation and design interesting, level-appropriate exercises to attract the greatest number of students voluntarily and enthusiastically.

#### References:

1. Chang, A.C. (2011). The Effect of Reading While Listening to Audiobooks: Listening Fluency and Vocabulary Gain. *Asian Journal of Language Teaching*, 21, 43–64.
2. Pardede, P. (2011). Using Short Stories to Teach Language Skills. *Journal of Language Teaching*, 1, 14–27.
3. Rufino, Gilliane G. (2024). Methods used in Youtube for teaching and learning English language: A systematic literature review. *International Journal of English Language Studies*, 6(1), 82-97.
4. Serafini, F. (2004). *Audiobooks and Literacy: An Educator's Guide to Utilizing Audiobooks in the Classroom*. New York, NY: Listening Library.

©Truong Thi Thanh Thuy, 2025

**Vu Huu Tuyen**

Doctor of Philosophy at Hanoi University of Mining and Geology, Vietnam

Email: vutuyen@humg.edu.vn

## **DEVELOPING STUDENTS' SELF-LEARNING ABILITY IN ENGINEERING THROUGH THE USE OF TECHNOLOGY IN TECHNICAL DRAWING**

### **Abstract**

Self-learning plays a vital role in renewing university teaching methods and enhancing educational quality. It fosters independent thinking, creativity, and problem-solving. This article outlines key concepts of self-learning and proposes measures to develop this ability among students.

### **Keywords:**

development; self-learning; self-learning ability; students.

### **1. Introduction**

Self-learning is a vital trend in modern education, shifting learners into active agents of their own development. It improves academic outcomes and teaching quality, fostering independence, creativity, and lifelong learning. Therefore, enhancing students' self-learning ability is an urgent and essential task in today's university education.

### **2. Some Basic Concepts**

#### **2.1. Self-learning**

Self-learning has attracted much scholarly attention. According to Nguyen Hien Le (1992), it is a voluntary process of acquiring knowledge without necessarily relying on a teacher. Luu Xuan Moi (2003) emphasizes both in-class and out-of-class learning, regardless of a fixed curriculum. Nguyen Canh Toan et al. (2009) view it as a cognitive and sometimes physical process using intellectual abilities and personal motivation.

In summary, self-learning is a self-directed, purposeful activity requiring awareness, planning, discipline, and skills to acquire and expand knowledge creatively.

#### **2.2. Self-learning Ability**

Self-learning ability refers to one's capacity to independently acquire and apply knowledge effectively in new contexts. It encompasses knowledge, skills, experience, and attitudes, serving as a core component of lifelong learning. This ability comprises four main elements: professional, methodological, social, and individual competence.

Key self-learning capacities include problem recognition, information processing, knowledge application, collaboration, self-development, and self-assessment. Evaluation is based on academic outcomes, presentations, self/peer reviews, learning products, and classroom observations.

This article explores how virtual models in technical drawing instruction can nurture these abilities.

### **3. Practical Research**

#### **3.1. Current Situation**

The author asserts that Asian students, including Vietnamese, are not inherently lacking in self-learning ability; rather, traditional educational systems have not adequately supported its development. In Vietnam, this ability can be enhanced through the use of technology, which is essential for success in a knowledge-based and globally integrated society. The 2019 Education Law highlights the importance of active, creative, and self-directed learning.

Comparative insights from Dutch higher education show strong emphasis on student initiative, time

management, and independent study. In contrast, Vietnam's higher education remains overly reliant on passive, rote learning, limiting students' confidence and teamwork skills. Though recent reforms promote a student-centered approach, much remains to be done to fully foster self-learning among university students.

### 3.2. The Development of Technology

The rapid advancement of technology, especially AI and virtual reality, is transforming teaching and learning. These tools offer great potential for enhancing self-learning, but effective use requires clear educational strategies. VR and simulation technologies enrich learning environments, though they may increase complexity.

AI applications—such as automated assessments and personalized learning tools—can support student autonomy, self-regulation, and reflective thinking. When thoughtfully designed, AI can serve as a personal learning assistant without compromising independence. However, to ensure ethical and effective implementation, issues of data privacy, transparency, and pedagogical relevance must be addressed.

### 4. Example

A student in the engineering field receives a technical drawing of an object, including two views: the front view and the top view. This drawing is illustrated below. The student's task is to self-learn how to draw the third view (side view) and the orthogonal projection of the given object.

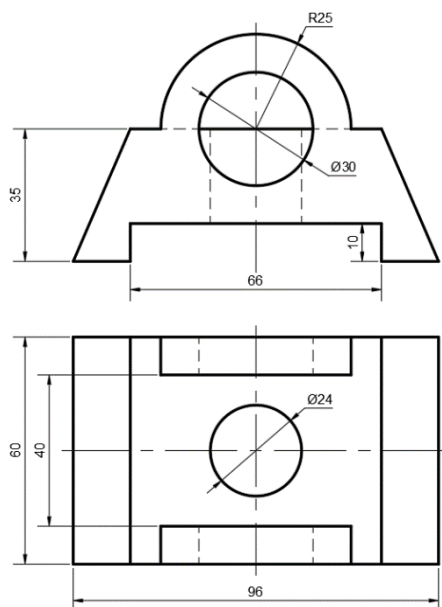


Figure 1

The student's self-learning process to complete the drawing will unfold as follows, utilizing self-learning abilities and the support of technology:

#### 1. Applying Self-learning Abilities (SLA):

In technical drawing, self-learning ability (SLA) manifests through several key competencies. Students first **recognize problems** by analyzing given views and identifying the need to construct the third view. They **gather and process information** on orthogonal projection principles using textbooks and digital resources. Next, they **remember and apply knowledge** by accurately drawing based on learned rules of projection. Through **personal development**, students apply critical thinking and perseverance to manage challenges during the drawing process. Finally, they **evaluate and self-evaluate** by checking their work, identifying and correcting errors to improve drawing quality. This cycle reinforces autonomy and readiness for technology-integrated learning environments.

The final result achieved by the student is illustrated below:

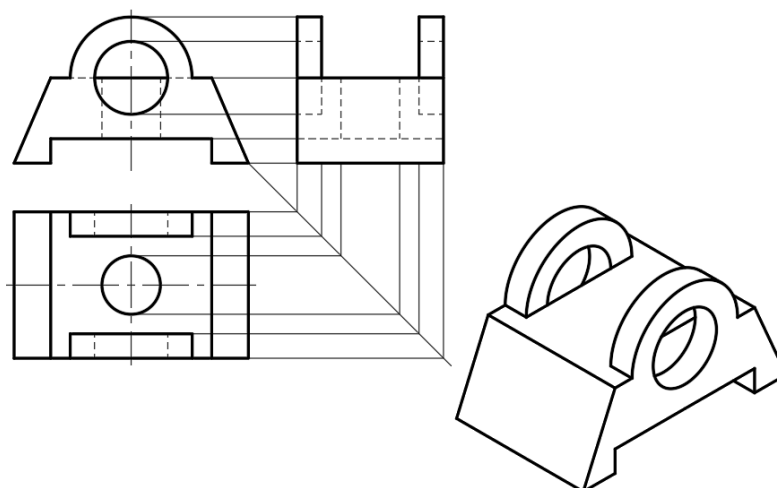


Figure 2

## 2. Support from Technology

In today's era of rapid technological advancement, integrating technology into teaching—especially in technical fields—offers significant benefits. In technical drawing, technology actively supports students' self-learning by enhancing visualization, access to resources, and feedback mechanisms.

**Virtual models and CAD software:** Students can utilize CAD software to create 3D virtual models from two given views, aiding in visualizing the object and reasoning the third view accurately. This enhances spatial understanding and supports more effective learning in Technical Drawing.

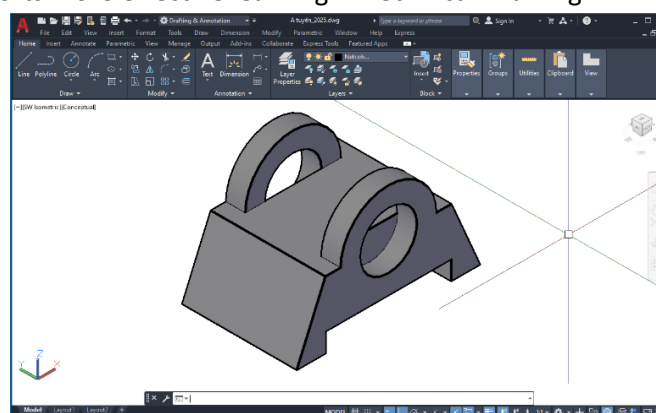


Figure 3

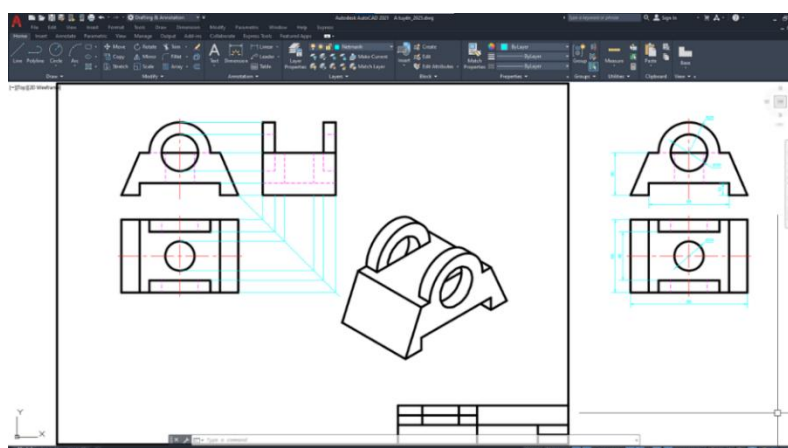


Figure 4

### ***Artificial Intelligence (AI):***

AI supports self-learning in technical drawing through intelligent search tools, personalized feedback systems, and learning assistants. These technologies help students access visual resources, identify errors, and track progress while maintaining autonomy.

By combining theoretical knowledge with self-learning skills—analysis, information gathering, application, and self-evaluation—students can effectively use AI and virtual tools to visualize, draw, and refine technical drawings. This enhances learning outcomes and nurtures lifelong self-learning capacity.

### **4. Conclusion**

Self-learning remains a challenge for many university students. Therefore, integrating self-learning methods into training objectives is essential—not only for academic success but also for lifelong societal integration. With strong self-learning skills, students can independently explore and master complex topics, while developing persistence, creativity, and autonomy. Teaching students how to learn should be prioritized to improve the overall quality and effectiveness of university education.

### **Reference:**

1. Nguyen Hien Le, (2007), Self-study - a need of the times, Culture - Information Publishing House, Hanoi.
2. Luu Xuan Moi, Training self-study skills for university students, Science Journal, Hanoi National University of Education, No. 2, 2003.
3. Nguyen Canh Toan – Le Khanh Bang (co-editor) - Le Dinh Trung, (2009), University teaching and learning methods, Hanoi National University of Education Publishing House.
4. Nguyen Canh Toan, (1997), Teaching Process - Self-study, Education Publishing House, Hanoi.
5. Dang Thanh Hung - Trinh Thi Hong Ha - Nguyen Khai Hoan - Tran Vu Khanh, (2012), Teaching method theory, Thai Nguyen University Publishing House.
6. Weinert F.E., (1983), Learning Theories and Teaching Models, Education Publishing House, Hanoi.
7. Abdullah - Mardziah Hayati, (2001), Self-Directed Learning, ERIC Digest. Office of Educational Research and Improvement (ED), Washington, DC, USA.
8. Richard Nelson - Jones, (2012), Basic Counseling Skill, Sage Publication India.
9. Hien Bui, (2001), Education Dictionary, Encyclopedia Dictionary Publishing House.

© Vu Huu Tuyen, 2025

**Мухидинов Магомед Госенгаджиевич**

Дагестанский государственный педагогический университет им. Р. Гамзатова

г. Махачкала, РФ

## **ПСИХОЛОГИЧЕСКИЕ ПРОБЛЕМЫ ИНФОРМАЦИОННОЙ ТРАНСФОРМАЦИИ ОБРАЗОВАНИЯ**

### **Аннотация**

Актуализированы основные психологические проблемы информационной трансформации образования, последствия и изменения. Определены последствия такой реструктуризации для архитектуры информационного и содержательного обеспечения образования. Обозначены позитивные и негативные психологические последствия трансформации образования в цифровой формат.

**Ключевые слова:**

трансформация образования, цифровой формат обучения, архитектура цифрового образования, психологические последствия, педагогические эффекты цифровой трансформации обучения.

**Mukhidinov Magomed Gosengadzhievich**

Dagestan State Pedagogical University named after R. Gamzatov  
Makhachkala, Russian Federation

**Abstract**

The main psychological problems of the information transformation of education, consequences and changes are actualized. The consequences of such restructuring for the architecture of information and substantive support of education are determined. The positive and negative psychological consequences of the transformation of education into a digital format are outlined.

**Keywords:**

transformation of education, digital format of training, architecture of digital education, psychological consequences, pedagogical effects of digital transformation of training.

Информационное общество стремительно развивается на пути построения его цифровой модели через внедрение цифровых технологий во все аспекты его жизнедеятельности, включая образование. Для управления и нормирования этого процесса в рамках государственной парадигмы актуализированы.

1. Закон "Об образовании в РФ" дающий основание учреждениям образования применять образовательные технологии цифрового формата совершенствования образовательного процесса.

2. Национальный проект "Цифровая экономика РФ" позволяющий планировать глубокую трансформацию различных областей жизни социума, а образовательная система обеспечивает подготовку будущих специалистов для цифрового общества [1].

3. Федеральная программа "Цифровая образовательная среда" обеспечивающая модернизацию образования через его трансформацию его в цифровой формат, а именно через оснащение учебных организаций цифровым оборудованием и активное использование цифровых ресурсов в процессе обучения [4].

В рамках цифровой реструктуризации социума в целом к 2030 году вузы РФ должны быть переведены в цифровой формат, а 2024 году все вузы трансформируются в систему цифрового университета, а каждый обучаемый должен иметь доступ к образовательному содержанию [5].

Включение цифровых технологий в образовательные организации – это основа цифровой трансформации образования, так как именно в они обеспечивают эффективность образовательных результатов. Реструктуризация образовательной среды в цифровой формат предоставляет всем участникам образовательного процесса широкие возможности для эффективного обмена информацией и совместной среде обучения [3].

Цифровые платформы позволяет автоматизировать ключевые процессы делопроизводства и документооборота, а именно: повышает скорость принятия решений; обеспечивает оперативное информирование участников процесса управления; оптимизирует планирование и управление образования в том числе и создание программ, планов и расписаний и т.п.

Перевод процесса образования в цифровой формат реструктурирует: архитектуру коммуникационной модели системы «ученик» и «педагог»; модель методической и учебной поддержки образовательной деятельности участников обучения; и расширяет дидактические

возможности и педагогический потенциал образовательной среды предметных областей.

Цифровые инструменты обучения создают новую среду как для преподавателя, так и для ученика, при этом: преподаватель получает возможность выйти за рамки простого транслятора знаний и сосредоточиться на развитии творческого потенциала учеников и управлении процессом обучения; ученик же получает возможность активно участвовать в процессе обучения, самостоятельно искать, анализировать и применять информацию.

**Новая архитектура образовательного процесса** расширяет дидактические возможности цифровых технологий: обеспечивают мгновенную обратную связь; усиливают визуализацию данных, полученных в ходе обучения; автоматизирует решение рутинных задач, связанных с вычислениями, поиском, обработкой и распространением учебной информации и др.

Ключевые преимущества цифрового образования в психологическом аспекты можно обозначать так: технологии, делающие образование доступным в любое время и из любой точки мира; создание условий, при которых каждый пользователь, независимо от своего социального положения, материального достатка или географического расположения, может полностью раскрыть свой образовательный потенциал; гибкая система обучения, где каждый обучаемый может выстраивать свою собственную траекторию и график учебного процесса; быстрая и своевременная обратная связь, включающая диагностику, оценку и рекомендации по улучшению; образование, ориентированное на раскрытие индивидуальных способностей обучающихся и др.

Необходимо обратить внимание на серьезные минусы цифрового формата образования: молодое поколение, сталкиваясь с огромным потоком противоречивой информации из разных источников, развивает повышенную критичность и скептицизм; недостаток авторитетных ориентиров; недостаток личного опыта взаимодействия с другими культурами что формирует **искаженное восприятия** мира; создание **упрощенных представлений** о различных явлениях и возникновение и закрепление формальных стереотипов о представителях других культур; проблемы цифровой социализации [6]; социальная изоляция и депрессия и чувство одиночества и т.д.

Психологические последствия цифрового формата образования требуют внимательного изучения, поскольку его применение имеет свои ограничения, а его эффективность не безгранична и требует осторожного подхода не только с позиции психолога.

1. Проведенный анализ выявил, трансформация межличностных коммуникаций в цифровой среде — это важный фактор, обуславливающие психологические последствия, зафиксированные в научной литературе.

2. Многие обучаемые сегодня испытывают трудности при электронном обучении, что связано с недостаточной информационной грамотностью, а также с психологическими факторами, такими как низкая мотивация, недостаточная самостоятельность и отсутствие ответственности за процесс обучения.

3. Эффективность цифрового образования определяет необходимость не только технологических решений, но и учета психологических рисков и создание условия для позитивного межличностного взаимодействия, развивая соответствующие личностные качества.

#### **Список использованной литературы:**

1. Министерство просвещения России: официальный сайт [Электронный ресурс]. – Режим доступа: <https://edu.gov.ru/national-project/projects/cos/> (дата обращения: 27.02.2022).
2. Мухидинов М.Г. Цифровая грамотность учителя // Наука и образование: Состояние, проблемы и перспективы развития /Материалы научной сессии профессорско-преподавательского состава Дагестанского государственного педагогического университета, посвященной 100-летию Героя Советского Союза, профессора Сулейманова Р. Б. Махачкала, 2021, С 165-167.

3. Мухидинов М.Г., Магомедова С.М., Магомедов Г.А. Проблемы формирования новой образовательной среды //Мир науки, культуры, образования. 2023. № 2 (99). С. 67-69.
4. Национальная программа «Цифровая экономика Российской Федерации»: утв. распоряжением Правительства Российской Федерации от 28.07.2017 г. №1632-р [Электронный ресурс]. – Режим доступа <https://www.garant.ru/products/ipo/prime/doc/71634878/> (дата обращения: 22.05.2023).
5. Об утверждении стратегического направления в области цифровой трансформации науки и высшего образования: утв. распоряжением Правительства Российской Федерации от 21.12.2021 г. №3759-р [Электронный ресурс]. – Режим доступа: <https://www.garant.ru/products/ipo/prime/doc/403203308/> (дата обращения: 22.05.2023).
6. Чагдурова Э.Д., Магомерзаев Х.А., Мухидинов М.Г. Социализация личности в цифровом социуме //Ежегодная итоговая научно-практическая конференция научно-педагогических работников. Сборник материалов конференции. Грозный, 2023. С. 24-28.

© Мухидинов М.Г., 2025



# МЕДИЦИНА

**Atayeva Annagozel Beknazarovna**

Lecturer of Medical Ecology and Hygiene Department  
State Medical University of Turkmenistan named after Myrat Garryyev  
Ashgabat, Turkmenistan

## THE INTEGRATED IMPERATIVE: MEDICAL ECOLOGY AND HYGIENE SCIENCE FOR GLOBAL HEALTH

### Abstract

Medical ecology and hygiene science, though distinct in their immediate focus, are two increasingly intertwined disciplines indispensable for understanding, preventing, and mitigating global health challenges. This article explores their individual characteristics and, more critically, their profound synergy. Medical ecology provides a holistic, systems-based understanding of how environmental factors, ecological shifts, and human interactions within ecosystems influence health and disease patterns. Hygiene science, conversely, translates this ecological understanding into practical, actionable measures for maintaining cleanliness, preventing pathogen transmission, and safeguarding public health at individual and community levels. In an era defined by pandemics, climate change, and persistent environmental degradation, their integrated application is paramount for fostering resilient populations and ensuring sustainable well-being.

### Keywords:

medical ecology, hygiene science, environmental health, public health, disease prevention, sanitation, infection control, one health, planetary health, holistic health.

### Introduction

The health challenges of the 21st century—from the rapid emergence and spread of novel pathogens to the insidious long-term impacts of climate change and pervasive environmental pollution—demand a more sophisticated, interconnected approach than ever before. It is no longer sufficient to view disease solely through a clinical lens or to address public health in isolation from the broader ecological context. This realization underscores the escalating importance of Medical Ecology Science and Hygiene Science, two fields that, when integrated, offer a powerful framework for navigating the complexities of human health in a rapidly changing world.

Medical ecology probes the fundamental why behind health outcomes, exploring how the intricate web of interactions within physical, biological, and social environments shapes disease dynamics and human well-being. It asks, for instance, how deforestation influences zoonotic disease spillover, or how urban green spaces impact mental health. Simultaneously, hygiene science provides the practical how, developing and implementing the essential measures that directly protect human populations from health threats. This ranges from fundamental practices like handwashing and safe water provision to advanced hospital infection control and resilient waste management systems. The COVID-19 pandemic vividly demonstrated this interdependence: while medical ecology elucidated the viral origins and transmission pathways in an ecological context, hygiene science provided the immediate, actionable interventions (masking, social distancing, sanitization) crucial for containment. As we confront a future of more frequent extreme weather events, increasing antimicrobial resistance, and growing pressures on natural resources, the integrated wisdom of medical ecology and hygiene science becomes not just beneficial, but an absolute imperative for proactive global health.

### Medical Ecology Science: Understanding Health in Context

Medical ecology is an interdisciplinary field that examines the complex, reciprocal relationships between human health and the broader natural and built environments. Its core characteristics include:

- **Holistic and Systems-Based Approach:** It views health and disease as emergent properties of complex adaptive systems, recognizing that human health is inextricably linked to the health of ecosystems. It considers the interplay of biological agents (pathogens, vectors, flora, fauna), physical factors (climate, geography, air, water, soil), and socio-cultural elements (population density, land use, cultural practices, economic systems).

- **Environmental Determinants of Health:** It systematically investigates how environmental changes—such as biodiversity loss, deforestation, urbanization, climate shifts, and chemical pollution—directly and indirectly influence human health outcomes, including the emergence of infectious diseases, chronic illnesses, and mental health conditions.

- **Disease Ecology:** A significant focus lies on understanding the ecological dynamics of infectious diseases. This involves studying pathogen reservoirs in animal populations, vector biology, environmental factors influencing transmission, and the impact of human activities on these cycles (e.g., how habitat fragmentation can bring wildlife closer to human settlements, increasing spillover risk).

- **Evolutionary Perspective:** It often considers the co-evolution of humans and their pathogens, as well as the adaptive capacities of human populations to environmental stressors over time.

- **Interdisciplinary Integration:** It synthesizes knowledge from public health, epidemiology, ecology, environmental science, anthropology, veterinary medicine, and geography to build a comprehensive understanding of health within its ecological context.

#### Hygiene Science: The Foundation of Disease Prevention

Hygiene science encompasses the principles and practices aimed at preserving health and preventing disease through cleanliness and sanitation. Its characteristics include:

- **Focus on Prevention:** The primary goal of hygiene is to break chains of infection, reduce exposure to harmful agents, and maintain a healthy environment through preventative measures rather than curative treatments.

- **Scope from Personal to Global:** Hygiene operates at multiple scales:

- **Personal Hygiene:** Practices like handwashing, bathing, oral care, and food hygiene to prevent individual illness and reduce pathogen spread.

- **Environmental Hygiene (Sanitation):** Management of waste (solid and liquid), water purification, air quality control, and vector control to ensure a healthy living environment for communities.

- **Institutional Hygiene:** Strict protocols in healthcare settings (infection control), food establishments, and public spaces to minimize disease transmission.

- **Evidence-Based Practices:** Modern hygiene is rooted in scientific understanding of microbiology, epidemiology, and public health principles (e.g., germ theory, modes of transmission).

- **Behavioral and Educational Components:** Effective hygiene often relies on public awareness, education, and the adoption of healthy behaviors by individuals and communities.

- **Adaptability:** Hygiene practices continuously evolve in response to new scientific knowledge, emerging pathogens, and technological advancements (e.g., advanced air filtration, smart sanitation systems).

#### The Synergy: Integrating Ecology and Hygiene for Proactive Health

The true power in addressing contemporary health challenges lies in the synergistic integration of medical ecology and hygiene science.

##### 1. Ecological Insight Informs Hygienic Practice:

- **Understanding Pathogen Reservoirs:** Medical ecology helps identify where pathogens exist in the environment (e.g., bats as reservoirs for coronaviruses, rodents for hantavirus, contaminated water sources). This ecological knowledge directly informs hygienic interventions, such as improved biosecurity measures, safe water purification protocols, and targeted pest control.

- Climate Change and Vector-Borne Diseases: As climate change alters habitats and extends the geographical range of disease vectors (e.g., mosquitoes carrying dengue or Zika), medical ecology predicts these shifts. Hygiene science then develops adaptive strategies, such as enhanced vector control programs in newly affected areas, improved warning systems, and personal protective measures.

- Antimicrobial Resistance (AMR): Medical ecology reveals the environmental spread of antimicrobial resistance genes from human, animal, and agricultural waste into soil and water. This understanding highlights the ecological necessity for improved wastewater treatment (environmental hygiene), responsible antibiotic use in all sectors (public health policy), and farm biosecurity to contain the spread of resistant bacteria, complementing clinical hygiene in hospitals.

2. Hygienic Practices Support Ecological Health:

- Sustainable Waste Management: Effective hygiene practices, such as proper solid waste disposal and wastewater treatment, prevent the pollution of natural ecosystems (rivers, oceans, soil). This not only protects human health by preventing disease spread but also safeguards biodiversity and ecosystem services.

- Reduced Environmental Contamination: Strict hygiene in industrial and agricultural settings prevents the release of harmful chemicals and pathogens into the environment, thereby protecting ecological health and reducing human exposure to toxins.

- Preserving Natural Resources: Water conservation, a key element of hygiene in water-scarce regions, contributes to the ecological balance of water systems.

In essence, medical ecology identifies the vulnerabilities and risks arising from human-environment interactions, while hygiene science provides the practical toolkit to mitigate those risks and build resilience. Their combined power enables a proactive, rather than reactive, approach to public health, moving beyond treating symptoms to addressing the root ecological causes of disease and fostering environments conducive to well-being.

**References:**

1. McMichael, A. J. (2017). Planetary Health: Protecting Nature to Protect Ourselves. Island Press.
2. Dubos, R. (1965). Man Adapting. Yale University Press.
3. Mandell, G. L., Bennett, J. E., & Dolin, R. (Eds.). (2020). Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases. Elsevier.
4. Park, K. (2021). Park's Textbook of Preventive and Social Medicine. M/s Banarsidas Bhanot.
5. One Health Initiative: <https://www.onehealthinitiative.com/>

© Atayeva A., 2025



# ВЕТЕРИНАРИЯ

**Гостев Даниил**

Омский государственный аграрный университет имени П.А. Столыпина  
г. Омск, РФ

**ПРАВОВАЯ И НОРМАТИВНО-ТЕХНИЧЕСКАЯ БАЗА ОБЕСПЕЧЕНИЯ БЕЗОПАСНОСТИ СУБПРОДУКТОВ****Аннотация**

Контроль качества и безопасности субпродуктов важен для предотвращения зоонозов и соблюдения ветеринарных норм. Цель. Проанализировать нормативно-правовую базу РФ и международные стандарты в сфере безопасности субпродуктов. Метод. Сравнительно-правовой анализ международных, региональных и национальных нормативов. Результат. Выявлена многоуровневая структура регулирования; установлены различия и проблемы гармонизации российских и международных требований. Выводы. Необходима актуализация национальных норм с учетом международных стандартов и принципов HACCP.

**Ключевые слова:**

субпродукты, безопасность, HACCP, ветеринарно-санитарный контроль, нормативное регулирование.

**Gostev Daniil**

Omsk State Agrarian University named after P.A. Stolypin  
Omsk, Russia

**LEGAL AND REGULATORY FRAMEWORK FOR ENSURING THE SAFETY OF BY-PRODUCTS****Annotation**

Quality and safety control of by-products is important to prevent zoonoses and comply with veterinary regulations. Purpose. To analyze the regulatory framework of the Russian Federation and international standards in the field of safety of by-products. Method. Comparative legal analysis of international, regional and national regulations. Result. A multi-level structure of regulation is revealed; the differences and problems of harmonization of Russian and international requirements are established. Findings. It is necessary to update national norms taking into account international standards and HACCP principles.

**Keywords:**

by-products, safety, HACCP, veterinary and sanitary control, regulatory regulation.

Введение. Современная система ветеринарно-санитарного контроля качества и безопасности субпродуктов, используемых в кормлении животных, представляет собой комплексную многоуровневую структуру, основанную на взаимодействующих нормативно-правовых актах различного статуса и юрисдикции. Эта система формировалась десятилетиями, вбирая в себя лучшие международные практики и адаптируя их к национальным особенностям производства и переработки животного сырья. В ее основе лежит трехуровневая иерархия регулирования: международные стандарты, разрабатываемые авторитетными межправительственными организациями; региональные директивы, характерные для отдельных экономических союзов; и национальные регламенты, учитывающие специфику конкретных стран [1].

Субпродукты могут быть источником токсичных, микробиологических и химических загрязнителей, способных нанести ущерб здоровью животных и человека через пищевую цепь. Учитывая рост объемов производства и переработки животного сырья, возрастает значимость

формирования и совершенствования нормативно-правовой базы, регулирующей качество и безопасность.

Обзор литературы. На международном уровне основополагающим документом выступает Кодекс Алиментариус (CAC/RCP), созданный совместными усилиями Продовольственной и сельскохозяйственной организации ООН и Всемирной организации здравоохранения. Этот свод стандартов представляет собой всеобъемлющий сборник гигиенических норм и правил, охватывающий всю цепочку производства – от первичной переработки сырья до выпуска готовых пищевых и кормовых продуктов. Особое внимание в Кодексе уделяется системе НАССР, которая является обязательной для всех производителей, работающих на международных рынках. Параллельно с этим Всемирная организация здравоохранения животных разрабатывает специализированные стандарты по профилактике зоонозов и обеспечению безопасности кормового сырья. Эти документы содержат детальные рекомендации по контролю потенциально опасных биологических агентов, включая возбудителей таких заболеваний как сальмонеллез, листериоз и ботулизм, которые могут передаваться через корма животного происхождения [3].

В Европейском союзе система регулирования безопасности субпродуктов достигла особой степени детализации, что нашло отражение в таких ключевых документах как Регламент ЕС No 1069/2009 и Регламент ЕС No 142/2011. Эти нормативные акты представляют собой образец комплексного подхода к регулированию всей цепочки переработки животного сырья.

На национальном уровне, в частности в Российской Федерации, система регулирования безопасности субпродуктов строится на гармонизации международных требований с местными производственными традициями и эпидемиологическими рисками. Основополагающим документом в этой сфере является Технический регламент Таможенного союза ТР ТС 034/2013 «О безопасности мяса и мясной продукции», который устанавливает единые для стран ЕАЭС требования к безопасности всех видов мясного сырья, включая субпродукты.

Основная часть. Анализ нормативных документов показывает многоуровневую систему регулирования качества и безопасности субпродуктов. На международном уровне Кодекс Алиментариус устанавливает унифицированные гигиенические нормы и требует обязательного внедрения системы НАССР. В Европейском союзе действуют строгие регламенты (1069/2009 и 142/2011), детально регламентирующие классификацию сырья и технологические требования к переработке. Национальное законодательство РФ и ЕАЭС включает технический регламент ТР ТС 034/2013, устанавливающий предельно допустимые концентрации токсичных элементов и микробиологические нормативы, а также ГОСТ 32244-2013, определяющий органолептические и физико-химические показатели качества. Особое внимание уделяется контролю остаточных количеств антибиотиков и пестицидов согласно СанПиН 2.3.2.1078-01. Для кормовых субпродуктов действует специальный регламент ТР ЕАЭС 047/2018, который предписывает обязательную термическую обработку при температуре не ниже +85°C и запрещает использование технических субпродуктов. Многоступенчатая система регулирования обеспечивает комплексный контроль безопасности субпродуктов на всех этапах производства и обращения, однако требует постоянного обновления нормативной базы в соответствии с новыми научными данными и технологическими возможностями [2].

Выявлено, что система регулирования включает многоуровневую структуру: международные стандарты (Кодекс Алиментариус), региональные регламенты (ЕС) и национальные нормативные акты (ТР ТС 034/2013, ГОСТ 32244-2013). Особое внимание уделено необходимости гармонизации российских стандартов с международными требованиями, а также важности внедрения системы НАССР для обеспечения комплексного контроля безопасности на всех этапах производства

Установлено, что национальные регламенты РФ в значительной степени ориентированы на международные стандарты, однако остаются зоны, требующие доработки — в частности, в области внедрения HACCP на предприятиях, занимающихся переработкой субпродуктов для кормовых целей.

Выводы и перспективы исследования. Нормативно-правовая база РФ и ЕАЭС, включая ТР ТС 034/2013, ГОСТ 32244-2013 и СанПин 2.3.2.1078-01, устанавливает четкие требования к безопасности субпродуктов, однако требует дальнейшего совершенствования и актуализации с международными стандартами (Кодекс Алиментариус, регламенты ЕС). Особое внимание следует уделить практическому внедрению системы HACCP, позволяющей системно управлять рисками на всех этапах производства.

Перспективы исследования связаны с разработкой адаптированных методических рекомендаций по применению HACCP в условиях российских предприятий, а также с анализом эффективности текущих механизмов контроля и мониторинга на разных этапах переработки субпродуктов.

#### **Список использованной литературы**

1. Датченко, О. О. Ветеринарно-санитарная экспертиза: учебное пособие / О. О. Датченко, Н. С. Титов, В. В. Ермаков. — Самара: СамГАУ, 2020. — 141 с. — ISBN 978-5-88575-606-8.
2. Демина, Е. Н. Использование вторичного сырья в мясной промышленности: учебное пособие / Е. Н. Демина. — Орел: ОГУ имени И.С. Тургенева, 2023. — 123 с. — ISBN 978-5-9929-1381-1.
3. Урбан, В. Г. Сборник нормативно-правовых документов по ветеринарно-санитарной экспертизе мяса и мясопродуктов / В. Г. Урба; Под ред.: Воронин Е. .. — 4-е изд., стер. — Санкт-Петербург: Лань, 2023. — 384 с. — ISBN 978-5-507-46287-2.

© Гостев Д., 2025



# ГЕОГРАФИЯ

Seydiyeva Jennet Charyyargulyyevna

Annayeva Lilianna

Lecturer

International horse breeding academy named after Aba Annayev

Arkadag, Turkmenistan

## CHARACTERISTICS OF TOURISM GEOGRAPHY: A SPATIAL LENS ON A GLOBAL PHENOMENON

### Abstract

Tourism geography, an increasingly vital sub-discipline within human geography, systematically examines the spatial patterns, processes, and impacts of tourism activities across various scales. This article delineates the key characteristics that define this field, highlighting its interdisciplinary nature, reliance on spatial analysis, focus on human-environment interactions, and dynamic adaptation to global changes. It explores how tourism geography contributes to understanding destination development, tourist mobility, socio-cultural implications, and the imperative for sustainable tourism practices. By applying a geographical lens, the discipline offers critical insights for effective planning, management, and policy-making in the complex global tourism industry.

### Keywords:

tourism geography, spatial analysis, destination management, human-environment interaction, sustainable tourism, mobility, interdisciplinary, tourism impacts, planning, place.

### Introduction

Tourism has emerged as one of the world's largest and fastest-growing economic sectors, profoundly shaping economies, societies, and environments across the globe. From the resurgence of international travel post-pandemic to the increasing awareness of climate change's direct impact on destinations, the spatial dimensions of tourism have never been more critical. It is within this dynamic context that tourism geography, as an academic and applied field, offers an indispensable framework for understanding the intricate relationships between people, places, and the phenomenon of travel.

Beyond simply mapping tourist attractions, modern tourism geography delves into complex questions such as: How do global events, like health crises or geopolitical shifts, instantaneously alter travel patterns and destination resilience? What role does digital transformation, including AI-driven personalized itineraries and virtual reality tours, play in shaping future tourism landscapes? How can destinations balance the economic benefits of tourism with the urgent need for environmental conservation and the preservation of local cultural authenticity in an era of "destination dupes" and "overtourism"? This evolving landscape demands a rigorous, geographically informed analysis that moves beyond traditional tourism studies, integrating insights from environmental science, urban planning, economics, sociology, and even psychology. Tourism geography provides this holistic, spatial perspective, illuminating the inherent geographical nature of tourism itself.

### Characteristics of Tourism Geography

Tourism geography is defined by several fundamental characteristics that distinguish its approach and scope:

1. **Spatial Perspective and Analysis:** At its core, tourism geography is the study of "where" and "why there" in relation to tourism. It focuses on the distribution of tourist attractions, the origins of tourists, the routes they take (flows), and the spatial organization of tourism infrastructure (e.g., airports, hotels, resorts). It employs geographical techniques such as mapping, Geographic Information Systems (GIS), and remote

sensing to visualize, analyze, and interpret these spatial patterns and relationships. This allows for identifying key source markets, understanding destination networks, and assessing the spatial concentration or dispersion of tourism impacts.

2. Interdisciplinary and Integrated Approach: Tourism is a multifaceted activity, and its geographical study necessarily draws upon a wide range of disciplines. It integrates concepts from:

- Physical Geography: Understanding the role of landforms, climate, water bodies, and ecosystems as natural attractions and their vulnerability to tourism pressures.
- Human Geography: Analyzing socio-cultural impacts, economic geographies of tourism (e.g., employment, revenue distribution), political geography (e.g., visa policies, border controls), and urban geography (e.g., tourist districts, urban regeneration).
- Economics: Examining supply and demand, cost-benefit analysis, and the multiplier effect of tourism spending.
- Sociology and Anthropology: Investigating tourist motivations, local community perceptions, acculturation, and the commodification of culture.
- Environmental Science: Assessing ecological footprints, biodiversity impacts, and the challenges of sustainable development.
- Planning and Management: Informing strategic destination planning, infrastructure development, and policy formulation.

3. Focus on Human-Environment Interaction: Tourism is inherently reliant on both natural and cultural environments. Tourism geography examines the complex, often symbiotic, sometimes antagonistic, relationship between human tourism activities and the environments in which they occur. This includes how natural features (mountains, beaches, wildlife) become resources for tourism, how cultural landscapes are shaped by and marketed for tourism, and crucially, the environmental and socio-cultural impacts (both positive and negative) that tourism exerts on host regions. Sustainable tourism and responsible travel are central concerns, aiming to mitigate negative impacts and enhance positive ones.

4. Emphasis on Place and Destination Development: Tourism geography places significant emphasis on the concept of "place"—not just as a location, but as a dynamic entity imbued with meaning, identity, and shared experiences. It investigates how destinations are developed, marketed, and managed. This includes studying the "destination life cycle" (exploration, involvement, development, consolidation, stagnation, decline/rejuvenation), the role of "sense of place" in attracting tourists, and the strategies for creating competitive and appealing tourism environments that reflect local distinctiveness.

5. Dynamic and Evolving Field: The tourism industry is highly susceptible to global trends, technological advancements, economic shifts, and unforeseen crises (e.g., pandemics, natural disasters, political instability). Tourism geography is thus a dynamic field that continually adapts its research agenda and methodologies to understand these new realities. Current research explores themes such as climate change adaptation in tourism, the implications of digital nomads, the gig economy's impact on tourism services, resilience building in tourism economies, and the ethical considerations of data collection from tourists.

6. Multi-Scalar Analysis: Tourism geography operates across multiple spatial scales, from the micro-level (e.g., the layout of a single resort or tourist attraction), to the meso-level (e.g., regional tourism planning, inter-city travel patterns), to the macro-level (e.g., global tourist flows, international policy agreements impacting travel). Understanding these interconnected scales is crucial for comprehending the complex spatial organization of tourism and for developing effective policies at appropriate levels.

7. Focus on Mobility and Flows: A key characteristic is the study of human mobility. Tourism inherently involves movement—the journey from the tourist's origin to the destination and within the destination. This

includes analyzing transportation networks, travel motivations, decision-making processes, and the logistical challenges of moving large numbers of people across space. It also extends to the flows of capital, information, and ideas that accompany tourist movements.

In conclusion, tourism geography provides an essential framework for understanding the spatial complexities of one of the world's most significant industries. By integrating diverse perspectives and utilizing powerful spatial analytical tools, it not only describes the "where" of tourism but also delves into the "why" and "what if," offering critical insights for fostering sustainable, equitable, and resilient tourism futures.

#### References:

1. Hall, C. M., & Page, S. J. (2021). *The Geography of Tourism and Recreation: Environment, Place and Space*. Routledge.
2. Lew, A. A., Hall, C. M., & Williams, A. M. (Eds.). (2018). *A Companion to Tourism*. Wiley Blackwell.
3. Pearce, D. G. (1989). *Tourism Today: A Geographical Analysis*. Longman Scientific & Technical.
4. Butler, R. W., & Pearce, D. G. (Eds.). (1995). *Tourism Development: An Introduction*. Routledge.

© Seydiyeva J. Annayeva L., 2025

**Seydiyeva Jennet Charyyargulyyevna  
Shamyradova Guncha**

Lecturer

International horse breeding academy named after Aba Annayev  
Arkadag, Turkmenistan

## TOURIST DESTINATIONS OF THE WORLD AND THEIR ENDURING CHARMS

### Abstract

The allure of global tourist destinations lies in their remarkable diversity and inherent beauty, encompassing natural wonders, architectural marvels, and profound cultural heritage. This article explores the multifaceted appeal of the world's most captivating destinations, categorizing their beauties into natural, historical/architectural, and cultural/experiential dimensions. It highlights how evolving traveler preferences, influenced by factors like sustainability concerns and a desire for authentic, immersive experiences, are shaping the tourism landscape. From established icons to emerging "destination dupes" and off-the-beaten-path gems, the article examines what makes a place truly beautiful and memorable, emphasizing the growing importance of responsible travel practices in preserving these invaluable global assets for future generations.

### Keywords:

tourism, destinations, beauty, natural wonders, cultural heritage, architecture, experiential travel, sustainable tourism, emerging destinations, travel trends.

### Introduction

In an increasingly interconnected yet often fast-paced world, the pursuit of travel remains a fundamental human desire, offering respite, enrichment, and a deeper understanding of our planet's myriad facets. Global tourist destinations, each with its unique tapestry of attractions, continue to captivate millions, drawing them into experiences that range from awe-inspiring natural immersion to profound cultural encounters. However, the landscape of global tourism is dynamic, constantly reshaped by emerging trends,

technological advancements, and a heightened collective consciousness regarding environmental and social impacts.

Beyond the timeless appeal of iconic landmarks and breathtaking landscapes, recent years have seen a significant shift in traveler motivations. There's a growing emphasis on experiential travel, where visitors seek authentic engagement with local communities, hands-on learning, and a deeper connection to the places they visit. This has led to the rise of niche tourism markets like "horti-culture" (botanical and agritourism), "art-venture" (immersive art and culture), and "gami-vacation" (gamified travel experiences). Furthermore, the concept of "destination dupes" has gained traction, as travelers increasingly seek out lesser-known, more affordable, and less crowded alternatives to popular hotspots, driven by a desire for unique discoveries and a conscious effort to avoid overtourism.

The beauty of a tourist destination, therefore, extends far beyond mere visual appeal. It encompasses the emotional resonance it evokes, the stories it tells, the sensory experiences it offers, and its capacity to inspire and transform. As the world continues to navigate the complexities of climate change and the imperative for responsible travel, understanding the diverse dimensions of destination beauty and adapting to evolving visitor expectations is crucial for sustainable growth and the preservation of these global treasures.

#### The Multifaceted Beauties of Global Destinations

The allure of the world's tourist destinations can be broadly categorized by the primary source of their captivating beauty:

1. Natural Wonders: These destinations are characterized by their untouched or minimally altered landscapes, showcasing the raw power and artistry of nature. Their beauty often evokes feelings of awe, serenity, and adventure. Examples include:

- Spectacular Landscapes: The dramatic fjords of Norway (e.g., Geirangerfjord), the majestic peaks of the Canadian Rockies (Banff National Park), the vastness of the Grand Canyon (USA), and the ethereal "hoodoos" of Cappadocia (Turkey). These offer panoramic vistas, opportunities for hiking, and a sense of scale that humbles the observer.

- Coastal and Marine Paradises: The vibrant coral ecosystems of the Great Barrier Reef (Australia), the pristine white sands and turquoise waters of the Maldives and Seychelles (e.g., Anse Source d'Argent), and the rugged, dramatic Nā Pali Coast (Hawaii). These invite relaxation, water sports, and unparalleled biodiversity.

- Unique Geological Formations: Pamukkale's white travertine terraces (Turkey), Bolivia's immense Salar de Uyuni salt flat, and the "rainbow mountains" of Zhangye National Geopark (China). These showcase Earth's geological processes in stunning, often surreal, forms.

- Lush Ecosystems: The biodiversity-rich Monteverde Cloud Forest (Costa Rica) and the Okavango Delta (Botswana), teeming with wildlife. These offer immersive experiences in untouched wilderness, often with opportunities for eco-tourism and wildlife observation.

2. Historical and Architectural Marvels: These destinations draw their beauty from the ingenuity, artistry, and history of human civilization. They offer glimpses into past eras and stand as testaments to cultural achievements.

- Ancient Civilizations: Machu Picchu's Incan citadel (Peru), the rock-cut city of Petra (Jordan), and the temple-strewn plains of Bagan (Myanmar). These sites whisper tales of bygone empires and offer a profound sense of history.

- Iconic Cityscapes and Landmarks: The romantic boulevards and iconic structures of Paris (France), the intricate tile work and ornate designs of Moroccan architecture (e.g., in Marrakech or Fes), and the architectural splendor of Rome (Italy). These urban centers are canvases of human creativity and historical evolution.

○ Engineering Feats: The Great Wall of China, the Roman Colosseum, or the engineering marvels of ancient Egyptian pyramids. These structures demonstrate incredible human ambition and skill.

3. Cultural and Experiential Richness: The beauty of these destinations lies not just in what can be seen, but in what can be felt, learned, and participated in. It's about the living culture, the local way of life, and the unique traditions.

○ Vibrant Festivals and Traditions: The colorful festivals of India, the spiritual practices in Kyoto (Japan), or the flamenco culture of Andalusia (Spain). These offer immersive cultural exchanges and sensory delights.

○ Culinary Journeys: Destinations renowned for their unique food scenes, from the street food of Southeast Asia to the gourmet experiences of Italy or France. Culinary tourism connects travelers directly with the heart of a culture.

○ Community Engagement: Places that offer opportunities for visitors to engage with local artisans, participate in workshops (e.g., pottery in Japan, textile weaving in Morocco), or contribute to local conservation efforts (contributing travel experiences).

○ Off-the-Beaten-Path Authenticity: Increasingly, travelers seek out "under-the-radar" spots like Tartu (Estonia) or Reggio Calabria (Italy), which offer genuine local experiences away from mainstream tourist crowds.

#### The Evolving Landscape of Tourist Preferences

Modern travelers are increasingly discerning. The rise of conscious tourism means more visitors are looking for:

- Sustainability: A desire to minimize environmental impact, support local economies, and preserve cultural integrity. This drives demand for eco-friendly accommodations, responsible tour operators, and a focus on leaving a positive footprint.

- Authenticity: A move away from curated, superficial experiences towards genuine interactions with local life, traditions, and environments.

- Wellness and "Calmcations": Destinations that offer opportunities for mental and physical rejuvenation, often in natural settings, promoting health and wellbeing.

- Adventure and Niche Interests: From "astro-adventurers" seeking the Northern Lights in Tromsø (Norway) to those interested in specific historical periods, art forms, or outdoor activities.

- Off-Season and "Coolcationing": A shift towards traveling during shoulder seasons or to cooler climate destinations, influenced by rising temperatures in traditional summer hotspots and a desire to avoid crowds.

Ultimately, the enduring beauty of the world's tourist destinations is a complex interplay of their inherent attributes and the evolving desires of those who visit them. As we look to the future, responsible tourism and a deep appreciation for the unique identity of each place will be paramount to preserving their beauty for generations to come.

#### References:

1. National Geographic (Various authors). Journeys of a Lifetime: 500 of the World's Greatest Trips. National Geographic Society.
2. Lonely Planet: <https://www.lonelyplanet.com/>
3. UN Tourism (formerly UNWTO): <https://www.e-unwto.org/>
4. Skyscanner: <https://www.skyscanner.net/>

© Seydiyeva J. Shamyradova G., 2025



# АРХИТЕКТУРА

**Charyyev Sohbet Maksadovich**  
**Agayev Bekgylych Hakberdiyevich**

Lecturer

International horse breeding academy named after Aba Annayev  
Arkadag, Turkmenistan

## **THE MODERN SCIENTIFIC FOUNDATIONS OF BUILDING MATERIALS: ENGINEERING A SUSTAINABLE FUTURE**

### **Abstract**

The scientific underpinnings of building materials have undergone a profound transformation, moving from empirical practices to a sophisticated, multi-scale engineering discipline. This article explores the modern scientific foundations that drive the innovation in building materials, emphasizing their crucial role in addressing contemporary challenges such as climate change, resource scarcity, and the demand for enhanced performance and longevity. Key areas of advancement include nanotech-driven material design, the development of smart and self-healing materials, the pursuit of low-carbon and circular economy solutions, and the integration of advanced computational modeling. These scientific breakthroughs are not only optimizing the structural and functional properties of materials but are also pivotal in constructing a more resilient, sustainable, and technologically advanced built environment for the future.

### **Keywords:**

building materials science, materials engineering, sustainable construction, smart materials, self-healing concrete, nanotechnology, low-carbon materials, circular economy, advanced composites, computational materials science

### **Introduction**

The structures that house us, facilitate our commerce, and connect our communities are fundamentally defined by the materials from which they are built. For centuries, the development of building materials was largely an empirical process, driven by trial and error and localized resource availability. While traditional materials like concrete, steel, wood, and brick have served humanity remarkably well, the demands of the 21st century—ranging from rapid urbanization and extreme climatic events to the urgent need for decarbonization—have necessitated a radical shift in how building materials are conceived, designed, and deployed.

Modern building materials science is no longer confined to merely improving strength or durability. It is a highly interdisciplinary field, drawing heavily from chemistry, physics, materials science, civil engineering, and increasingly, nanotechnology and artificial intelligence. The focus has broadened to include the entire lifecycle of a material, from cradle to grave (or more ideally, from cradle to cradle, embodying circular economy principles). Contemporary research is deeply intertwined with global sustainability goals, aiming to drastically reduce embodied carbon, enhance energy efficiency in buildings, facilitate material reuse and recycling, and create materials that are not just passive components but active participants in improving structural performance and environmental impact. This new era of building materials is characterized by unprecedented precision in design, the ability to imbue materials with novel functionalities, and a profound commitment to environmental stewardship, redefining the very essence of construction in the modern world.

### **Modern Scientific Foundations of Building Materials**

The advancements in building materials are underpinned by several interconnected scientific principles and technological frontiers:

1. Atomistic and Nanoscale Engineering: The ability to manipulate materials at the atomic and molecular levels has opened up unprecedented possibilities. Nanotechnology allows for the precise tailoring of material properties by incorporating nanomaterials (e.g., carbon nanotubes, nanosilica, nano-titanium dioxide).

- Enhanced Strength and Durability: Nanoparticles can refine the microstructure of cementitious materials, leading to denser, less permeable, and significantly stronger concrete. Carbon nanotubes can offer exceptional tensile strength, reinforcing composites.

- Self-Cleaning and Air-Purifying Surfaces: Nanocoatings with titanium dioxide (TiO<sub>2</sub>) can create photocatalytic surfaces that break down pollutants and organic dirt upon exposure to sunlight, leading to self-cleaning facades and improved air quality.

- Improved Thermal Performance: Nanoporous materials like aerogels, despite being incredibly lightweight (often 99.8% air), offer superior thermal insulation properties due to their minimized solid conduction and convection.

2. Smart and Multifunctional Materials: Beyond their primary structural roles, modern building materials are being engineered to possess active, responsive, or multiple functionalities, transforming buildings into dynamic systems.

- Self-Healing Concrete: Inspired by biological systems, this concrete incorporates healing agents (e.g., encapsulated polymers, bacteria that produce calcium carbonate) that are released upon crack formation, autonomously repairing micro-cracks and extending the material's lifespan, significantly reducing maintenance costs and improving durability.

- Phase-Change Materials (PCMs): Integrated into building envelopes, PCMs can absorb and release latent heat as they change phase (e.g., solid to liquid), helping to regulate indoor temperatures, reduce energy consumption for heating and cooling, and improve thermal comfort.

- Thermochromic and Electrochromic Glass: These "smart windows" can dynamically adjust their light transmission and heat gain properties in response to temperature changes or electrical currents, optimizing natural lighting and energy efficiency.

- Energy Harvesting Materials: Photovoltaic materials are being integrated into transparent coatings, roof tiles, and even pavements, allowing buildings to generate their own electricity from solar energy.

3. Low-Carbon and Sustainable Material Development: A critical driver in modern building materials science is the imperative to reduce the massive carbon footprint of the construction industry.

- Alternative Cements: Research focuses on replacing traditional Ordinary Portland Cement (OPC), a major CO<sub>2</sub> emitter, with alternative binders like geopolymers (derived from industrial waste like fly ash and blast furnace slag) that offer significantly lower embodied carbon.

- Bio-based Materials: Advances in engineered wood products (e.g., Cross-Laminated Timber (CLT), Glued Laminated Timber (Glulam)), hempcrete, mycelium composites (from fungi), and bamboo-based products are offering renewable, carbon-sequestering, and often lightweight alternatives.

- Recycled and Waste-Derived Materials: Scientific efforts are maximizing the incorporation of recycled content (e.g., recycled concrete aggregates, plastic waste, industrial by-products) into new building materials, aligning with circular economy principles and reducing landfill waste.

4. Advanced Composites and Hybrid Materials: Combining different materials at various scales to leverage their synergistic properties is a cornerstone of modern materials science.

- Fiber-Reinforced Polymers (FRPs): Lightweight and corrosion-resistant, FRPs (e.g., carbon fiber, glass fiber) are increasingly used to reinforce concrete structures, strengthening them and extending their lifespan, particularly in corrosive environments.

- Functionally Graded Materials: Materials designed with continuously varying properties across their

volume, optimizing performance for specific loading or environmental conditions.

#### Conclusion

The modern scientific foundations of building materials represent a dynamic and evolving frontier, essential for addressing the complex challenges facing our planet and society. By harnessing the power of nanoscale engineering, developing smart and multifunctional capabilities, pioneering low-carbon and circular economy solutions, and leveraging advanced computational intelligence, materials scientists are not just creating better bricks and mortar; they are engineering the very fabric of our future built environment. These scientific advancements are propelling construction towards an era of unprecedented sustainability, resilience, and intelligent performance, fundamentally redefining what a "building material" can be and do.

#### References:

1. Chudley, R., & Greeno, R. (2018). Building Construction Handbook. Routledge.
2. Mehta, P. K., & Monteiro, P. J. M. (2017). Concrete: Microstructure, Properties, and Materials. McGraw-Hill Education.
3. Ramachandran, V. S. (Ed.). (2010). Concrete Science: A Historical Perspective, Twentieth Century Achievements and Twenty-First Century Challenges. CRC Press.
4. Pacheco-Torgal, F., & Labrincha, J. A. (Eds.). (2013). Eco-Efficient Concrete. Woodhead Publishing.
5. MIT Concrete Sustainability Hub: <https://cshub.mit.edu/>

© Charyyev S., Agayev B., 2025