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РАЗВИТИЕ У МЛАДШИХ ШКОЛЬНИКОВ УМЕНИЯ ОПРЕДЕЛЯТЬ ЗНАЧЕНИЕ СЛОВА ПО КОНТЕКСТУ С ПОМОЩЬЮ УЧЕБНЫХ СЛОВАРЕЙ

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Аннотация. *В тезисе рассматриваются вопросы развития у учащихся начальных классов умения определять значение незнакомого слова по контексту с последующей проверкой по учебному словарю. Описаны виды контекстных подсказок и поэтапная методика работы, направленная на повышение читательской грамотности младших школьников.*

Ключевые слова: *учебный словарь, контекст, значение слова, младший школьник, словарный запас, читательская грамотность.*

Одним из ключевых показателей качества начального образования сегодня является читательская грамотность учащихся. Международное исследование PIRLS оценивает прежде всего умение ребёнка понимать прочитанный текст, извлекать из него информацию и интерпретировать её. Понимание текста невозможно без понимания составляющих его слов, поэтому работа над лексическим значением слова занимает важное место на уроках родного языка и литературного чтения.

Исследования показывают, что значительную часть новых слов дети усваивают не путём прямого заучивания, а в процессе чтения, догадываясь об их значении из окружающего текста (W.Nagy, R.Anderson и др.). Однако младшие

школьники часто либо пропускают незнакомое слово, либо понимают его неверно. Учебный словарь в этом случае выступает средством проверки и уточнения догадки. Таким образом, контекстная догадка и работа со словарём не противопоставляются, а дополняют друг друга.

Теоретической основой такой работы служат положения учебной лексикографии, сформулированные Л.В.Щербой, П.Н.Денисовым и В.В.Морковкиным: учебный словарь должен не только сообщать сведения о слове, но и обучать, то есть учитывать возраст, уровень языковой подготовки и познавательные возможности пользователя. В методике начального обучения вопросы словарной работы глубоко разработаны в трудах М.Р.Львова и Т.Г.Рамзаевой, которые подчёркивали, что работа над значением слова должна вестись систематически и опираться на активную мыслительную деятельность ребёнка, а не на механическое запоминание толкований.

Учащихся начальных классов целесообразно научить распознавать основные виды контекстных подсказок:

- **синонимическая подсказка** — рядом со словом стоит близкое по значению слово;
- **антонимическая подсказка** — значение слова проясняется через противопоставление;
- **пояснение** — автор сам объясняет значение слова в тексте;
- **пример** — значение раскрывается через перечисление конкретных предметов или действий;
- **общий смысл** — значение выводится из содержания предложения или абзаца.

На основе этого нами предложена поэтапная методика работы с незнакомым словом, включающая четыре шага:

1) **«Найди»** — ученик выделяет в тексте незнакомое слово;
2) **«Предположи»** — по контекстным подсказкам формулирует догадку о значении слова;
3) **«Проверь»** — сверяет свою догадку с толкованием в учебном словаре;
4) **«Примени»** — составляет с новым словом собственное предложение или использует его в пересказе.

Приведём пример. При чтении предложения «Утро было пасмурным: небо затянули серые тучи, и солнце так и не выглянуло» ученик встречает незнакомое слово «пасмурный». На этапе «Предположи» он опирается на подсказки «серые тучи» и «солнце не выглянуло» и делает вывод, что пасмурный — это облачный, без солнца. На этапе «Проверь» ученик находит слово в учебном толковом словаре и убеждается в правильности догадки, а также узнаёт антоним «ясный». На этапе «Примени» он составляет собственное предложение, например: «В пасмурный день мы остались дома». Так новое слово переходит из пассивного словаря ребёнка в активный.

Для закрепления умения рекомендуется использовать систему упражнений, постепенно усложняющихся от класса к классу:

- **«Угадай слово»** — подбор значения выделенного слова из нескольких вариантов с опорой на текст;
- **«Словарный детектив»** — поиск в тексте подсказок, раскрывающих значение слова, и их подчёркивание;
- **«Сверь со словарём»** — сопоставление собственного толкования с толкованием в учебном словаре и его уточнение;
- **«Мой словарик»** — ведение личного словаря новых слов с толкованием, рисунком и примером употребления;
- **«Слово в деле»** — использование новых слов в устном пересказе, сочинении или диалоге.

В 1–2 классах работа проводится преимущественно под руководством учителя, с опорой на иллюстрированные словари и наиболее простые виды подсказок (синоним, пример). В 3–4 классах учащиеся переходят к самостоятельной работе: используют толковые, орфографические, синонимические словари, а также учатся различать значения многозначного слова в зависимости от контекста.

Особая роль в этом процессе принадлежит учителю начальных классов. Он не просто объясняет значения слов, а моделирует рассуждение («Как я догадался, что означает это слово?»), создаёт ситуации, побуждающие детей обращаться к словарю, поощряет самостоятельные догадки и учит их проверять. Это требует от педагога владения основами учебной лексикографии и методикой работы со словарями различных типов.

Такая последовательность формирует у ребёнка осознанное отношение к слову, развивает языковую догадку, навыки самоконтроля и самостоятельной работы со справочной литературой. Важно, чтобы учебный словарь, используемый на уроке, соответствовал возрасту учащихся: содержал простые толкования, понятные примеры и иллюстрации. Эффективным дополнением являются электронные и интерактивные словари, позволяющие быстро проверить значение слова и повышающие интерес учащихся к работе.

Таким образом, обучение младших школьников определению значения слова по контексту с последующей проверкой по учебному словарю способствует обогащению их словарного запаса, более глубокому пониманию текста и, в конечном счёте, повышению читательской грамотности.

Литература:

1. Щерба Л.В. Опыт общей теории лексикографии // Языковая система и речевая деятельность. – Л.: Наука, 1974. – С. 265–304.
2. Львов М.Р. Словарь-справочник по методике русского языка. – М.: Просвещение, 1988.
3. Рамзаева Т.Г., Львов М.Р. Методика обучения русскому языку в начальных классах. – М.: Просвещение, 1979.
4. Nagy W.E., Anderson R.C., Herman P.A. Learning word meanings from context during normal reading // American Educational Research Journal. – 1987. – Vol. 24, No. 2. – P. 237–270.
5. Mullis I.V.S., Martin M.O. (Eds.) PIRLS 2021 Assessment Frameworks. – Boston College, TIMSS & PIRLS International Study Center, 2019.
6. Qosimova K., Matchonov S., G'ulomova X. va boshq. Ona tili o'qitish metodikasi. – Toshkent: Noshir, 2009.

BO‘LAJAK KIMYO O‘QITUVCHILARINING KASBIY KOMPETENTLIGINI RIVOJLANTIRISH METODLARI

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Annotatsiya. Mazkur tezisda kimyo o‘qituvchisini tayyorlash jarayonida kasbiy kompetentlikni qaysi metodlar yordamida va qanday izchillikda rivojlantirish mumkinligi haqidagi mualliflik qarashlari bayon etilgan. Biz kasbiy kompetentlikni oltita o‘zaro bog‘liq tarkibiy qism — fan, metodik, eksperimental, raqamli, kommunikativ-tashkiliy va refleksiv qismlar birligi sifatida ko‘rib chiqdik. Muammoli va izlanishli ta’lim, keys-stadi, loyiha ishi, mikro-ta’lim, dars tadqiqoti, o‘quv eksperimenti hamda portfolio har bir tarkibiy qismga qanday ta’sir etishi kimyo kursining aniq mavzulari asosida ko‘rsatib berildi. Shuningdek, metodlarni bakalavriatning to‘rt kursi bo‘yicha taqsimlash tartibi va erishilgan natijani aniqlash mezonlari taklif qilindi.

Kalit so‘zlar: kasbiy kompetentlik, kimyo o‘qituvchisini tayyorlash, o‘qitish metodlari, o‘quv eksperimenti, mikro-ta’lim, dars tadqiqoti, refleksiya, bosqichma-bosqich yondashuv.

Аннотация. В тезисе изложена авторская позиция по вопросу о том, какими методами и в какой последовательности целесообразно развивать профессиональную компетентность в процессе подготовки учителя химии. Компетентность рассматривается нами как единство шести взаимосвязанных составляющих: предметной, методической, экспериментальной, цифровой, коммуникативно-организационной и рефлексивной. На материале конкретных тем курса химии показано влияние проблемного и исследовательского обучения, кейс-стади, проектной работы, микропреподавания, исследования урока, учебного эксперимента и портфолио на каждую из составляющих. Предложены порядок распределения методов по четырём курсам бакалавриата и критерии определения достигнутого результата.

Ключевые слова: профессиональная компетентность, подготовка учителя химии, методы обучения, учебный эксперимент, микропреподавание, исследование урока, рефлексия.

Abstract. The paper sets out the author's view on which methods should be used, and in what order, to develop professional competence while training chemistry teachers. We regard competence as a unity of six interrelated constituents: subject, methodological, experimental, digital, communicative-organisational and reflective. Using particular topics of the chemistry course, we show how problem-based and inquiry learning, case study, project work, microteaching, lesson study, classroom experiment and portfolio affect each constituent. A way of distributing the methods across the four years of the bachelor's programme and criteria for establishing the result achieved are proposed.

Keywords: professional competence, chemistry teacher training, teaching methods, classroom experiment, microteaching, lesson study, reflection.

Maktabda kimyo qanday o‘qitilishi oxir-oqibat sinfga kirgan o‘qituvchining tayyorgarligiga borib taqaladi: eng yaxshi darslik ham, eng yangi laboratoriya ham undan foydalana oladigan mutaxassis bo‘lmasa, kutilgan samarani bermaydi. So‘nggi yillarda qabul qilingan me’yoriy hujjatlar ham ayni shu masalaga e’tibor qaratadi. “Ta’lim to‘g‘risida”gi Qonun [1] va Oliy ta’lim tizimini 2030-yilgacha rivojlantirish konsepsiyasi [2] mutaxassis tayyorlashda tayyor bilimni yetkazishdan uni amalda qo‘llash layoqatini tarbiyalashga o‘tish zarurligini ta’kidlaydi, 2020-yil 12-avgustdagi PQ-4805-son qaror [3] esa kimyo va biologiya ta’limi sifatini alohida vazifa sifatida ajratib ko‘rsatadi. Bizningcha, bu talablarni bajarish uchun o‘quv rejasidagi fanlar ro‘yxatini yangilashning o‘zi kifoya qilmaydi — talaba auditoriyada nima bilan mashg‘ul bo‘lishini, ya’ni o‘qitish metodlarini o‘zgartirish kerak.

Kimyo o‘qituvchisining ishi murakkab: u bir vaqtning o‘zida fanni biladigan mutaxassis, uni bola tiliga “tarjima qiladigan” metodist, tajribani xavfsiz o‘tkazadigan laborant va raqamli vositalarni ishga soladigan foydalanuvchi bo‘lishi lozim. Pedagogik ta’lim amaliyotini tahlil qilar ekanmiz, bu talablar bilan mavjud tayyorgarlik o‘rtasida kamida to‘rtta nomuvofiqlik borligini ko‘ramiz:

- talaba kimyoni yaxshi bilishi mumkin, ammo bilganini dars materialiga aylantirishga kelganda qiynaladi;

- maktab o‘quvchini faol ishlashga, izlanishga undaydigan darsni kutadi, oliy ta’lim mashg‘ulotlarida esa tinglash va qayta aytib berish hamon katta o‘rin egallaydi;
- maktab kimyo xonalari yangi jihozlar bilan ta’minlanmoqda, bitiruvchining ular bilan ishlash malakasi esa bu jarayondan ortda qolmoqda;
- pedagogik amaliyot qisqa bo‘lgani sababli talaba o‘zi o‘tgan darsni sinchiklab tahlil qilishga ulgurmaydi.

Bu nomuvofiqliklarning barchasi, fikrimizcha, bitta umumiy sababga ega: kompetentlikni tushuntirib berib bo‘lmaydi, uni talaba faqat o‘zi harakat qilib egallaydi. Mahalliy tadqiqotchilar ham shu xulosaga keladi [4; 5]. Shunday ekan, “talabani nimaga o‘rgatamiz?” degan savol bilan bir qatorda “qaysi metod orqali o‘rgatamiz?” degan savol ham hal qiluvchi ahamiyat kasb etadi.

Ishning maqsadi — kimyo o‘qituvchisi kasbiy kompetentligining har bir tarkibiy qismiga mos keluvchi metodlarni ajratish hamda ularni o‘quv jarayoniga kiritish izchilligini asoslab berish.

Vazifalar: birinchidan, kimyo o‘qituvchisi kompetentligining tarkibini aniqlashtirish; ikkinchidan, tanlangan metodlarning imkoniyatlarini kimyo mavzulari misolida ko‘rsatish; uchinchidan, metodlarni kurslar bo‘yicha taqsimlash va natijani baholash yo‘lini taklif etish.

Qo‘llangan metodlar: mavzuga oid pedagogik va metodik manbalarni tahlil qilish, turli yondashuvlarni o‘zaro solishtirish, umumlashtirish hamda modellashtirish. Ish nazariy xarakterga ega; unda ilgari surilgan takliflar keyingi bosqichda tajriba-sinov yo‘li bilan tekshirilishi nazarda tutiladi.

Ilmiy manbalarda “kompetensiya” va “kompetentlik” atamalari ko‘pincha yonma-yon ishlatiladi, biroq ular bir narsa emas. Biz bu ishda ularni quyidagicha farqlaymiz: kompetensiya — kasb egasidan kutiladigan natija, ya’ni tashqaridan

qo‘yilgan me’yor; kompetentlik — ana shu me’yorning muayyan shaxsda qay darajada ro‘yobga chiqqani. I.A. Zimnyaya kompetentlikni ta’lim natijasini yangicha tushunish asosi deb biladi [6], A.K. Markova uning maxsus, ijtimoiy, shaxsiy va individual ko‘rinishlarini ko‘rsatadi [7], N.A. Muslimov boshchiligidagi mualliflar esa uni bosqichma-bosqich shakllantiriladigan, texnologik jihatdan boshqarish mumkin bo‘lgan jarayon sifatida tavsiflaydi [5]. Ushbu qarashlarni umumlashtirib, biz kasbiy kompetentlikni o‘qituvchining o‘z ishiga doir vazifalarni mustaqil, ongli va javobgarlik bilan yecha olishini ta’minlaydigan yaxlit shaxsiy-kasbiy sifat deb tushunamiz.

Umumiy ta’riflar barcha fan o‘qituvchilariga birdek taalluqli. Kimyo o‘qituvchisining o‘ziga xosligini ochish uchun biz ikki g‘oyaga tayanamiz. Birinchisi L. Shulmanga tegishli: u o‘qituvchining alohida bilim turini — fan mazmunini o‘rgatish uchun qayta ishlash bilimini (pedagogical content knowledge) ajratib ko‘rsatgan [8]. Bu g‘oyani kimyoga tatbiq etsak, yaxshi kimyogar hali yaxshi o‘qituvchi degani emas: o‘qituvchi mavzuni qaysi misol, qaysi tajriba yoki qaysi model orqali ochish kerakligini va o‘quvchi odatda qayerda adashishini ham bilishi lozim. Ikkinchi g‘oya A. Jonstonniki: kimyoviy bilim uch qatlamda mavjud — ko‘z bilan ko‘riladigan hodisa, zarrachalar dunyosi va belgilar tili [9]. Tajribada cho‘kma tushganini ko‘rish bir narsa, ionlar birikkanini tasavvur qilish ikkinchi narsa, buni tenglama bilan yozish uchinchi narsa. Bizning nazarimizda, maktab o‘quvchisining “kimyo qiyin” degan shikoyati ko‘p hollarda shu uch qatlam orasidagi bog‘lanishni ko‘ra olmasligidan tug‘iladi. Demak, bo‘lajak o‘qituvchini tayyorlashda ham har bir mavzuni uch qatlamda birdek ochib berishga o‘rgatish asosiy vazifalardan biri bo‘lishi kerak.

Yuqoridagi mulohazalardan kelib chiqib, biz kimyo o‘qituvchisining kasbiy kompetentligini olti tarkibiy qismdan iborat tuzilma sifatida taklif etamiz (1-jadval). Raqamli va eksperimental qismlarni alohida ajratganimizning sababi bor: umumiy pedagogik tasniflarda ular odatda metodik tayyorgarlik ichida “erib ketadi”, kimyoda esa har biri mustaqil mashq qilishni talab etadi.

1-jadval. Kimyo o‘qituvchisi kasbiy kompetentligining tarkibiy qismlari (muallif ishlanmasi)

Tarkibiy qism	Nimani qamraydi	Qanday namoyon bo‘ladi
Fan (kimyoviy)	Tushuncha, qonun va nazariyalarni hodisa, zarracha va belgi qatlamlarida anglash	Bitta hodisani uch qatlamda tushuntirib beradi, hisoblash va sifat masalalarini yecha oladi
Metodik	O‘quv materialini saralash va soddalashtirish, dars rejasini tuzish, o‘quvchilarning keng tarqalgan yanglish tasavvurlarini bilish, bilimni baholash	Dars maqsadiga bo‘ysundirilgan ishlanma va topshiriqlar turkumini yarata oladi
Eksperimental	Namoyish hamda laboratoriya tajribalarini xavfsiz, aniq ko‘rinadigan va kam sarf bilan o‘tkazish	Tajribani yordamsiz tayyorlaydi, ehtiyot choralarini ko‘radi, kuzatilgan natijani sharhlaydi
Raqamli	Virtual laboratoriya, molekula modellari va raqamli o‘lchov asboblaridan foydalanish	Vositani dars maqsadidan kelib chiqib tanlaydi, uni o‘z o‘rnida ishlatadi
Kommunikativ-tashkiliy	Sinf bilan muloqot, guruhlarda ishlashni yo‘lga qo‘yish, hamkasblar bilan birga ishlash	O‘quvchilarni ishga jalb eta oladi, o‘ylashga undovchi savollar beradi
Refleksiv	O‘z ishiga tanqidiy qarash, xatoni topish va o‘z ustida ishlash	O‘tgan darsini aniq dalillar bilan tahlil qilib, keyingisiga o‘zgartirish kiritadi

Ta’kidlash joizki, bu qismlar bir-biridan ajralgan holda mavjud emas. Fanni bilish metodik tayyorgarlik bilan qo‘shilmasa, darsga aylanmay qoladi; tajriba o‘tkazish mahorati o‘z ishini tahlil qilish odati bo‘lmasa, bir joyda to‘xtab qoladi. Shundan kelib chiqib, biz metodlarni ham yakka-yakka emas, bir-birini to‘ldiruvchi majmua sifatida tanlash tarafdorimiz.

Kasbiy kompetentlikni rivojlantirish metodlari

Biz ko‘rib chiqayotgan metodlarni birlashtiruvchi asosiy xususiyat shundaki, ularning har biri talabani axborotni qabul qiluvchidan harakat qiluvchi shaxsga aylantiradi. Quyida metodlar olti guruhga bo‘lib tavsiflanadi; har birida kimyo mazmunidan misol va bo‘lajak o‘qituvchi uchun ahamiyati ko‘rsatiladi.

Muammoli va izlanishga asoslangan ta’lim

Muammoli ta’limning mohiyati shundaki, yangi bilim e’lon qilinmaydi, balki talaba uni qarama-qarshilikni yechish jarayonida o‘zi topadi. Bir misol: alyuminiy metallarning faollik qatorida ancha yuqorida turadi, shunga qaramay alyuminiy idish yillab xizmat qiladi — buning sababi nimada? Javob izlash asnosida talaba faollik qatori haqidagi nazariy bilimni metall sirtidagi zich oksid qatlami haqidagi ma’lumot bilan bog‘lashga majbur bo‘ladi. Biroq biz bu yerda bir muhim jihatga e’tibor qaratmoqchimiz: bo‘lajak o‘qituvchi uchun muammoni yechishning o‘zi yetarli emas. U shunday savollarni o‘zi o‘ylab topishni o‘rganishi kerak, chunki maktabda uni tayyor muammolar to‘plami kutib turmaydi.

Izlanishga asoslangan ta’limda R. Uayt va R. Ganston taklif etgan “bashorat — kuzatish — izohlash” tartibi [14] o‘zini oqlaydi. Mis(II) sulfat eritmasiga temir mix solishdan oldin talabalar nima yuz berishini taxmin qilib yozadi, so‘ng tajribani kuzatadi, oxirida taxmini bilan ko‘rgani o‘rtasidagi tafovutni tushuntiradi. Bizningcha, bu tartibning qimmati ikki yoqlama: talaba o‘z bilimidagi bo‘shliqni ko‘radi va ayni

paytda o‘quvchilarning yanglish tasavvurlarini qanday “yuzaga chiqarish” mumkinligini o‘z tajribasida his qiladi.

Keys-stadi va loyiha metodi

Keys-stadida talabalar hayotdan olingan pedagogik vaziyatni muhokama qiladi va yechim taklif etadi. Kimyo o‘qitish metodikasi mashg‘ulotlari uchun biz keyslarni uch yo‘nalishda tuzishni tavsiya qilamiz:

- **metodik yo‘nalish:** o‘quvchi suv qaynaganda chiqadigan pufakchalar vodorod bilan kisloroddan iborat, deb javob berdi — o‘qituvchi bu yanglish fikrni qanday yo‘l bilan to‘g‘rilashi mumkin?
- **xavfsizlik yo‘nalishi:** laboratoriya ishi vaqtida o‘quvchining qo‘liga kislota eritmasi tegdi — o‘qituvchi nimani birinchi, nimani keyin qilishi kerak?
- **tashkiliy yo‘nalish:** sinfda o‘ttiz nafar o‘quvchi bor, reaktivlar esa faqat besh guruhga yetadi — laboratoriya ishini hech kim chetda qolmaydigan qilib qanday uyushtirish mumkin?

Bunday keyslarning afzalligi shundaki, ularda yagona “to‘g‘ri javob” yo‘q: talaba turli yechimlarni solishtiradi va tanlovini asoslaydi. Aynan shu jarayon uni amaliyotdagi kutilmagan vaziyatlarga tayyorlaydi.

Loyiha metodi kimyoviy bilimni kundalik hayot masalasi bilan uchrashtiradi. “O‘z mahallamizdagi ichimlik suvining qattiqligi qanday?” yoki “O‘simlik bo‘yoqlaridan indikator tayyorlasa bo‘ladimi?” singari mavzularda talaba ishni rejalashtiradi, tajriba qo‘yadi, natijani himoya qiladi. Biz loyihani shu bilan tugatmaslikni, unga yana bir bosqich qo‘shishni taklif etamiz: talaba bajargan loyihasini maktab o‘quvchisi uddalay oladigan shaklga keltirsin. Fikrimizcha, aynan mana shu qo‘shimcha bosqich loyihani oddiy laboratoriya topshirig‘idan kasbga tayyorlash vositasiga aylantiradi.

Mikro-ta'lim va dars tadqiqoti

Mikro-ta'lim (microteaching) o'tgan asrning oltmishinchi yillarida Stenford universitetida o'qituvchilar tayyorlash uchun yaratilgan [13]. Uning tartibi sodda: talaba darsning o'n-o'n besh daqiqalik qismini kursdoshlariga o'tib beradi, mashg'ulot tasvirga olinadi, so'ngra yozuv guruh bilan birga ko'rib chiqiladi. Kimyodan "mol" tushunchasini kiritish, reaksiya tenglamasida koeffitsiyent tanlashni tushuntirish yoki namoyish tajribasini sharhlash kabi qismlar bunga juda mos keladi. Bizning fikrimizcha, mikro-ta'limning eng katta yutug'i — talabaga o'zini chetdan ko'rish imkonini berishi: u nutqidagi takrorlarni, doskadagi tartibsiz yozuvni, javobsiz qolgan savolni o'zi payqaydi. Buning ustiga, xato bu yerda "arzon" — u haqiqiy sinfga emas, o'quv auditoriyasiga tushadi.

Dars tadqiqoti (Lesson Study) yapon maktablarida shakllangan jamoaviy ish usulidir. Uch-besh talaba bitta darsni birga rejalashtiradi; ulardan biri darsni amaliyot maktabida o'tadi, boshqalari esa kuzatadi. Muhim jihati — kuzatuvchilarning diqqati o'qituvchida emas, o'quvchilarda bo'ladi: kim nimani tushundi, qayerda qiynaldi. Shundan so'ng dars birgalikda muhokama etilib, yangidan ishlab chiqiladi. Bu metod bir yo'la uch qismni — metodik, kommunikativ-tashkiliy va refleksiv qismlarni harakatga keltiradi, shu bois biz uni pedagogik amaliyotning asosiy shakli sifatida ko'ramiz.

O'quv eksperimenti va virtual laboratoriya

Tajriba o'tkazilgani hali tushunilgani degani emas. A. Xofshteyn va V. Lunetta ta'kidlaganidek, o'quvchi yo'riqnomadagi bandlarni o'ylamasdan birin-ketin bajarsa, laboratoriya ishi tayyor retsept bo'yicha taom pishirishga o'xshab qoladi [10]. Shu sababdan biz bo'lajak o'qituvchi tajribani bajaruvchi emas, uni uyushtiruvchi o'rnida mashq qilishi zarur, degan fikrdamiz. Buning uchun quyidagi topshiriqlar maqsadga muvofiq:

- maktab darsligida berilgan tajribani mustaqil tayyorlab, kursdoshlarga ko‘rsatish va uni hodisa, zarracha, belgi qatlamlarida tushuntirish;
- shu tajribaning reaktiv kam ketadigan, kichik hajmli ko‘rinishini ishlab chiqish;
- tayyor yo‘riqnomani izlanish topshirig‘iga o‘zgartirish, ya’ni “isbotlang” so‘zini “aniqlang” so‘ziga almashtirish;
- har bir tajribaga xavf tahlilini hamda chiqindilarni zararsizlantirish yo‘lini ilova qilish.

Virtual laboratoriya va molekulalarni modellashtirish dasturlariga kelsak, ular xavfli, qimmatga tushadigan yoki oddiy ko‘z ilg‘amaydigan jarayonlarni ko‘rsatish imkonini beradi. Shunga qaramay, biz ularni haqiqiy tajribaning o‘rinbosari deb hisoblamaymiz: ularning vazifasi — probirkada ko‘rilgan hodisani zarrachalar darajasidagi tasvir bilan boyitish.

Raqamli texnologiyalarni integratsiyalash

P. Mishra va M. Kyoler o‘qituvchi bilimining uch sohasi — texnologiya, pedagogika va fan mazmuni — bir-biri bilan kesishgan nuqtada rivojlanishi lozimligini asoslagan [11]. Bu fikrdan biz quyidagi amaliy xulosani chiqaramiz: talabaga dasturning tugmalarini o‘rgatish yetarli emas, u dasturni muayyan mavzuda va muayyan o‘quv maqsadi yo‘lida ishlatib ko‘rishi kerak. Jumladan, “Kimyoviy bog‘lanish” mavzusida molekulaning hajmiy modelini yasash, “Reaksiya tezligi” mavzusida raqamli datchik bilan o‘lchash o‘tkazish mumkin. Har gal talaba o‘ziga bitta savol berishi shart deb o‘ylaymiz: bu vosita o‘quvchining tushunishiga nima qo‘shdi? Javob topilmasa, vosita dars uchun emas, ko‘rgazma uchun ishlatilgan bo‘ladi.

Refleksiv metodlar

D. Shyon mutaxassisning kasbiy o‘sishini uning ish jarayonida va ishdan keyin o‘z harakatlari ustida fikr yuritishi bilan izohlaydi [12]. Bunday odatni tarbiyalashda elektron portfolio, refleksiv kundalik, o‘z darsi yozuvini tahlil qilish va kursdoshlar

ishini o‘zaro baholash yordam beradi. Portfolioda dars ishlanmalari, tajriba videoyozuvlari, o‘quvchilar ishlaridan namunalar hamda ularning har biriga talabaning qisqacha sharhi jamlanadi. Biz sharhni portfolioning eng muhim qismi deb bilamiz: usiz portfolio shunchaki hujjatlar yig‘indisi bo‘lib qoladi, sharh bilan esa u talabaning yildan yilga qanday o‘sayotganini ko‘rsatuvchi oynaga aylanadi.

Ko‘rib chiqilgan metodlarning qaysi tarkibiy qismga ko‘proq ta’sir etishini biz 2-jadvalda umumlashtirdik.

2-jadval. Metodlarning kompetentlik tarkibiy qismlariga ta’siri (muallif ishlanmasi)

Metod	Ko‘proq ta’sir etadigan tarkibiy qism	Kimyo kursidan misol
Muammoli ta’lim	Fan, metodik	Alyuminiy nega havoda yemirilmasligi haqidagi savol
Bashorat — kuzatish — izohlash	Fan, eksperimental	Temirning mis(II) sulfat eritmasi bilan ta’sirlashuvi
Keys-stadi	Metodik, kommunikativ-tashkiliy	O‘quvchining qaynash hodisasini yanglish tushunishi
Loyiha metodi	Fan, eksperimental, kommunikativ-tashkiliy	Ichimlik suvi qattiqligini o‘rganish
Mikro-ta’lim	Metodik, refleksiv	“Mol” tushunchasini 10–15 daqiqada ochib berish
Dars tadqiqoti	Metodik, kommunikativ-tashkiliy, refleksiv	“Elektroliz” darsini jamoa bo‘lib rejalashtirish va takomillashtirish
Haqiqiy va virtual eksperiment	Eksperimental, raqamli	Kichik hajmli tajriba hamda molekula modeli

Metod	Ko‘proq ta’sir etadigan tarkibiy qism	Kimyo kursidan misol
Portfolio, refleksiv kundalik	Refleksiv	Amaliyotda o‘tilgan darslar yozuvini tahlil qilish

Metodlarni kurslar bo‘yicha taqsimlash va natijani baholash

Metodlarning ro‘yxatini bilish hali ularni to‘g‘ri qo‘llash degani emas. Birinchi kurs talabasidan dars tadqiqotini, bitiruvchidan esa faqat tayyor savollarga javob berishni talab qilish birdek samarasiz. Shu sababli biz metodlarni talabaning tayyorgarligi o‘sib borishiga mos ravishda to‘rt bosqichga joylashtirishni taklif etamiz.

1. **Motivatsion-yo‘naltiruvchi bosqich (1-kurs).** Bu davrda asosiy vazifa — talabada tanlagan kasbiga qiziqish uyg‘otish va kimyodan puxta zamin hozirlash. Umumiy hamda anorganik kimyo mashg‘ulotlariga muammoli savollar va “bashorat — kuzatish — izohlash” tartibi kiritiladi, talabalar maktabga borib dars kuzatadi.
2. **Nazariy-metodik bosqich (2-kurs).** Talaba o‘zlashtirgan kimyoviy bilimiga endi “buni qanday o‘rgataman?” degan ko‘z bilan qaray boshlaydi. Metodik keyslar yechiladi, maktab darsliklari tahlil qilinadi, o‘quvchilarning yanglish tasavvurlari o‘rganiladi, dastlabki mikro-ta’lim mashg‘ulotlari o‘tkaziladi.
3. **Amaliy-faoliyatli bosqich (3-kurs).** Metodik va eksperimental malakalar bevosita mashq qilinadi. Tasvirga olinadigan mikro-ta’lim, maktab kimyo eksperimenti praktikumi, loyiha ishlari va raqamli vositalarni darsga kiritish yetakchi o‘ringa chiqadi.
4. **Refleksiv-ijodiy bosqich (4-kurs).** Talaba mustaqil ish boshlashga tayyorlanadi. Pedagogik amaliyot dars tadqiqoti shaklida o‘tadi, portfolio himoya qilinadi, bitiruv malakaviy ishi doirasida kichik metodik izlanish bajariladi.

Bu taqsimot qat’iy chegara emas: masalan, muammoli savollar barcha kurslarda saqlanib qoladi. Bosqich nomi faqat o‘sha davrda qaysi metodlar yetakchi bo‘lishini bildiradi.

Erishilgan natijani aniqlash uchun biz uch darajani ajratamiz:

- **reproduktiv daraja** — talaba boshqalar tuzgan dars ishlanmasi va yo‘riqnomaga tayanadi, tajribani namunaga qarab takrorlaydi;
- **produktiv daraja** — mavjud materialni o‘z sinfi sharoitiga moslaydi, metodni maqsaddan kelib chiqib tanlaydi, o‘tgan darsini belgilangan mezonlar bo‘yicha tahlil qila oladi;
- **ijodiy daraja** — muammoli vaziyatlar, tajribalar va topshiriqlarni o‘zi yaratadi, o‘quvchilar ko‘rsatgan natijaga qarab darsni qaytadan tuzib chiqadi.

Fikrimizcha, darajani yagona o‘lchov vositasi bilan belgilab bo‘lmaydi, chunki har bir tarkibiy qism o‘ziga xos tarzda namoyon bo‘ladi. Fan qismini test va masalalar, metodik qismni dars ishlanmasini ekspert baholashi, eksperimental qismni amaliy sinov hamda kuzatuv varaqasi, refleksiv qismni portfolio va o‘z-o‘zini baholash so‘rovnomasi yordamida aniqlash o‘rinli. Yana bir shart: baholash mezonlari talabaga ish boshlanishidan avval e’lon qilinishi lozim. Shunda talaba nimaga intilishi kerakligini biladi va baholash nazorat vositasidan o‘rgatish vositasiga aylanadi.

Taklif etilayotgan metodlar o‘z-o‘zidan ishlab ketmaydi. Ularning samarasi, bizningcha, to‘rt shartga bog‘liq: kimyo fanlari va metodika kafedralari o‘qituvchilari bir-biri bilan kelishib ishlashi; oliy ta’lim muassasasi tayanch maktab bilan doimiy aloqada bo‘lishi; o‘quv laboratoriyasi maktabdagi jihozlarga yaqin bo‘lishi; talaba xato qilishdan cho‘chimaydigan va xatosini ochiq muhokama qila oladigan muhit yaratilishi.

Xulosa va tavsiyalar

Olib borilgan tahlil asosida biz quyidagi xulosalarga keldik.

1. Kimyo o‘qituvchisining kasbiy kompetentligi oltita — fan, metodik, eksperimental, raqamli, kommunikativ-tashkiliy va refleksiv — tarkibiy qismning birligidan iborat. Bu tuzilmaning markazida fan mazmunini o‘quvchi uchun tushunarli ko‘rinishga keltira olish layoqati turadi.
2. Barcha tarkibiy qismlarni bir xilda rivojlantiradigan universal metod mavjud emas. Muammoli va izlanishli ta’lim ko‘proq fan qismiga, keys-stadi bilan mikro-ta’lim metodik qismga, o‘quv eksperimenti eksperimental qismga, dars tadqiqoti va portfolio refleksiv qismga ta’sir ko‘rsatadi. Bundan metodlarni majmua holida qo‘llash zarurligi kelib chiqadi.
3. Metod tanlashda kimyo fanining o‘ziga xos tomonlari — bilimning uch qatlamliligi va tajribaning yetakchi o‘rni — bosh mezon bo‘lishi kerak. Umumiy pedagogik metod kimyo mazmuni bilan boyitilgan taqdirdagina bo‘lajak o‘qituvchini kasbga tayyorlaydi.
4. Metodlarni to‘rt bosqichda — motivatsion-yo‘naltiruvchi, nazariy-metodik, amaliy-faoliyatli va refleksiv-ijodiy bosqichlarda — izchil joriy etish talabaning tayyor namunaga ergashishdan mustaqil ijod qilish sari ko‘tarilishiga sharoit yaratadi.

Shu xulosalarga tayanib, biz quyidagilarni **tavsiya etamiz:**

- kimyo o‘qitish metodikasi fanida mikro-ta’limni tasvirga olib tahlil qilish bilan birga doimiy mashg‘ulot turiga aylantirish;
- maktab kimyo eksperimenti praktikumida talabaga tajribani uyushtiruvchi vazifasini yuklash, xavf tahlilini esa har bir ishning majburiy qismi qilish;
- pedagogik amaliyotni talabalar guruhi, metodist va maktab o‘qituvchisi hamkorligidagi dars tadqiqoti tarzida o‘tkazish;
- elektron portfolioni birinchi kursdan boshlab yuritish hamda yakuniy attestatsiyada uni inobatga olish;
- ushbu ishda taklif etilgan metodlar majmuasi samaradorligini navbatdagi bosqichda tajriba-sinov ishlari bilan tekshirib ko‘rish.

Foydalanilgan adabiyotlar

1. O‘zbekiston Respublikasining “Ta’lim to‘g‘risida”gi Qonuni. 2020-yil 23-sentabr, O‘RQ-637-son.
2. O‘zbekiston Respublikasi Prezidentining 2019-yil 8-oktabrdagi “O‘zbekiston Respublikasi oliy ta’lim tizimini 2030-yilgacha rivojlantirish konsepsiyasini tasdiqlash to‘g‘risida”gi PF-5847-son Farmoni.
3. O‘zbekiston Respublikasi Prezidentining 2020-yil 12-avgustdagi “Kimyo va biologiya yo‘nalishlarida uzluksiz ta’lim sifatini va ilm-fan natijadorligini oshirish chora-tadbirlari to‘g‘risida”gi PQ-4805-son Qarori.
4. Azizxo‘jayeva N.N. Pedagogik texnologiyalar va pedagogik mahorat. – Toshkent, 2006.
5. Muslimov N.A., Usmonboyeva M.H., Sayfurov D.M., To‘rayev A.B. Kasb ta’limi o‘qituvchilarining kasbiy kompetentligini shakllantirish texnologiyasi. – Toshkent: Fan va texnologiya, 2013.
6. Зимняя И.А. Ключевые компетенции – новая парадигма результата образования // Высшее образование сегодня. – 2003. – № 5. – С. 34–42.
7. Маркова А.К. Психология профессионализма. – Москва: Знание, 1996. – 308 с.
8. Shulman L.S. Those who understand: Knowledge growth in teaching // Educational Researcher. – 1986. – Vol. 15, No. 2. – P. 4–14.
9. Johnstone A.H. Why is science difficult to learn? Things are seldom what they seem // Journal of Computer Assisted Learning. – 1991. – Vol. 7, No. 2. – P. 75–83.
10. Hofstein A., Lunetta V.N. The laboratory in science education: Foundations for the twenty-first century // Science Education. – 2004. – Vol. 88, No. 1. – P. 28–54.
11. Mishra P., Koehler M.J. Technological pedagogical content knowledge: A framework for teacher knowledge // Teachers College Record. – 2006. – Vol. 108, No. 6. – P. 1017–1054.
12. Schön D.A. The Reflective Practitioner: How Professionals Think in Action. – New York: Basic Books, 1983.
13. Allen D., Ryan K. Microteaching. – Reading, MA: Addison-Wesley, 1969.
14. White R., Gunstone R. Probing Understanding. – London: Falmer Press, 1992.

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РАЗВИТИЕ МЕТОДИЧЕСКОЙ ГОТОВНОСТИ БУДУЩИХ УЧИТЕЛЕЙ МАТЕМАТИКИ К ИСПОЛЬЗОВАНИЮ ИНТЕРАКТИВНЫХ ЦИФРОВЫХ РЕСУРСОВ В ОБРАЗОВАТЕЛЬНОМ ПРОЦЕССЕ

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Аннотация

В статье анализируется проблема развития методической готовности будущих учителей математики к использованию интерактивных цифровых ресурсов в образовательном процессе. Рассматриваются педагогические возможности динамических математических моделей, электронных образовательных платформ, интерактивных заданий и цифровых средств обратной связи. Раскрываются основные направления совершенствования методической подготовки студентов педагогических образовательных организаций, включающие проектирование цифровых уроков, разработку заданий исследовательского характера, организацию самостоятельной работы и применение критериального оценивания. Обосновывается необходимость формирования у будущих педагогов способности выбирать цифровые инструменты с учётом целей обучения, содержания математического материала и познавательных потребностей учащихся. Предлагаются критерии оценки методической готовности студентов и направления дальнейшего исследования эффективности соответствующих педагогических решений.

Ключевые слова: методическая готовность, будущие учителя математики, интерактивные цифровые ресурсы, цифровая образовательная среда, математическое моделирование, самостоятельная работа, педагогическое проектирование, критериальное оценивание.

Введение. Современная система педагогического образования ориентирована на подготовку специалистов, способных обеспечивать качественное обучение в условиях расширения цифровой образовательной среды. В этой связи особую актуальность приобретает развитие методической готовности будущих учителей математики к использованию интерактивных цифровых ресурсов.

Методическая готовность педагога не ограничивается владением определёнными компьютерными программами или умением размещать учебные материалы на образовательной платформе. Она предполагает способность анализировать содержание учебной темы, определять дидактические задачи, подбирать соответствующие цифровые инструменты, проектировать учебные действия учащихся и оценивать достигнутые результаты.

Математика как учебная дисциплина обладает значительными возможностями для применения интерактивных технологий. Визуализация графиков, динамическое построение геометрических фигур, моделирование зависимостей и изменение математических параметров позволяют представить абстрактные закономерности в наглядной форме. Однако результативность таких средств зависит от того, насколько последовательно они включены в структуру учебного занятия.

В отчёте UNESCO по мониторингу образования за 2023 год подчёркивается, что использование технологий должно определяться образовательными потребностями, обоснованностью применения и доступностью соответствующих ресурсов. Следовательно, цифровизация математического образования требует не механического внедрения новых инструментов, а совершенствования методической подготовки педагогов.

Цель настоящей статьи заключается в теоретическом обосновании направлений развития методической готовности будущих учителей математики к проектированию и использованию интерактивных цифровых ресурсов.

Материалы и методы исследования. Исследование основывается на компетентностном, деятельностном и системном подходах к профессиональной подготовке будущего учителя. При разработке методических положений учитывается необходимость интеграции математического содержания, педагогических технологий и цифровых средств обучения.

Основными методами теоретического исследования выступают анализ научно-педагогической литературы, обобщение методических подходов, классификация цифровых образовательных ресурсов и педагогическое моделирование. Для последующей практической проверки предложенных положений могут применяться наблюдение, анкетирование, экспертная оценка разработанных студентами учебных материалов и анализ результатов выполнения методических заданий.

Теоретическая модель, представленная в статье, предполагает последовательный переход от освоения цифровых инструментов к их самостоятельному применению при решении профессиональных педагогических задач.

Результаты и обсуждение. Методическая готовность будущего учителя математики формируется в процессе взаимодействия нескольких составляющих профессиональной подготовки. К ним относятся знание предмета, понимание закономерностей обучения, владение методами организации познавательной деятельности и способность использовать цифровые ресурсы для достижения конкретных образовательных результатов.

Одним из важных направлений развития методической готовности является освоение принципов педагогически обоснованного выбора цифровых инструментов. При подготовке будущего учителя необходимо учитывать, что один и тот же ресурс может быть полезен для решения различных задач, но его

применение должно соответствовать содержанию учебной темы и уровню подготовленности учащихся.

Например, при изучении функций интерактивная визуализация позволяет исследовать изменение графика в зависимости от параметров выражения. При изучении геометрии динамические модели помогают устанавливать взаимосвязи между элементами фигур, проверять предположения и формулировать выводы. При решении прикладных задач электронные таблицы могут использоваться для обработки данных, анализа зависимостей и построения математических моделей.

Таким образом, цифровой ресурс становится средством развития математического мышления тогда, когда учащийся не только наблюдает готовую визуализацию, но и выполняет осмысленные действия: изменяет параметры, сравнивает результаты, выдвигает гипотезы, проверяет их и аргументирует полученные выводы.

Для систематизации процесса подготовки студентов целесообразно выделить четыре взаимосвязанных направления.

Первое направление — информационно-аналитическая подготовка. Оно предусматривает формирование у студентов умений находить, анализировать и отбирать электронные образовательные материалы. Будущий педагог должен оценивать достоверность математической информации, соответствие ресурса учебным целям, удобство использования и возможность адаптации материалов к конкретным образовательным условиям.

Второе направление — методическое проектирование. На данном этапе студенты учатся разрабатывать структуру цифрового урока, определять последовательность учебных действий, подбирать интерактивные задания и устанавливать критерии оценки. Особое внимание уделяется согласованию цифровых средств с содержанием математической темы и планируемыми результатами обучения.

Третье направление — практическое применение цифровых ресурсов. Оно включает создание электронных упражнений, разработку математических моделей, подготовку интерактивных презентаций и организацию самостоятельной работы. Студенты должны уметь применять цифровые средства как для объяснения нового материала, так и для закрепления знаний, проверки гипотез и анализа ошибок.

Четвёртое направление — рефлексивно-корректирующая деятельность. Оно предполагает анализ результатов использования цифровых материалов, выявление затруднений учащихся и корректировку методических решений. Важную роль играют самооценка студента, экспертное обсуждение разработанных материалов и обоснование выбранных способов обучения.

Реализация указанных направлений может осуществляться посредством практико-ориентированных заданий. Например, студентам предлагается разработать электронный учебный модуль по определённой теме школьного

курса математики. Модуль должен включать краткое объяснение теоретического материала, визуальный или интерактивный элемент, систему заданий различного уровня сложности и инструмент проверки результатов.

При выполнении задания студент обосновывает выбор цифрового ресурса, формулирует ожидаемые результаты, определяет порядок самостоятельной работы учащихся и разрабатывает критерии оценивания. В результате формируется не только техническое умение использовать электронные инструменты, но и способность самостоятельно проектировать методическое обеспечение учебного процесса.

Особое значение имеет организация самостоятельной деятельности будущих учителей. Выполнение индивидуальных и групповых проектов позволяет студентам проявлять инициативу, искать альтернативные решения и развивать навыки педагогического взаимодействия. При этом преподаватель выполняет функцию консультанта, направляя деятельность студентов и обеспечивая содержательную обратную связь.

Для оценки методической готовности будущих учителей математики предлагается использовать следующие критерии.

Мотивационно-ценностный критерий характеризует интерес к применению цифровых ресурсов, понимание их педагогического назначения и готовность к профессиональному саморазвитию.

Содержательно-когнитивный критерий отражает уровень математических знаний, понимание дидактических возможностей цифровых инструментов и способность устанавливать связь между содержанием учебного материала и средствами его представления.

Практико-методический критерий показывает умение проектировать цифровые учебные материалы, разрабатывать интерактивные задания, организовывать самостоятельную работу и применять критерии оценивания.

Рефлексивно-оценочный критерий характеризует способность анализировать результаты собственной деятельности, выявлять методические недостатки и совершенствовать разработанные материалы.

Для каждого критерия необходимо определить наблюдаемые показатели и диагностические задания. По совокупности полученных данных могут выделяться высокий, средний и низкий уровни методической готовности. Высокий уровень предполагает самостоятельное и обоснованное проектирование цифрового обучения; средний — выполнение основных методических действий при частичной поддержке преподавателя; низкий — затруднения при выборе ресурсов и их включении в учебный процесс.

Предложенная система критериев может использоваться для организации входной и итоговой диагностики. При проведении педагогического эксперимента важно обеспечить единые условия оценивания, сопоставимость диагностических материалов и прозрачность требований к выполнению заданий.

Следует также учитывать ограничения цифрового обучения. К ним относятся различия в технической оснащённости образовательных организаций, неодинаковый уровень цифровой грамотности студентов, доступность программного обеспечения и риск подмены содержательной математической деятельности демонстрацией готовых решений. Поэтому цифровые инструменты необходимо сочетать с устным объяснением, письменными вычислениями, обсуждением математических доказательств и традиционными формами самостоятельной работы.

Методически грамотное сочетание цифровых и традиционных средств позволяет создавать условия для осмысленного освоения математического содержания и формирования устойчивых профессиональных умений будущего педагога.

Заключение. Развитие методической готовности будущих учителей математики к использованию интерактивных цифровых ресурсов является важным направлением совершенствования педагогического образования. Данная готовность формируется не только посредством освоения цифровых инструментов, но и через развитие способности обоснованно выбирать их, проектировать учебные задания и оценивать педагогические результаты.

Основными направлениями совершенствования методической подготовки выступают информационно-аналитическая деятельность, проектирование цифровых учебных материалов, практическое применение интерактивных ресурсов и рефлексивная корректировка педагогических решений. Их последовательная реализация обеспечивает взаимосвязь предметной подготовки студентов с реальными задачами будущей профессиональной деятельности.

Перспективным направлением дальнейшего исследования является экспериментальная проверка предложенной системы критериев и показателей, а также выявление условий, при которых интерактивные цифровые ресурсы способствуют повышению качества математической подготовки и профессиональной самостоятельности будущих учителей.

Список использованной литературы

1. Полат Е. С., Бухаркина М. Ю. Современные педагогические и информационные технологии в системе образования. — Москва: Академия, 2010.
2. Роберт И. В. Теория и методика информатизации образования (психолого-педагогический и технологический аспекты). — Москва: БИНОМ. Лаборатория знаний, 2014.
3. UNESCO. Global Education Monitoring Report 2023: Technology in Education: A Tool on Whose Terms? — Paris: UNESCO, 2023.
4. Mishra P., Koehler M. J. Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge // *Teachers College Record*. — 2006. — Vol. 108, No. 6. — P. 1017–1054. DOI: 10.1111/j.1467-9620.2006.00684.x.

5. Koehler M. J., Mishra P. What Is Technological Pedagogical Content Knowledge (TPACK)? // *Contemporary Issues in Technology and Teacher Education*. — 2009. — Vol. 9, No. 1. — P. 60–70.

6. Mayer R. E. Multimedia Learning. — 2nd ed. — Cambridge: Cambridge University Press, 2009.

SARMOYA KIRITISH, RENTABELLILIK, LIKVIDLIK VA INFLYATSIYA O‘ZGARISHINING JAMG‘ARMA BALANSIGA TA’SIRI

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Annotatsiya. Mazkur maqolada sarmoya kiritish jarayonining iqtisodiy mohiyati, rentabellik va likvidlik ko‘rsatkichlarining ahamiyati hamda inflyatsiya darajasidagi o‘zgarishlarning jamg‘arma balansiga ta’siri yoritilgan. Shuningdek, jamg‘armalarni samarali boshqarish, investitsion qarorlar qabul qilish va moliyaviy barqarorlikni ta’minlash masalalari tahlil qilingan. Maqolada nominal va real daromadlilik o‘rtasidagi farq, moliyaviy aktivlarning likvidligi hamda inflyatsiya sharoitida jamg‘armalarning xarid qobiliyatini saqlash usullari ko‘rib chiqilgan. Tadqiqot natijalari jamg‘armalarni boshqarishda daromadlilik, likvidlik va inflyatsiya omillarini birgalikda hisobga olish zarurligini ko‘rsatadi.

Kalit so‘zlar: sarmoya, investitsiya, jamg‘arma, rentabellik, likvidlik, inflyatsiya, moliyaviy balans, daromadlilik, xarid qobiliyati, moliyaviy barqarorlik.

Kirish. Bugungi kunda iqtisodiyotning barqaror rivojlanishi, aholi farovonligining oshishi va korxonalar faoliyatining samaradorligini ta’minlashda jamg‘armalar hamda investitsiyalar muhim o‘rin tutadi. Moliyaviy resurslarni to‘g‘ri taqsimlash, mavjud mablag‘lardan samarali foydalanish va kelajakdagi moliyaviy ehtiyojlarni hisobga olish har bir iqtisodiy subyekt uchun dolzarb vazifalardan hisoblanadi.

Jamg‘arma — bu daromadning iste’mol uchun sarflanmagan va kelajakda foydalanish maqsadida saqlab qo‘yilgan qismidir. Jamg‘armalar nafaqat kutilmagan xarajatlarni qoplash, balki uzoq muddatli moliyaviy maqsadlarga erishish uchun ham xizmat qiladi. Biroq mablag‘larni shunchaki saqlash har doim ham ularning qiymatini saqlab qolishni anglatmaydi. Inflyatsiya, moliyaviy bozorlarning o‘zgarishi va investitsiya vositalarining xususiyatlari jamg‘armalarning haqiqiy qiymatiga sezilarli ta’sir ko‘rsatishi mumkin.

Shu sababli sarmoya kiritish, rentabellik, likvidlik va inflyatsiya o‘rtasidagi bog‘liqlikni o‘rganish jamg‘arma balansini samarali boshqarishning muhim shartidir.

1. Sarmoya kiritishning iqtisodiy mohiyati va jamg‘arma balansiga ta’siri

Sarmoya kiritish yoki investitsiya — mavjud moliyaviy resurslarni kelajakda daromad olish yoki iqtisodiy foyda ko‘rish maqsadida turli aktivlarga yo‘naltirish jarayonidir. Investitsiyalar bank omonatlari, aksiyalar, obligatsiyalar, ko‘chmas mulk, ishlab chiqarish vositalari va boshqa moliyaviy yoki real aktivlar shaklida amalga oshirilishi mumkin.

Sarmoya kiritishning asosiy maqsadi mavjud mablag‘larni ko‘paytirish, kapitalni saqlash va kelajakdagi moliyaviy imkoniyatlarni kengaytirishdan iborat. Masalan, jismoniy shaxs o‘z daromadining bir qismini bank omonatiga joylashtirishi yoki tadbirkor ishlab chiqarishni rivojlantirish uchun yangi uskunalar sotib olishi mumkin.

Sarmoya kiritish jamg‘arma balansiga bir necha yo‘nalishda ta’sir ko‘rsatadi:
- Jamg‘arma hajmining oshishi. Daromad keltiruvchi aktivlarga yo‘naltirilgan mablag‘lar foizlar, dividendlar yoki boshqa daromadlar hisobiga ko‘payishi mumkin.
- Moliyaviy resurslarning samarali taqsimlanishi. Mablag‘larni turli aktivlarga joylashtirish orqali moliyaviy imkoniyatlardan oqilona foydalanish mumkin.
- Kapitalning uzoq muddatli o‘sishi. Daromadni qayta investitsiya qilish murakkab foiz mexanizmi orqali jamg‘arma hajmining ortishiga yordam beradi.
- Moliyaviy xavfning yuzaga kelishi. Ayrim investitsiyalar yuqori daromad keltirishi mumkin, biroq ular kapitalning qisman yoki to‘liq yo‘qotilishi xavfini ham o‘z ichiga oladi.

Investitsiya qarorlarini qabul qilishda mablag‘ning qancha muddatga yo‘naltirilishi, kutilayotgan daromad, xavf darajasi va mablag‘ga qayta ehtiyoj tug‘ilish ehtimoli hisobga olinishi lozim.

Shuningdek, barcha jamg‘armalarni bitta investitsiya vositasiga yo‘naltirish maqsadga muvofiq emas. Moliyaviy resurslarni turli aktivlar o‘rtasida taqsimlash investitsion xavflarni kamaytirishga yordam berishi mumkin.

2. Rentabellik va uning jamg‘arma balansiga ta’siri. Rentabellik — investitsiya yoki xo‘jalik faoliyati natijasida sarflangan kapitalga nisbatan olingan foydani ifodalovchi iqtisodiy ko‘rsatkichdir. U investitsiya samaradorligini baholashda muhim ahamiyatga ega.

Rentabellikni umumiy ko‘rinishda quyidagi formula orqali hisoblash mumkin:

Rentabellik = (Olingan foyda / Investitsiya miqdori) × 100%.

Masalan, investor 10 000 000 so‘m mablag‘ni ma’lum bir moliyaviy vositaga joylashtirdi va bir yil davomida 1 500 000 so‘m daromad oldi. Boshqa xarajatlar va soliqlar hisobga olinmaganda, investitsiyaning daromadliligi quyidagicha bo‘ladi:

Rentabellik = (1 500 000 / 10 000 000) × 100% = 15%.

Demak, investitsiya bo‘yicha yillik daromadlilik 15 foizni tashkil etadi.

Rentabellik jamg‘arma balansiga bevosita ta’sir ko‘rsatadi. Daromadlilik yuqori bo‘lsa, boshqa shartlar teng bo‘lganida, jamg‘arma hajmining tezroq o‘sishi mumkin. Biroq yuqori daromadlilik har doim ham yuqori moliyaviy xavfsizlikni anglatmaydi. Ayrim hollarda yuqori foyda olish imkoniyati katta xavf bilan bog‘liq bo‘ladi.

Shu sababli investitsiyalarni baholashda nafaqat kutilayotgan daromad, balki uning barqarorligi, investitsiya muddati va mablag‘ni yo‘qotish ehtimoli ham hisobga olinishi kerak. Bundan tashqari, nominal daromadlilik bilan real daromadlilikni farqlash muhimdir. Nominal daromadlilik investitsiyadan olingan foizli daromadni ifodalasa, real daromadlilik inflyatsiya ta’siri hisobga olinganidan keyingi daromadni ko‘rsatadi.

Real daromadlilikni taxminiy hisoblash formulasi quyidagicha:

Real daromadlilik ≈ Nominal daromadlilik − Inflyatsiya darajasi.

Aniqroq hisoblash uchun quyidagi formuladan foydalaniladi:

Real daromadlilik = [(1 + nominal daromadlilik) / (1 + inflyatsiya darajasi) − 1] × 100%.

Masalan, investitsiyaning nominal daromadliligi 15 foiz, yillik inflyatsiya esa 10 foiz bo‘lsa, real daromadlilik taxminan 4,55 foizni tashkil etadi.

Bu misol nominal daromadning o‘zi jamg‘armaning haqiqiy iqtisodiy qiymati qay darajada oshganini to‘liq ko‘rsatmasligini anglatadi.

3. Likvidlik va uning moliyaviy barqarorlikdagi o‘rni. Likvidlik — aktivni qisqa vaqt ichida, uning qiymatini sezilarli darajada yo‘qotmasdan, pul mablag‘lariga aylantirish imkoniyatidir. Likvidlik darajasi moliyaviy resurslardan qanchalik tez va qulay foydalanish mumkinligini belgilaydi.

Masalan, naqd pul va talab qilib olinguncha saqlanadigan bank hisobvaraqlaridagi mablag‘lar odatda yuqori likvidlikka ega. Ko‘chmas mulk esa sotish uchun vaqt talab qilishi va bozor sharoitiga qarab narxi o‘zgarishi sababli nisbatan past likvidli aktiv hisoblanadi.

Likvidlikning jamg‘arma balansiga ta’siri quyidagi jihatlarda namoyon bo‘ladi.

Birinchidan, likvid mablag‘lar kutilmagan xarajatlarni qoplash imkonini beradi. Masalan, sog‘liq bilan bog‘liq xarajatlar, ish faoliyatidagi uzilishlar yoki oilaviy ehtiyojlar yuzaga kelganda tez foydalanish mumkin bo‘lgan mablag‘lar moliyaviy barqarorlikni saqlashga yordam beradi.

Ikkinchidan, likvidlik investitsion qarorlarning moslashuvchanligini oshiradi. Zarurat tug‘ilganda mablag‘larni tezda boshqa yo‘nalishga o‘tkazish imkoniyati paydo bo‘ladi.

Uchinchidan, likvidlik va rentabellik o‘rtasida muayyan muvozanat mavjud. Yuqori likvidli vositalar mablag‘dan tez foydalanish imkonini beradi, biroq ularning daromadliligi ayrim uzoq muddatli investitsiyalarga nisbatan pastroq bo‘lishi mumkin. Shu bilan birga, bu holat barcha moliyaviy vositalar uchun bir xil emas.

Shuning uchun jamg‘armalarni boshqarishda mablag‘larning bir qismini tez foydalanish mumkin bo‘lgan shaklda saqlash, qolgan qismini esa moliyaviy maqsadlar va xavf darajasiga mos investitsiya vositalariga yo‘naltirish maqsadga muvofiq.

Bunday yondashuv daromad olish imkoniyatini saqlab qolgan holda, kundalik moliyaviy ehtiyojlarni qondirishga yordam beradi.

4. Inflyatsiya o‘zgarishining jamg‘arma balansiga ta’siri. Inflyatsiya — iqtisodiyotda tovarlar va xizmatlarning umumiy narxlar darajasi oshishi natijasida pulning xarid qobiliyati pasayishidir. Inflyatsiya jamg‘armalarning nominal miqdoriga bevosita ta’sir qilmasligi mumkin, biroq ularning real qiymatini kamaytiradi. Masalan, shaxs bank hisobvarag‘ida 10 000 000 so‘m mablag‘ saqlayotgan bo‘lsin. Agar bir yil davomida bu mablag‘ga daromad hisoblanmasa va narxlar darajasi 10 foizga oshsa, uning xarid qobiliyati dastlabki davrga nisbatan kamayadi. Boshqacha aytganda, hisobvaraqdagi pul miqdori o‘zgarmagan bo‘lsa ham, ushbu pulga sotib olish mumkin bo‘lgan tovar va xizmatlar miqdori qisqaradi.

Inflyatsiyaning jamg‘armalarga ta’siri bir necha omilga bog‘liq:

1. Jamg‘armaning daromadlilik darajasi. Agar jamg‘arma bo‘yicha olinadigan daromad inflyatsiya darajasidan past bo‘lsa, uning real qiymati kamayishi mumkin.

2. Jamg‘armaning saqlanish shakli. Naqd pul shaklida yoki daromad keltirmaydigan hisobda saqlanayotgan mablag‘lar inflyatsiya ta’siriga ko‘proq duch kelishi mumkin.
3. Investitsiya muddati. Inflyatsiyaning uzoq muddat davom etishi jamg‘armalarning xarid qobiliyatiga sezilarli ta’sir ko‘rsatishi mumkin.
4. Iste’mol xarajatlarining tarkibi. Har bir oilaning xarajatlari turlicha bo‘lgani sababli uning shaxsiy inflyatsiya darajasi umumiy inflyatsiya ko‘rsatkichidan farq qilishi mumkin.

Inflyatsiya ta’sirini kamaytirish uchun daromadlilik, xavf va likvidlik jihatidan mos keladigan moliyaviy vositalarni tanlash muhimdir. Bunda bank omonatlari, davlat yoki korporativ obligatsiyalar, diversifikatsiyalangan investitsiyalar va boshqa aktivlar ko‘rib chiqilishi mumkin. Biroq ularning har biri o‘ziga xos xavf va cheklovlarga ega.

Shuni ta’kidlash kerakki, inflyatsiyadan himoyalanish maqsadida investitsiya qilish har doim ham ijobiy natijani kafolatlamaydi. Investitsiya vositasini tanlashda uning shartlari, xarajatlari, soliqlari va ehtimoliy qiymat o‘zgarishlari hisobga olinishi lozim.

5. Rentabellik, likvidlik va inflyatsiyaning o‘zaro bog‘liqligi

Jamg‘arma balansini samarali boshqarishda rentabellik, likvidlik va inflyatsiyani alohida emas, balki o‘zaro bog‘liq omillar sifatida baholash zarur.

Rentabellik mablag‘larning o‘sish imkoniyatini ko‘rsatsa, likvidlik ulardan qanchalik tez foydalanish mumkinligini belgilaydi. Inflyatsiya esa olingan daromadning haqiqiy xarid qobiliyatiga qanday ta’sir ko‘rsatishini aniqlashga yordam beradi.

Ushbu omillar o‘rtasidagi munosabatni quyidagi jadval orqali ifodalash mumkin.

Omil | Ijobiy ta’siri | Salbiy ta’siri yoki xavfi
Sarmoya kiritish | Kapitalni ko‘paytirish va qo‘shimcha daromad olish imkoniyati | Investitsiya qiymatining pasayishi va kapitalni yo‘qotish xavfi |
Rentabellik | Jamg‘arma hajmining o‘sishiga yordam beradi | Yuqori daromad ortida yuqori xavf bo‘lishi mumkin |
Likvidlik | Mablag‘lardan tez foydalanish imkonini beradi | Ayrim yuqori likvidli vositalar past daromad keltirishi mumkin |
Inflyatsiya | Inflyatsiya darajasiga mos yoki undan yuqori daromadli aktivlarni tanlash zaruratini yuzaga keltiradi | Jamg‘armaning real xarid qobiliyatini pasaytiradi |

Jadvaldan ko‘rinib turibdiki, jamg‘armalarni boshqarishda faqat bitta ko‘rsatkichga e’tibor qaratish yetarli emas. Masalan, yuqori rentabellik taklif qiluvchi, ammo uzoq muddat davomida mablag‘ni yechib olish imkonini bermaydigan vosita qisqa muddatli

moliyaviy ehtiyojlar uchun mos kelmasligi mumkin.Xuddi shuningdek, barcha mablag‘larni yuqori likvidli, ammo daromadliligi past vositalarda saqlash uzoq muddatda inflyatsiya ta’sirini to‘liq qoplamasligi mumkin.
Demak, samarali moliyaviy boshqaruv ushbu omillar o‘rtasidagi muvozanatni ta’minlashga asoslanadi.

6. Jamg‘arma balansini samarali boshqarish yo‘llari. Jamg‘arma balansini samarali boshqarish uchun bir qator amaliy choralarni qo‘llash mumkin.
Birinchidan, moliyaviy maqsadlarni belgilash. Jamg‘armaning qanday maqsad uchun shakllantirilayotgani aniqlanishi kerak. Qisqa muddatli xarajatlar uchun mo‘ljallangan mablag‘lar bilan uzoq muddatli investitsiyalarni boshqarish usullari bir-biridan farq qiladi. Ikkinchidan, daromad va xarajatlarni rejalashtirish. Oylik daromadlar, majburiy xarajatlar va jamg‘arish uchun ajratiladigan mablag‘lar muntazam nazorat qilinishi lozim. Bu ortiqcha xarajatlarni kamaytirishga va jamg‘arma hajmini izchil oshirishga yordam beradi. Uchinchidan, favqulodda vaziyatlar uchun zaxira yaratish. Kutilmagan xarajatlarni qoplash maqsadida tez foydalanish mumkin bo‘lgan mablag‘larni shakllantirish muhimdir. Zaxira miqdori shaxsning daromadi, majburiyatlari va moliyaviy sharoitiga qarab belgilanadi. To‘rtinchidan, investitsiyalarni diversifikatsiya qilish. Mablag‘larni turli aktivlar va moliyaviy vositalar o‘rtasida taqsimlash ayrim xavflarning ta’sirini kamaytirishi mumkin. Bunda aktivlarning bir-biriga bog‘liqligi va umumiy xavf darajasi ham hisobga olinadi. Beshinchidan, real daromadlilikni hisoblash. Investitsiya samaradorligini baholashda nominal foiz bilan cheklanmasdan, inflyatsiya va tegishli xarajatlarni hisobga olish zarur. Oltinchidan, moliyaviy holatni muntazam tahlil qilish. Daromadlar, xarajatlar, qarzlar va aktivlar holatini davriy ravishda ko‘rib chiqish jamg‘arma balansidagi o‘zgarishlarni aniqlashga yordam beradi. Mazkur choralarning izchil amalga oshirilishi moliyaviy intizomni mustahkamlaydi va jamg‘armalardan oqilona foydalanishga xizmat qiladi.

Xulosa. Xulosa qilib aytganda, sarmoya kiritish, rentabellik, likvidlik va inflyatsiya jamg‘arma balansining shakllanishi hamda o‘zgarishiga ta’sir ko‘rsatuvchi muhim iqtisodiy omillardir. Ularning har biri moliyaviy resurslarni boshqarishda o‘ziga xos vazifani bajaradi. Sarmoya kiritish mavjud mablag‘larni ko‘paytirish imkonini yaratadi. Rentabellik investitsiya samaradorligini baholashga yordam beradi. Likvidlik moliyaviy

resurslardan zarur vaqtda foydalanish imkoniyatini ta’minlaydi. Inflyatsiya esa jamg‘armalarning real qiymati va xarid qobiliyatiga ta’sir ko‘rsatadi.

Shu sababli jamg‘armalarni samarali boshqarish uchun daromadlilik, likvidlik va xavfsizlik o‘rtasida oqilona muvozanatni shakllantirish lozim. Bunda moliyaviy maqsadlarni aniq belgilash, daromad va xarajatlarni rejalashtirish, investitsiyalarni diversifikatsiya qilish hamda real daromadlilikni hisobga olish alohida ahamiyatga ega. Umuman olganda, moliyaviy savodxonlikni oshirish va iqtisodiy omillarni muntazam tahlil qilish shaxsiy hamda korporativ jamg‘armalarning barqarorligini mustahkamlashga xizmat qiladi. To‘g‘ri rejalashtirilgan jamg‘arma va puxta o‘ylangan investitsion qarorlar uzoq muddatli moliyaviy barqarorlikka erishishning muhim omillaridan biri hisoblanadi.

Foydalanilgan adabiyotlar:

1. Mankiw, N. G. Principles of Economics. Cengage Learning.
2. Mishkin, F. S. The Economics of Money, Banking, and Financial Markets. Pearson.
3. Bodie, Z., Kane, A., Marcus, A. J. Investments. McGraw-Hill Education.
4. Samuelson, P. A., Nordhaus, W. D. Economics. McGraw-Hill.
5. O‘zbekiston Respublikasi Markaziy bankining rasmiy materiallari va iqtisodiy sharhlari.
6. O‘zbekiston Respublikasi Milliy statistika qo‘mitasining inflyatsiya va iste’mol narxlari indeksiga oid statistik ma’lumotlari.

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VAGINAL MICROBIOME DYSBIOSIS AND RECURRENT BACTERIAL VAGINOSIS: BIOFILM ECOLOGY, CLINICAL EVIDENCE, REAL-WORLD ANALYTICS AND PRECISION PREVENTION

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Abstract

Background: Recurrent bacterial vaginosis (BV) constitutes a persistent clinical challenge in which temporary symptom resolution after antimicrobial therapy frequently fails to produce durable microbial recovery. Its pathobiology involves loss of protective lactic-acid-producing vaginal communities, expansion of diverse anaerobic organisms, surface-associated polymicrobial structures, host–microbe interactions, and sexual exchange of BV-associated bacteria. Objective: To critically synthesize microbiological and clinical evidence explaining recurrence, compare conventional and emerging prevention strategies, and assess the role of real-world evidence (RWE) and computational methods. Methods: This structured critical narrative review integrated identifiable clinical trials, peer-reviewed syntheses, public guidance, and regulatory sources available through October 2026. The manuscript does not claim a prospectively registered systematic search, individual-patient access, or de novo meta-analysis. Evidence quality, definitions of recurrence, selection processes, and transportability were evaluated qualitatively. Results: In a randomized phase 2b trial involving 228 women, vaginal Lactobacillus crispatus CTV-05 after metronidazole was associated with recurrence by week 12 in 30% versus 45% receiving placebo (risk ratio 0.66; 95% confidence interval 0.44–0.87). A 2025 randomized partner-treatment trial added substantive evidence that sexual-partner reservoirs can contribute to recurrence in selected heterosexual couples. Established CDC treatment guidance supports nitroimidazole- or clindamycin-based regimens and recognizes options for multiple recurrences, while emerging microbiome restoration and antibiofilm interventions require context-specific appraisal of regulatory status and evidence strength. Real-world data from electronic clinical records, prescriptions, laboratories, microbiome profiles and longitudinal patient reports may reveal heterogeneous treatment response, adherence barriers and safety patterns.

However, incomplete symptom ascertainment, confounding and compositional sequencing artifacts can strongly bias estimates. Conclusions: Recurrent BV is better understood as an ecological and relational syndrome than an isolated episode of growth by a single bacterial species. Durable prevention requires accurate diagnostic phenotyping, attention to biofilm persistence, evidence-based therapy, selected partner-related strategies and rigorous study of microbiome restoration. AI-enabled prediction and precision interventions should not displace validated clinical assessment before prospective and external validation.

Keywords

bacterial vaginosis; recurrent bacterial vaginosis; vaginal dysbiosis; vaginal microbiome; Gardnerella; Fannyhessea vaginae; Lactobacillus crispatus; polymicrobial biofilm; metronidazole; Lactin-V; partner treatment; real-world evidence; machine learning; antimicrobial stewardship

Abstract (English: complementary clinical summary)

Clinical framing: Recurrence of bacterial vaginosis after antimicrobial therapy is not necessarily evidence of individual nonadherence or failure by one specific antibiotic. A subset of women experience persistent ecological vulnerability characterized by reduced protective lactobacilli, complex anaerobic populations and microbial exchanges that may occur within intimate partnerships. Existing diagnostic methods remain essential to distinguish symptomatic BV from other causes of discharge. Evidence framing: The 2020 randomized Lactin-V trial provides intervention-specific proof of principle for restoration with a defined Lactobacillus crispatus strain, while a 2025 randomized trial supports a role for male-partner treatment in a selected clinical population. Both require attention to treatment eligibility and implementation constraints. Data-science framing: Observational data and predictive models can aid understanding of repeated clinical episodes but are vulnerable to confounding, misdiagnosis, technical batch effects, informative follow-up and overfitting. Implementation framing: Reliable episode tracking, diagnostic verification, patient-reported outcomes and appropriate antimicrobial stewardship should precede any deployment of artificial-intelligence-guided decisions. The conclusions are based on source-level critical synthesis, not on newly collected clinical data. No unreported sample, effect estimate, or statistically significant finding is created in this manuscript.

Keywords (English)

The preceding keyword set is presented in English.

1. Introduction

The healthy vaginal environment is not microbiologically sterile. In many reproductive-age women it is characterized by communities enriched for lactic-acid-producing lactobacilli, yet there is substantial biological variation across individuals, menstrual phases, hormonal states and populations. A composition dominated by Lactobacillus crispatus is frequently associated with a comparatively stable, low-pH environment, whereas communities with greater anaerobic diversity are linked to bacterial vaginosis (BV) and other reproductive-health outcomes. The causal significance of any single detected organism, however, must be judged within its broader ecological and clinical setting. DNA detection is not synonymous with microbial viability, metabolic activity or disease.

BV is a clinical syndrome defined by characteristic vaginal discharge, odor and microbiological changes rather than a disease caused by one universally sufficient pathogen. In recurrent disease, the principal challenge is not only the initial suppression of associated anaerobes, but also restoration of a resilient microbial community and reduction of processes that repeatedly destabilize it. Gardnerella species, Fannyhessea vaginae (formerly Atopobium vaginae), Prevotella species and other BV-associated bacteria often coexist in surface-associated communities. Their ecological interactions may influence adherence to epithelium, production of enzymes, metabolite exchange, immune recognition and treatment failure. The field has therefore shifted from the simplistic concept of an infection 'eradicated' by one antibiotic course toward longitudinal microbial ecology.

Recurrence has operational definitions that vary substantially across trials and clinical services. A commonly used research definition is three or more symptomatic episodes requiring treatment in twelve months, while refractory BV describes failure to achieve satisfactory clinical or microbiological resolution following a standard course. These entities should not be treated as interchangeable. Clinical recurrence after an apparently successful regimen may arise from residual organisms protected in an adherent community, re-expansion of anaerobes following failure to re-establish lactobacilli, renewed microbial exchange between sexual partners, or a combination of these processes. Accordingly, cross-study comparison requires common definitions

for baseline cure, time to recurrence, microbiological thresholds and symptom-based endpoints [1,2].

Real-world data (RWD) are information routinely collected during delivery of healthcare or through related sources, such as electronic records, prescription dispensing, laboratory information systems, registries and patient-generated digital reports. Real-world evidence (RWE) consists of clinically interpretable evidence about use, benefits or harms derived from the analysis of such data. RWD are the raw materials; RWE is an inferential product whose trustworthiness depends on data provenance, explicit clinical questions, valid designs and bias control. Longitudinal recurrence is particularly suited to thoughtful RWD research because repeated episodes, discontinuation, follow-up losses and care across institutions are often insufficiently captured in traditional efficacy trials [7,8].

Randomized controlled trials (RCTs) reduce baseline confounding through assignment of interventions, enabling a more defensible interpretation of efficacy under a defined protocol. Routine clinical care yields effectiveness information under real adherence, access, co-medication and patient-preference constraints. The two types of evidence are complementary rather than competing hierarchies: an RCT may establish a treatment effect for eligible participants, and a carefully designed real-world study may characterize transportability, uncommon adverse events or durability in the broader population. Yet observational comparisons cannot automatically be interpreted causally. Severity-driven prescribing, recurrent exposure, unmeasured sexual practices and differential follow-up can generate very convincing but misleading associations.

Regulatory science increasingly recognizes the qualified use of RWE. FDA guidance specifies issues in using clinical-care data for regulatory decisions, while the European Medicines Agency has developed network-based evidence generation, including DARWIN EU. Neither agency asserts that routine databases are inherently reliable, nor that predictive AI creates causal evidence. The World Health Organization emphasizes governance, equity, evaluation and accountability in health AI. In a sensitive domain such as vaginal symptoms and sexual health, stigma, intimate information, consent, representativeness and cybersecurity are not peripheral design issues but determine whether an intervention is ethical and useful.

AI has potential roles in reading microscopy images, integrating molecular profiles with clinical symptoms, detecting misclassification in documentation, forecasting recurrence and identifying possible adverse reactions after antimicrobial use. However, models trained at high-prevalence referral clinics can overestimate risk in primary care, and sequencing models can learn laboratory batch signatures instead of biology. A clinically meaningful AI tool requires calibration, external validation, explainability appropriate to the clinical task, prospective workflow evaluation and explicit testing for unequal error rates. The scientific question addressed in this review is thus both biological and translational: what causes recurrent dysbiosis, what treatments have credible evidence, and what data infrastructure can evaluate outcomes without mistaking statistical association for mechanistic proof?

2. Materials and Methods

Study design and scope. The present article is a structured critical integrative narrative review, not a new prospective cohort study and not a PRISMA-certified systematic review. It synthesizes trial findings, guidance documents, microbiological studies and methodological literature relevant to recurrent BV and vaginal dysbiosis. Sources were investigated through publicly accessible PubMed-indexed records, PMC full texts, CDC and FDA resources, and primary publications in journals including the New England Journal of Medicine and Journal of Infectious Diseases. Scopus, Web of Science, Embase and Cochrane were treated as recommended verification and comprehensive-search sources; access to their complete subscriber indexes was not independently established, so exhaustive screening counts, registration numbers and false claims of having interrogated every platform are intentionally omitted.

Search concepts and eligibility. Core search concepts included 'bacterial vaginosis', 'recurrent', 'vaginal microbiome', 'Gardnerella', 'Fannyhessea', 'Lactobacillus crispatus', 'polymicrobial biofilm', 'partner treatment', 'metronidazole', 'probiotic', 'vaginal microbiota transplantation', 'real-world evidence' and 'machine learning'. Peer-reviewed human studies and syntheses, authoritative clinical guidance, microbiology experiments with translational relevance, and methodological or regulatory sources were eligible. Publications during 2020–2026 received priority; older foundational studies were included only where they defined microbiome community states, diagnosis or laboratory methods. Editorials and early mechanistic research were distinguished from controlled clinical efficacy evidence.

Critical extraction and synthesis. Data elements prioritized were study design, setting, eligibility, microbiological diagnostic criterion, whether recurrent or first-episode BV was enrolled, baseline treatment, randomized unit, intervention, comparator, follow-up, recurrence definition, effect estimate, adverse events, and funding or implementation limitations. No independent effect pooling was attempted because a reproducible complete study inventory and patient-level data were not available. Trial estimates are quoted only where identifiable publications allow direct source verification. Evidence tables distinguish established clinical practice from investigational approaches and avoid fabricating pooled statistics or claims of local cohort recruitment.

Propensity score matching (PSM) may compare similar patients receiving different recurrent-BV therapies in observational datasets by estimating the probability of treatment from baseline covariates. Appropriate predictors include previous recurrences, symptoms, age, pregnancy status, concurrent sexually transmitted infections, hormonal contraception, sexual exposure indicators if ethically collected, access to care and antibiotic history. Balance diagnostics are essential; a propensity score does not correct for unknown or poorly measured confounders. Matching may reduce sample size and alter the target population. Inverse probability weighting (IPW) instead uses treatment probabilities to create a weighted pseudopopulation; extreme weights, lack of overlap and misspecified models can destabilize inference and must be inspected.

Target trial emulation explicitly specifies eligibility, treatment strategies, treatment assignment, time zero, follow-up, outcomes, causal contrast and analysis before examining observational records. For recurrent BV, an illustrative comparison might begin on the day of a documented recurrent episode and compare an eligible suppressive regimen with a clinically appropriate alternative, with recurrence-free time assessed over a prespecified follow-up period. Immortal-time bias arises if patients must survive symptom-free until a later prescription to enter a treatment arm. Baseline and postbaseline factors must be separated, especially because subsequent symptoms influence treatment switches. Sequential trial emulation may be preferable for recurrent episodes, provided within-person correlation is considered.

Kaplan–Meier survival curves can represent time to first symptomatic recurrence while treating censoring transparently. Cox proportional-hazards regression can estimate adjusted hazard ratios if proportional-hazards assumptions are plausible; clinically interpretable absolute recurrence risks should accompany relative measures. Recurrent-event approaches, including counting-process models or frailty models, may be more informative than first-event models where episodes recur repeatedly. Competing events, changes in reproductive status or loss to follow-up can alter the risk set. Survival analysis estimates from a database require real event times; they cannot be reconstructed faithfully from descriptive publications or generated as illustrations and presented as observed findings.

Machine learning may include penalized regression, random forests and gradient boosting for nonlinear interactions between longitudinal symptoms, microbiome measurements and exposure history. Deep learning is potentially suited to microscopy images and high-dimensional sequence data, though small cohorts and batch effects create a high risk of overfitting. Natural language processing (NLP) may identify episodic symptoms and treatment failure from free-text notes, but false negation interpretation and multilingual documentation require clinician review. Reinforcement learning is sometimes proposed for dynamic treatment policies; its offline reward functions, action-space constraints, distribution shifts and safety requirements make routine deployment premature. Large language models should serve controlled abstraction and drafting tasks rather than independent diagnosis or unsupervised treatment decisions.

Missingness and bias. Missing laboratory tests may reflect a clinician's degree of suspicion; absent follow-up often differs between symptom-free and symptomatic patients; missing sexual-practice data may correlate with privacy concerns. These are not necessarily missing-at-random mechanisms. Multiple imputation should be evaluated against plausible mechanisms, and prespecified sensitivity analyses may explore informative dropout. Selection bias can arise when sequencing is preferentially ordered for severe recurrent cases. Microbiome relative abundance is compositional: one organism's proportion may rise merely because another falls. Absolute quantification, negative controls, strain-level methods and batch harmonization are important complements to routine sequencing outputs.

3. Results: Critical Evidence Synthesis

3.1 Vaginal ecological stability and community state patterns

A vaginal community should be interpreted through its function and temporal stability rather than taxonomic composition alone. Lactic acid, epithelial glycogen metabolism, hormone-related substrate availability and local inflammation interact across the menstrual cycle. Lactobacillus crispatus frequently defines a low-diversity ecological state; Lactobacillus iners can occur in both apparently stable and transitional states and may not afford equivalent resilience. Anaerobe-rich states are heterogeneous, so a single community-state category can conceal clinically relevant differences in bacterial metabolic potential. Stable microbiome recovery is therefore a better research target than a solitary posttreatment swab with a reduced Nugent score.

Repeated sampling can distinguish short-lived fluctuations from persistent dysbiosis. A snapshot taken during menstruation, recent sexual exposure or shortly after medication may reflect a transient perturbation rather than sustained recovery or failure. This distinction is critical when evaluating probiotic products and molecular diagnostics. Cross-sectional correlations between vaginal pH and particular taxa cannot determine whether acidification selected for the community or the community produced acidification; longitudinal mechanistic designs and controlled perturbation studies are needed.

3.2 Gardnerella, Fannyhessea and polymicrobial organization

Gardnerella is a species-rich group with variable virulence-associated characteristics, making older laboratory reports of a single species inadequate for strain-specific causal claims. Some organisms adhere to vaginal epithelial surfaces, facilitate polymicrobial assembly and participate in enzymatic pathways associated with mucus and epithelial disruption. Fannyhessea vaginae, Prevotella and other anaerobes can coexist with Gardnerella in adherent communities. The biological behavior of these consortia cannot be accurately extrapolated from monoculture antibiotic susceptibility studies because interspecies cooperation changes the environment and can influence microbial tolerance [3,4].

Polymicrobial detection itself is not proof of an organized biofilm. Fluorescence in situ hybridization and other microscopy support extensive epithelial-associated microbial layers, but the precise extracellular matrix architecture and in vivo interactions

remain active research subjects. Biofilm terminology should therefore be used mechanistically rather than as an explanation invoked automatically for every recurrence. Tests that distinguish attached structures from free-living organisms might clarify whether targeted antibiofilm therapy has a useful biological target. Without standardization, investigators risk comparing unrelated substrates, laboratory media and endpoint definitions [3,4].

3.3 Biochemical pathways: acidity, metabolites, enzymes and inflammation

Changes in lactic-acid isomers, amines, short-chain fatty acids and other metabolites provide a functional bridge between dysbiosis and symptoms. Metabolites can influence mucosal pH, epithelial barrier function, inflammatory signaling and microbial competitiveness. Amines are clinically associated with characteristic odor, but a chemical readout is not equivalent to a validated clinical recurrence endpoint. Lactobacillus-mediated acid production may constrain the expansion of anaerobes, whereas enzyme-producing organisms may reshape the environment in ways that favor their own persistence.

The vaginal epithelial response is not uniform across all women with BV. Some present prominent discharge and odor with little tissue inflammation, whereas others have coexisting sexually transmitted infections or mucosal irritation. Inflammatory cytokines may signal disrupted barrier homeostasis, but their diagnostic usefulness requires specificity relative to concurrent pathogens and reproductive states. A mechanistic study should link strain-level composition, absolute microbial loads, metabolites and host markers in the same individuals over time to distinguish disease drivers from secondary consequences.

3.4 Defining recurrence, persistence, relapse and reinfection

Clinical and microbiological recurrence are distinct outcomes. A woman may be symptom-free while a molecular assay still detects BV-associated bacteria; another may experience symptoms due to candidiasis, trichomoniasis, cervicitis or noninfectious irritation despite an apparent shift in vaginal microbial composition. For trials, the time origin should be a documented remission following initial therapy, not an arbitrary date after enrollment. Misclassifying refractory cases as true recurrence inflates apparent relapse rates and undermines comparisons across therapies [2].

Strain-resolution data and concordant partner samples may help distinguish persistence from microbial reintroduction, although demonstrating shared strains does not establish exact direction of transmission. The patient's lived symptom burden is also critical: laboratory-defined disease without discomfort or reproductive implications is not necessarily equivalent to clinically troublesome recurrent BV. Patient-reported outcomes, treatment disruption and sexual-health impact should be recorded separately from Nugent or molecular outcomes. Combining these dimensions is more informative than asserting a universal numerical cure rate.

3.5 Conventional diagnosis: Amsel, Nugent and point-of-care approaches

Amsel clinical criteria combine discharge characteristics, vaginal pH, amine odor after potassium hydroxide and clue cells; a standard diagnosis typically requires at least three of four components. Nugent scoring examines bacterial morphotypes on Gram stain and provides a different, microscopy-based construct. These methods should not be regarded as interchangeable with sequencing-defined community types. Point-of-care tests and nucleic-acid amplification assays may be useful in selected symptomatic patients, but interpretation must respect the platform's intended use and the possibility of mixed vaginitis [1].

In recurrent cases, the first diagnostic priority is often to verify what actually recurred. A prior prescription or patient-reported odor alone does not establish repeated BV episodes. Testing for alternative or concomitant causes can prevent serial empirical antibiotic courses that are unlikely to help. Molecular assays detect targets, not clinical necessity for treatment; positive results require symptom correlation and awareness of the specific assay's validation population. Standardizing case ascertainment would markedly improve the clinical interpretability of retrospective recurrent-BV datasets.

3.6 Molecular diagnostics and 16S rRNA sequencing

16S rRNA sequencing profiles bacterial communities through amplified marker regions, but taxonomic resolution depends on the selected region, primer performance, pipeline and reference database. Whole-metagenome approaches can offer finer strain and functional resolution at greater cost and with more complex bioinformatic demands. Quantitative PCR can provide targeted absolute or semi-absolute measures for clinically specified organisms. No single technique is sufficient for all ecological and diagnostic questions: assays optimized to identify high-risk

dysbiosis are not necessarily optimized to monitor a transplanted strain or infer drug resistance.

Measurement reproducibility requires details of swab location, collection timing, transport, storage, extraction procedures, sequencing depth and contamination controls. Studies comparing pre- and posttreatment microbiomes should batch or randomize specimens to minimize artifactual time trends. Relative-abundance data require compositional methods and, when feasible, companion absolute-load measurements. An apparently large numerical shift in a rare organism may be biologically trivial if the baseline biomass is small. Clinical classification should remain anchored to validated thresholds rather than unsupervised taxonomic clusters alone.

3.7 Conventional antimicrobial treatment and its ecological limitations

CDC guidance recognizes oral metronidazole, intravaginal metronidazole and intravaginal clindamycin as recommended therapies for symptomatic BV, with specified alternative regimens [1]. These drugs can relieve symptoms, but biological remission is vulnerable if an anaerobe-rich community reconstitutes after treatment or protective lactobacilli fail to regain dominance. Antibiotic effectiveness is influenced by exposure, tolerability, administration route, concurrent infections, adherence and species-specific susceptibility. Short-term improvement should not be mistaken for prevention of later recurrence.

For multiple recurrences, CDC describes prolonged suppressive intravaginal metronidazole approaches and certain sequential regimens based on limited evidence [1]. The qualifying phrase matters: suppression may reduce episodes during use without resolving the underlying vulnerability once therapy stops. Frequent empirical retreatment also creates burdens from adverse effects, candidiasis, cost and possible selection for less susceptible organisms. Decisions require individualized assessment, differential diagnosis and an explicit treatment goal, rather than indefinitely repeating the same intervention in the absence of response data.

3.8 Antimicrobial tolerance and emerging antibiofilm strategies

Resistance, tolerance and biofilm-mediated persistence are not identical phenomena. Resistance implies altered susceptibility under standardized antimicrobial testing; tolerance may permit transient survival without a large change in minimum inhibitory concentration; biofilm-associated physiological heterogeneity can shelter

subpopulations. A 2024 systematic narrative review screened 201 unique titles and included 35 relevant studies, most of which were preclinical. Its central conclusion was that human clinical validation and safety testing of experimental antibiofilm products remain essential [3].

Promising laboratory mechanisms include enzymes, peptides, antiseptics, probiotics and surface-active compounds, but an in vitro reduction in biofilm signal does not by itself establish vaginal safety, durable remission or preservation of beneficial organisms. Exposure concentrations achievable on mucosa, effects on epithelial cells and reproductive compatibility require special evaluation. Future trials should distinguish disruption of adherent structures from direct antibacterial killing and from restoration of protective taxa. Comparative clinical trials must use patient-relevant recurrence endpoints rather than only staining intensity or early microscopy appearance.

3.9 Lactobacillus crispatus restoration: randomized evidence

The 2020 randomized phase 2b Lactin-V trial evaluated vaginal Lactobacillus crispatus CTV-05 after standard vaginal metronidazole among 228 randomized participants. Recurrence by week 12 occurred in 46 of 152 women assigned Lactin-V (30%) and 34 of 76 assigned placebo (45%). The trial reported a multiple-imputation risk ratio of 0.66 (95% CI 0.44–0.87), and found evidence of continued benefit through week 24. These figures are tied to a particular live biotherapeutic formulation, dosing sequence and study population; they do not imply that any over-the-counter probiotic has equivalent efficacy [5].

The biological hypothesis is that reinoculation with an adapted protective strain can create an ecological barrier against dysbiosis after antibiotic-induced perturbation. Yet colonization is conditional on the existing community, host mucosal environment, recent antimicrobial exposure and sexual or menstrual factors. Clinical performance therefore requires independent replication and careful assessment of manufacturing quality, strain identity, cold-chain requirements where applicable, acceptability and local regulatory authorization. Although mechanistically attractive, microbiome restoration should be evaluated as a specific intervention, not as a marketing category.

3.10 Sexual partners, bacterial exchange and the 2025 StepUp trial

The sexual exchange hypothesis has often been oversimplified as a dispute over whether BV is a classic sexually transmitted infection. The more precise question is whether microbial exchange within partnerships can maintain or reintroduce a BV-associated community despite effective treatment of an individual woman. The 2025 StepUp randomized trial evaluated concomitant treatment of male partners in selected couples and reported less BV recurrence than treatment of women alone. Its importance lies in testing a modifiable mechanism with clinical endpoints, not in proving that every case of BV originates in a male partner [6].

Partner treatment decisions depend on the regimen, population, adherence, safety and contemporaneous professional guidance. Prior routine recommendations generally did not advise treating male partners based on older evidence [1], while the later RCT changes the evidence landscape for a defined context. This difference must be acknowledged rather than silently projecting the 2025 result backward into 2021 guidance. Trials of partner-directed care require careful consent, avoidance of blame, attention to nonheterosexual partnerships and equitable access to sexual-health services. Biological plausibility alone does not justify universal treatment without clinical assessment.

3.11 Vaginal microbiota transplantation and experimental ecosystems

Vaginal microbiota transplantation has attracted interest because a complex donor-derived community might reconstitute functions that cannot be recreated by a single bacterial strain. It remains an investigational intervention with significant donor-screening, pathogen transmission, microbial ecology, quality-control and long-term safety concerns. A transient shift in sequencing composition after transplantation would not suffice to show a favorable benefit–risk balance. Trial registries, controlled follow-up and careful determination of clinical endpoints are necessary before any broad implementation claim.

Ethical issues are especially complex because a living microbiome is not a chemically homogeneous medicine. Donor variability, strain transfer, potential antimicrobial-resistance genes and undetected organisms can create poorly quantified risks. Regulatory classification varies across jurisdictions and may evolve with evidence. Research designs should prioritize serious adverse events and sustained symptomatic

remission, with independent monitoring and preplanned stopping rules. No locally improvised transfer procedure should be promoted as established care.

3.12 Environmental, behavioral and hormonal modifiers

Menstrual bleeding, contraceptive exposures, smoking, sexual practices, partner change, intravaginal products and antibiotic use can influence vaginal ecology, but associations vary across studies. The direction of causality is often difficult to separate from confounding by symptoms or care-seeking. For example, a product used in response to symptoms may appear associated with recurrence because it follows early disease manifestations. Ecological exposure models should respect time-ordering and capture both patient decisions and clinician recommendations.

Recommendations must avoid stigmatizing normal hygiene or sexuality and should distinguish biological evidence from speculation. Counseling can discourage douching based on clinical guidance while acknowledging that no behavioral modification guarantees freedom from recurrence. Hormonal and reproductive changes may alter glycogen availability, epithelial maturation and microbial composition, but causal effects should not be inferred from simple comparisons between users and nonusers of contraception. Repeated-measures cohorts offer a more appropriate design for investigating temporal influences.

3.13 Pregnancy, obstetric outcomes and special populations

BV is associated with several reproductive-health outcomes, yet an association does not mean that treating all asymptomatic women will necessarily reduce those outcomes. Pregnancy changes microbial ecology, immune signaling and the balance of treatment risks. Studies enrolling reproductive-age nonpregnant women should not be generalized to pregnant populations without specific evidence of safety and effectiveness. Clinical protocols must use locally applicable pregnancy guidance and document gestational status before medication selection.

Adolescents, immunocompromised patients and individuals with coexisting sexually transmitted infections may have different diagnostic and management needs. Differential access to testing and specialist referral creates additional inequalities in recurrence ascertainment. Research should disaggregate outcomes by clinically justified strata while protecting privacy. Researchers must not interpret microbiome differences across racial or geographic populations as intrinsic biological hierarchies;

social, environmental and methodological determinants often explain part of the observed variation.

3.14 Electronic health records and structured clinical episodes

Electronic health records can link symptoms, point-of-care findings, pregnancy status, laboratory tests and repeat treatment episodes. The central difficulty is defining a genuine episode: the same symptomatic event may generate multiple consultations, prescriptions or diagnostic codes. A reliable recurrence algorithm needs an episode-spacing rule, clinically corroborated diagnostic evidence and time to remission. Misclassification can be differential when patients with frequent symptoms are more often tested or referred.

Natural language processing may recover free-text details such as prior treatment failure or odor recurrence, but negation, hypothetical language and clinician shorthand require validation against manually reviewed notes. Abstraction should avoid unnecessary disclosure of sexual-history detail. An auditable common data model, with versioned code sets and explicit follow-up windows, makes results more comparable across institutions than a simple count of billing codes.

3.15 E-prescriptions, dispensing, exposure and adherence

Electronic prescribing supplies useful information about which antibiotic was recommended, when it was ordered and whether treatment was modified. It does not prove pharmacy dispensing, correct administration or completion of a prescribed course. A study classifying women as 'metronidazole exposed' based only on an order can substantially misestimate real clinical effectiveness. Linkage to dispensing and patient-reported adherence should be considered where feasible and legally permitted.

In recurrent BV, prescription records help characterize repeated antibiotic exposure and possible downstream adverse events. They can also identify switching patterns that are easily mistaken for treatment failure. For example, a clinician may switch medications because of intolerance or formulary barriers despite microbiological response. Analyses should identify treatment strategy and timing before outcomes and avoid defining adherence using future information that can introduce selection bias.

3.16 Laboratory systems, national registries and insurance claims

Laboratory databases store point-of-care readings, molecular assay results and microscopy scores, but different laboratories may use incompatible reference intervals or organisms panels. A negative result from one assay is not necessarily equivalent to negative findings on an expanded molecular panel. National or regional registries could facilitate longitudinal follow-up across settings if episode definitions, patient identifiers and data-use permissions are sufficiently robust.

Insurance claims describe utilization and costs but often lack symptom severity or confirmation of microbial remission. Claims-based recurrence therefore requires validation against clinical information. Registry studies can address long-term comparative effectiveness and equity, but linkage errors, differential attrition and selective inclusion can invalidate otherwise precise-looking estimates. Data linkage should use privacy-preserving governance and clearly state what individual-level information was not measured.

3.17 Pharmacovigilance and treatment-related harms

Pharmacovigilance should characterize suspected adverse drug reactions to nitroimidazoles, clindamycin and emerging microbiome-directed therapeutics, including gastrointestinal intolerance, hypersensitivity, treatment-associated candidiasis and adverse effects that prompt discontinuation. Spontaneous reporting systems can detect unusual safety signals, but the absence of a reliable denominator and selective reporting prevent direct calculation of incidence. Observational comparative safety studies need control for baseline health status, concurrent medication and clinical indication.

Drug safety signal detection may use disproportionality statistics, temporal sequencing and manual adjudication. Such signals are hypotheses rather than confirmed causal risks. Pharmacovigilance analytics can use NLP to group case narratives and screen duplicates, but explainable and human-reviewed adjudication remains necessary. In a reproductive-health population, pregnancy and fertility-related exposure windows should be specified with particular care. Safety measures must be integrated with symptom outcomes because a strategy that reduces short-term relapse but causes excessive harms may have negative net benefit.

3.18 Wearables, mobile symptom diaries and patient-generated data

Wearable sensors do not directly diagnose BV. Nonetheless, symptom diaries and consent-based mobile tools can describe odor, discharge, discomfort, menstruation, treatment adherence and quality-of-life fluctuations over time. These data may reveal clinically meaningful relapse earlier than scheduled clinic visits and help discriminate persistent symptoms from a new episode. Their subjective nature is not an inherent weakness if instruments are validated, timestamps are reliable and recall biases are minimized.

Digitally engaged participants may differ from the population receiving care, and frequent app reminders can themselves change reporting or health behavior. A mobile symptom signal should trigger appropriate evaluation rather than automatic antibiotic prescribing. Studies should report missing diary days, dropout, language accessibility and whether users can withdraw or delete their data. Combining high-frequency symptom data with occasional microbiological assays may be more realistic than demanding frequent invasive visits.

3.19 Machine learning and clinical recurrence prediction

Prediction models may estimate who is most likely to experience recurrence after an initial course of therapy by integrating baseline recurrence count, microbiome profile, concurrent infections, medication history, symptom severity and follow-up access. The prediction target must be explicit: 12-week symptomatic recurrence is not the same as detection of anaerobes at six weeks. Internal cross-validation is insufficient if every sample from one person is split across training and test sets; patient-level separation is mandatory.

Evaluation should include discrimination, calibration, decision-curve analysis and subgroup performance. An algorithm with high area under the curve can still be clinically harmful if a selected threshold misses severe recurrent cases or creates unnecessary retreatment. Rare species, changing assay panels and site-specific prescribing patterns create dataset shift. Appropriate reporting requires independent validation, a locked model version and a prespecified action tied to the risk score.

3.20 Deep learning, images, multiomics and batch effects

Deep learning can extract features from Gram-stain images or integrate microbiome sequences, host transcriptomic responses and metabolites. Its value depends on

sample size, technical reproducibility and a coherent biological endpoint. Imaging data can leak laboratory identity through color, microscope settings and slide preparation; sequence-based models may similarly classify extraction batches rather than pathology. Balanced multicenter design is more persuasive than a complex architecture trained on a small convenience cohort.

Multimodal fusion might eventually distinguish symptomatic from asymptomatic anaerobe-rich communities and identify mechanisms of refractory BV. However, clinical decisions require a model that is stable under missing modalities and differences in instrumentation. Explainability tools, such as feature attribution, should be interpreted as model diagnostics, not proof that an organism causes relapse. External laboratory validation and prospective comparative utility studies are prerequisites to clinical reliance.

3.21 NLP and large language models in reproductive-health records

Clinical NLP can convert narrative descriptions into a timeline of episodes, prior therapy and symptom response. Generative language models may help draft standardized summaries or extract prespecified variables with human validation. They can also hallucinate dates, confuse reported symptoms with clinician conclusions and inadvertently reveal sensitive information. No model should be allowed to diagnose recurrent BV or prescribe antimicrobials solely from unverified chat narratives.

Multilingual documentation presents particular challenges where Uzbek, Russian and Latinized terminology appear in the same clinical record. Models trained on English clinical notes may fail on local abbreviations or transliterated symptoms. Evaluation therefore needs local chart review, documented disagreement rates, clear data governance, opt-out provisions where required and clinician override. High apparent extraction accuracy in a benchmark dataset should not be confused with safety in production.

3.22 Reinforcement learning and adaptive treatment policies

Reinforcement learning proposes sequential decisions optimized against a reward that incorporates symptom-free time, adverse effects and treatment burden. Recurrent BV is an intuitively relevant test case because the best decision may depend on a series of previous responses rather than a single exposure. However, historical

prescribing records reflect clinician preferences and unmeasured indications, creating confounded action selection. Offline policy evaluation requires strong assumptions and robust off-policy methods, which are rarely verifiable in sparse outpatient data.

Direct autonomous policy learning is not appropriate for routine practice. A safer near-term approach would compare predefined, guideline-concordant treatment sequences in prospective pragmatic studies. Such designs can adapt evidence generation while maintaining human oversight and predefined stopping rules. Researchers must separately evaluate whether a treatment-selection algorithm improves clinical outcomes above a simple transparent protocol; algorithmic complexity is not itself a patient benefit.

3.23 Personalized medicine and biomarker classification

Precision management depends on distinguishing prognostic markers of recurrence from predictive markers that identify differential treatment benefit. A recurrent-BV risk marker does not automatically select the best antibiotic or live biotherapeutic. Candidate biomarkers include species-level profiles, lactate-related functional measures, epithelial inflammatory responses, strain persistence and broader host variables. Each needs analytical reproducibility, validation across populations and demonstration of clinical utility.

Pharmacogenetics may affect drug metabolism or intolerance for particular therapies, while pharmacogenomics uses broader genomic variation; neither currently provides a universally validated routine treatment-selection system for recurrent BV. Any personalized algorithm should compare risks and benefits against standard clinical assessment, not against the absence of care. Biomarkers should be considered only if their incremental information changes a decision that matters to patients and clinicians.

3.24 Treatment-response prediction across other disease domains

The requested cross-disease analogy is most valuable as a methodological comparison rather than as a claim that BV drug-response models are interchangeable with those developed for diabetes or cardiology. In diabetes, drug-response prediction may incorporate serial metabolic values and adherence; cardiovascular models often rely on competing outcomes and long-term event risk. These settings

highlight the need for consistent time zero, longitudinal measurements and risk calibration, all relevant to recurrent BV.

Oncology offers lessons on molecular subtyping and biomarker-driven treatment selection, infectious diseases on pathogen resistance and stewardship, and neurology on symptom trajectories that are imperfectly aligned with biological measurements. Yet transport of algorithms across disease areas is inappropriate because event definitions and treatment mechanisms differ. For BV specifically, a justified model must incorporate community-level ecology rather than assume that a single host laboratory value predicts outcome.

3.25 Comparative effectiveness: trial efficacy versus real-world performance

The benefit seen in a tightly controlled trial can diverge from effectiveness when real patients cannot obtain the product, discontinue it due to side effects, lack refrigeration or experience repeat exposures. Observational treatment comparisons should use active comparators and equivalent follow-up schedules whenever possible. A biased comparison between highly adherent specialist patients and less closely monitored routine patients cannot isolate the treatment effect. Absolute recurrence risk and patient-reported symptom burden are particularly useful for communicating clinical relevance.

RWD may uncover which patients fail to achieve durable benefit even when average efficacy is positive. However, effect modification is difficult to establish when subgroup selection occurs after looking at the data. Prespecified groups and interaction tests with appropriate uncertainty reporting are preferable to unsupported claims of personalized response. The regulatory acceptability of a dataset depends on fitness for purpose, traceability and validity, not on size alone [7,8].

3.26 Missing data, selection bias and clinical misclassification

Women who do not return for follow-up are not necessarily cured, and those who attend frequently may appear to have more recurrence simply because episodes are more likely to be detected. Informative observation creates bias that ordinary regression may not eliminate. Repeat microbiome measurements obtained only from refractory patients produce an enriched study population that does not represent all

individuals with BV. A future registry should capture contact attempts, test indication, care-seeking outside the main institution and loss-to-follow-up reasons.

Selection of antibiotic by disease severity creates confounding by indication; differential laboratory verification creates verification bias; classifying exposure using a future prescription creates immortal-time bias. Quantitative sensitivity analyses are useful, but cannot guarantee correction of missing causal variables. Reporting frameworks should disclose missingness patterns, censoring, assay version changes and all preplanned sensitivity comparisons. Transparent limitations are more valuable than artificially precise confidence intervals.

3.27 Explainable AI, fairness and clinical decision support

Explainability should be tailored to a clinician's decision. A list of microbiome features may help a researcher debug a model but may not explain why a specific patient should undergo further testing rather than empirical retreatment. Useful clinical decision support can prompt confirmation of symptoms, highlight pregnancy-specific safety restrictions, display a recurrence timeline and link to current guidelines. It must not convert uncertain model risk into a categorical disease label without an appropriate diagnostic standard.

Fairness means measuring whether predictive errors differ by age, geography, language, care setting and other clinically relevant groups, and examining whether disparities arise from unequal access to diagnostic testing. Privacy protection is particularly important because sexual-health records can cause substantial social harm if disclosed. WHO's ethics framework and evolving FDA/EMA approaches provide principles for accountability and lifecycle monitoring, but local governance must translate principles into responsible access controls, clinician escalation rules and patient explanations.

3.28 Uzbekistan: digital health, e-prescriptions and registry architecture

Uzbekistan has pursued staged digital-health and electronic-prescription implementation. A December 2025 official government notice describes the phased introduction of an e-prescription framework, including initial categories of systemic antibacterials and hormonal medicines [10]. This provides a potential building block for studying treatment episodes and antimicrobial stewardship, but its existence must not be mistaken for evidence that a national recurrent-BV registry or standardized

microbiome surveillance system is already operational. The Ministry of Health could support pilot definitions and interoperability rather than claiming comprehensive coverage without published audit data.

A practical multicenter pilot might begin with gynecology and primary-care clinics using standardized symptoms, Amsel or Nugent results where available, STI co-testing, medication and dispensing records, pregnancy status, repeat episodes and patient-reported outcomes. A laboratory subcohort could collect validated 16S or targeted PCR measurements at baseline, posttreatment and recurrence. Consent, pseudonymization, strict role-based access and an ethical review mechanism should precede data linkage. The pilot should collect data on who declines testing, who drops out and whether referral barriers change treatment effectiveness.

3.29 Uzbekistan: capacity, local validation and staged AI implementation

Clinical pharmacology and antimicrobial-stewardship services could evaluate repeated nitroimidazole exposure, adverse events and prescribing variation. A linked pilot should prioritize accurate episode identification before advanced machine learning: a simple validated rule-based algorithm may deliver more operational value than a poorly calibrated deep network. Laboratories would need harmonized specimen handling, standardized reporting of molecular assays, external quality assurance and transparent costs. Such conditions are proposed recommendations, not claims about currently functioning national infrastructure.

A phased policy evaluation should first document care pathways and data completeness, then pilot a registry with independent manual chart review, then assess the external validity of recurrence prediction and finally test whether decision support improves patient-important outcomes. RWE-based effectiveness comparisons can follow if enough well-characterized treatment strategies and confounders are available. The most defensible near-term measure of success is reliable access to diagnosis, appropriate therapy, safer repeat prescribing and a measurable reduction in avoidable symptomatic recurrence.

3.30 Integrated evidence assessment and clinical implications

Taken together, the evidence favors a multifactorial model of recurrence involving microbial community instability, surface-associated persistence, treatment and host context, and microbial exchange within some partnerships. The strongest

intervention evidence in this synthesis comes from identifiable randomized trials for a specific L. crispatus live biotherapeutic after initial antibiotic therapy and for selected male-partner treatment strategies. Evidence for generalized commercial probiotics, transplantation and novel antibiofilm products remains more heterogeneous or preliminary. Each proposed innovation must be judged against conventional, documented clinical care rather than against a simplistic absence-of-treatment comparator.

Clinical translation should privilege the person experiencing recurrence: confirm the diagnosis, distinguish refractory disease from a new event, evaluate alternative causes and concurrent infections, explain uncertainty and choose a guideline-consistent plan with follow-up criteria. Claims of universal cure, guaranteed probiotic replacement or autonomous AI prescription lack sufficient support. A successful translational program will measure repeated symptomatic events, time to recurrence, adverse effects, quality of life, treatment acceptability and equitable access, alongside microbiome changes.

3.31 Summary of directly verifiable clinical findings

Evidence	Design and population	Reported result	Interpretation
Lactin-V (Cohen et al., 2020)	Randomized phase 2b; 228 women	Week-12 BV recurrence 30% versus 45%; RR 0.66 (95% CI 0.44–0.87)	Specific strain/formulation following metronidazole; not all probiotics [5]
Male-partner treatment (Vodstrcil et al., 2025)	Randomized partner-treatment trial	Significant improvement in recurrence prevention in eligible couples	Context-specific partner strategy; assess local guidance and access [6]
Antibiofilm evidence (Gao et al., 2024)	Systematic narrative review; 35 included studies	Most studies preclinical; clinical validation limited	Avoid extrapolating laboratory efficacy to established therapy [3]

CDC clinical guidance (2021)	Evidence-based national practice recommendations	Standard oral and intravaginal treatment options; strategies for multiple recurrences	Clinical standard depends on current local updates [1]

3.32 Proposed longitudinal data dictionary for recurrent BV

Domain	Variables	Collection period	Validation
Phenotype	Symptoms, Amsel, Nugent, alternative diagnoses	Baseline / each recurrence	Chart adjudication
Microbial ecology	Quantitative assays, taxonomy, assay batch	Baseline / post-treatment / recurrence	QC controls, absolute loads
Treatment	Regimen, dose, route, dispensing, adherence	Each episode	Pharmacy reconciliation
Safety	Suspected adverse events, pregnancy status	During and after exposure	Causality review
Follow-up	New episode date, censoring, QOL	Standardized monthly interval	Contact ascertainment
Context	Partner strategy, healthcare access	Baseline and time varying	Consent and privacy controls

3.33 Analytical framework: causal questions and design choices

Question	Appropriate design	Principal threat	Recommended guardrail
Does a therapy reduce recurrence?	Randomized trial or target-trial emulation	Confounding by severity	Time-zero alignment, active comparator

How long until recurrence?	Kaplan–Meier / recurrent-event survival	Informative censoring	Report loss and sensitivity
Which microbiome predicts relapse?	Prospective external validation	Batch effects and leakage	Patient/site-level split
Can AI improve decision quality?	Prospective decision-impact trial	Automation bias	Human oversight, decision curves
Which adverse effects emerge?	Active safety cohort and signal review	Underreporting	Verified outcomes and denominators

4. Discussion

The evidence synthesis challenges the tendency to assign BV recurrence to one failed antibiotic choice. A biologically plausible framework must accommodate microbial persistence, community reassembly, host conditions, antimicrobial tolerance, and potential exchange within partnerships. These mechanisms are not necessarily mutually exclusive. Their relative contribution may vary within the same individual over time. Consequently, a one-size-fits-all recurrence model is unlikely to capture the clinical heterogeneity observed across healthcare systems. Clinical studies that stratify by prior episodes, microbial state, partner exposure, and initial response can generate more actionable evidence than those reporting one average microbial diversity score.

The randomized Lactin-V trial and the more recent partner-treatment trial represent important advances because they directly intervene on distinct hypothesized drivers of recurrence. Still, they should not be amalgamated into a pooled 'microbiome therapy efficacy' estimate: interventions, eligibility and biological targets differ. The former supports the promise of selected strain restoration after antimicrobial therapy, whereas the latter supports addressing microbial exchange in defined relationships. Neither result validates unsupervised use of commercial products nor establishes an intervention for every patient subgroup. Pragmatic effectiveness research should examine whether these improvements persist under ordinary treatment adherence and diverse healthcare access.

The biofilm hypothesis is attractive partly because it makes recurrence understandable after apparent clearance of free-living bacteria. Nonetheless, current evidence is not uniform regarding structural criteria, assay interpretation or which biofilm-related endpoints reliably predict clinical relapse. Laboratory experiments often use surfaces and growth conditions poorly representative of the vaginal epithelium. It would be premature to describe every candidate biofilm disruptor as a practical option for patients. Reproducible human randomized studies, with adequate follow-up and adverse-event assessment, are required before routine guideline inclusion [3].

Real-world analytics can complement the sparse long-term follow-up of certain clinical trials. Their strength is population reach, not automatic validity. For instance, a dataset containing repeated antibiotic prescriptions may identify high-use patients, but without symptoms, adherence and test confirmation it cannot quantify genuine microbiological recurrence or drug resistance. The same data limitations can produce biased algorithmic predictions. External validation, prospective deployment trials and equity-focused implementation evaluation therefore belong to the scientific agenda, rather than being presented as administrative final steps.

Ethical AI is especially important for recurrent BV because sexual and reproductive-health histories are sensitive, some inputs are subjective, and a wrong prediction may invite stigmatizing advice or unnecessary antimicrobial therapy. Explainable algorithms cannot eliminate biased measurements; neither can a transparent decision tree compensate for absent clinical information. Governance must therefore address consent, retention, access rights, model monitoring, human override, and the ability to contest or correct an erroneous label. Large language models may be valuable for controlled administrative abstraction, but their fluency must not be mistaken for validated clinical reasoning.

Several limitations of this manuscript merit explicit acknowledgment. It is a critical narrative synthesis rather than a preregistered systematic review, and no exhaustive search ledger or formal risk-of-bias scoring is claimed. The concentration of evidence in identifiable guidelines, a small number of pivotal randomized trials and selected reviews means that publication bias and geographic transportability remain concerns. No local Uzbek patient-level dataset was provided, and therefore no Uzbekistan-specific recurrence rate, model accuracy, hazard ratio or effect-size estimate has been

created. Forward-looking implementation proposals are labeled as such. These choices prioritize verifiability over a false appearance of quantitative completeness.

Regulatory trends support controlled use of RWD and lifecycle evaluation of AI, not bypass of clinically established evidence standards. FDA guidance on RWE highlights fitness-for-purpose and data standards [7,8]; WHO ethics guidance emphasizes human autonomy and accountability, and EMA's DARWIN EU initiative illustrates a structured framework for observational evidence across systems. A recurrent-BV registry aligned with these principles would require explicit case definitions, provenance tracking, permitted data uses and a local accountability mechanism. Cross-border transfer of sensitive microbiome and sexual-health data would also require particular attention to legal and ethical constraints.

A high-value research agenda would first build a multicenter, longitudinal phenotype-rich cohort with scheduled follow-up and strain-level microbiome measures in a subcohort. It would then test mechanistic hypotheses within prospective studies, distinguish microbial remission from symptomatic remission, and conduct comparative trials of specific restoration or partner strategies. Long-term outcomes should include recurrence-free intervals, antimicrobial use, adverse events and quality of life. The principal scientific advance will not be the complexity of sequencing or computational models; it will be better alignment between measured ecology and decisions that actually improve durable patient outcomes.

4.1 WHO, FDA, EMA and DARWIN EU: governance implications

WHO guidance on ethical use of artificial intelligence in health emphasizes autonomy, safety, transparency, accountability, inclusiveness and sustainability. For recurrent-BV research these considerations translate into patient-controlled consent, responsible handling of sensitive reproductive-health data and disclosure of uncertainty. FDA recommendations for real-world evidence require study-specific assessment of reliability and relevance. EMA’s DARWIN EU framework exemplifies networked observational analysis, but a large federated dataset is not inherently free from misclassification or unmeasured confounding. For AI-enabled clinical decision support, regulatory consideration depends on intended medical use, change management and evaluated clinical performance. None of these initiatives substitutes for context-specific clinical validation.

4.2 Reporting standards and limitations of this review

The paper uses IMRAD headings to organize published evidence and proposed analytical strategies. Its Results section comprises findings from published sources, not new statistical analyses. A true systematic review should preregister a protocol as appropriate, reproduce complete database-by-database search strategies, report screening counts with a PRISMA flow diagram, assess risk of bias using suitable tools and establish eligibility before screening. A real-world causal study would require an explicitly populated source cohort and a prespecified analysis plan consistent with STROBE/RECORD principles. Since those components were not supplied or executed, this article avoids simulated p-values, invented study counts, unsupported pooled estimates and unwarranted claims of systematic-review status.

4.3 Prioritization of unanswered research questions

The most pressing unresolved issue is whether microbial phenotypes can be used prospectively to assign therapies that improve durable remission compared with simple guideline-based care. Studies should prospectively separate initial clinical response, molecular community recovery and time to subsequent symptoms, because these outcomes are only partially aligned. A second priority is to quantify the relative roles of within-host microbial persistence, partner-associated exchange and environment-related destabilization using paired longitudinal specimens with adequately documented treatment and exposure timing. A third priority is to establish which candidate host or microbial markers offer incremental decision value beyond careful symptom-based diagnosis. Negative studies and unsuccessful strain colonization attempts should be published to limit selective dissemination of favorable findings.

Pragmatic trials can address how patient preference, dosing burden, medication cost, follow-up capability and access to partner care change observed effectiveness. Endpoints should include validated quality-of-life scales, avoidance of unnecessary antimicrobials and clinically verified recurrence intervals, rather than assuming sequencing-defined Lactobacillus dominance is sufficient. Studies involving microbiome-directed interventions should distinguish biological colonization, product safety and relief of patient-important symptoms. For algorithm evaluation, external-site testing should be followed by a prospective comparison of decisions with and

without the model; silent observational deployment is not an adequate substitute for impact assessment.

Finally, geographic representation matters. A microbiome prediction rule trained in one region may fail in Uzbekistan because of laboratory methods, prescribing practices, disease ascertainment and structural healthcare differences rather than intrinsic properties of local patients. A transparent pilot with ethics approval, reproducible laboratory protocols and registered statistical questions would create a platform for testing transportability. The publication of missing-data summaries and protocol deviations should be treated as a scientific strength. These research priorities emphasize modest, verifiable improvements in care rather than promises of universal recurrence prevention.

5. Conclusion

Recurrent bacterial vaginosis is a dynamic syndrome arising from vaginal microbial dysbiosis, unstable recovery after antimicrobial therapy, adherent polymicrobial communities, host and environmental influences, and in some contexts microbial exchange within partnerships. Evidence-based clinical care should begin with verified diagnosis and a distinction between treatment-refractory disease and recurrent symptomatic episodes. Established antimicrobial regimens remain foundational; controlled evidence for particular L. crispatus restoration and partner-directed strategies broadens prevention options without justifying indiscriminate use of unvalidated products. Real-world data and computational models can improve longitudinal understanding and implementation only when case definition, causal design, data quality, privacy and external validation are robust. An Uzbekistan-focused pilot linking structured gynecologic care, laboratory diagnostics, medication exposure and longitudinal patient reports would be a defensible platform for future evaluation. The objective is durable patient benefit, not merely short-term removal of detectable anaerobic taxa.

Declaration of evidence and research integrity

No participants were recruited and no patient-level datasets were analyzed for this review. No novel recurrence rate, odds ratio, hazard ratio or meta-analytic pooled estimate is represented as newly calculated. Author contributions, conflicts of interest, funding, ethics declarations and institutional details must be supplied and

verified before submission. The UDC is provisional. Text originality and similarity index can only be assessed using the target journal's specified screening procedures.

References (Vancouver-style; primary URLs included for verification)

1. Centers for Disease Control and Prevention. Bacterial Vaginosis. Sexually Transmitted Infections Treatment Guidelines, 2021. https://www.cdc.gov/std/treatment-guidelines/bv.htm

2. Muzny CA, Sobel JD. Understanding and Preventing Recurring Bacterial Vaginosis: Important Considerations for Clinicians. Int J Womens Health. 2023. https://pmc.ncbi.nlm.nih.gov/articles/PMC10423565/

3. Gao M, Manos J, Whiteley G, et al. Antibiofilm Agents for the Treatment and Prevention of Bacterial Vaginosis: A Systematic Narrative Review. J Infect Dis. 2024;230:e508-e517. doi:10.1093/infdis/jiae134.

4. Bacterial Vaginosis—Vaginal Polymicrobial Biofilms and Dysbiosis. 2023. https://pmc.ncbi.nlm.nih.gov/articles/PMC10412922/

5. Cohen CR, Wierzbicki MR, French AL, et al. Randomized Trial of Lactin-V to Prevent Recurrence of Bacterial Vaginosis. N Engl J Med. 2020;382:1906-1915. doi:10.1056/NEJMoa1915254.

6. Vodstrcil LA, Plummer EL, Fairley CK, et al. Male-Partner Treatment to Prevent Recurrence of Bacterial Vaginosis. N Engl J Med. 2025;392:947-957. doi:10.1056/NEJMoa2405404.

7. Food and Drug Administration. Considerations for the Use of Real-World Data and Real-World Evidence to Support Regulatory Decision-Making for Drug and Biological Products. Guidance for Industry. 2023. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/considerations-use-real-world-data-and-real-world-evidence-support-regulatory-decision-making-drug

8. Food and Drug Administration. Data Standards for Drug and Biological Product Submissions Containing Real-World Data. Guidance for Industry. 2023. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/data-standards-drug-and-biological-product-submissions-containing-real-world-data

9. Food and Drug Administration. Use of Real-World Evidence to Support Regulatory Decision-Making for Medical Devices. Final Guidance. 2025. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/use-real-world-evidence-support-regulatory-decision-making-medical-devices

10. Government of the Republic of Uzbekistan. Procedure for Phased Implementation of Electronic Prescriptions. 23 December 2025. https://digital.gov.uz/oz/advice/784/document/4462

11. Ministry of Health of the Republic of Uzbekistan. Discussion of Implementation of Electronic Prescription System. 15 December 2025. https://gov.uz/ru/ssv/news/view/110849

12. Workowski KA, Bachmann LH, Chan PA, et al. Sexually Transmitted Infections Treatment Guidelines, 2021. MMWR Recomm Rep. 2021;70(4):1-187. https://www.cdc.gov/mmwr/volumes/70/rr/rr7004a1.htm

13. Muzny CA, Sobel JD. Bacterial Vaginosis—Time to Treat Male Partners. N Engl J Med. 2025;392:1026-1027. doi:10.1056/NEJMe2500373.

14. Bacterial vaginosis: a review of approaches to treatment and prevention. 2023. https://pmc.ncbi.nlm.nih.gov/articles/PMC10264601/

15. Bacterial vaginosis and biofilms: Therapeutic challenges and innovations—a narrative review. 2024. doi:10.25259/IJDVL_1322_2023.

16. World Health Organization. Ethics and Governance of Artificial Intelligence for Health: WHO Guidance. 2021. https://www.who.int/publications/i/item/9789240029200

17. World Health Organization. Ethics and Governance of Artificial Intelligence for Health: Guidance on Large Multi-Modal Models. 2024. https://www.who.int/news/item/18-01-2024-who-releases-ai-ethics-and-governance-guidance-for-large-multi-modal-models

18. European Medicines Agency. Data Analysis and Real World Interrogation Network (DARWIN EU). https://www.ema.europa.eu/en/about-us/how-we-work/big-data/data-analysis-real-world-interrogation-network-darwin-eu

19. European Medicines Agency. Real-world evidence. https://www.ema.europa.eu/en/human-regulatory-overview/research-development/real-world-evidence

20. Food and Drug Administration. Artificial Intelligence-Enabled Medical Devices. https://www.fda.gov/medical-devices/digital-health-center-excellence/artificial-intelligence-enabled-medical-devices

21. Food and Drug Administration. Marketing Submission Recommendations for a Predetermined Change Control Plan for Artificial Intelligence-Enabled Device Software Functions. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/marketing-submission-recommendations-predetermined-change-control-plan-artificial-intelligence

22. World Health Organization. WHO releases AI ethics and governance guidance for large multi-modal models. 2024. https://www.who.int/news/item/18-01-2024-who-releases-ai-ethics-and-governance-guidance-for-large-multi-modal-models

23. Food and Drug Administration. Real-World Evidence. https://www.fda.gov/science-research/science-and-research-special-topics/real-world-evidence

24. World Health Organization. WHO recommendations on interventions against sexually transmitted infections and associated conditions. https://www.who.int/health-topics/sexually-transmitted-infections

25. Food and Drug Administration. FDA Guidances with Digital Health Content. https://www.fda.gov/medical-devices/digital-health-center-excellence/guidances-digital-health-content

26. World Health Organization. Global strategy for health sector responses to sexually transmitted infections. https://www.who.int/teams/global-hiv-hepatitis-and-stis-programmes/stis/strategies

27. Food and Drug Administration. Predetermined Change Control Plans for Machine Learning-Enabled Medical Devices: Guiding Principles. https://www.fda.gov/medical-devices/software-medical-device-samd/predetermined-change-control-plans-machine-learning-enabled-medical-devices-guiding-principles

28. European Medicines Agency. Big data. https://www.ema.europa.eu/en/about-us/how-we-work/big-data

29. World Health Organization. Sexual and reproductive health and research. https://www.who.int/teams/sexual-and-reproductive-health-and-research

30. European Medicines Agency. European medicines regulatory network data strategy. https://www.ema.europa.eu/en/about-us/how-we-work/big-data

MODERN FASHION: THE HARMONY OF CREATIVITY AND THOUGHT

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Abstract. This article explores modern fashion design as a process in which artistic creativity and logical, analytical thinking work together. It describes the stages of the design process — research, concept, sketching, material selection, prototyping and evaluation — and shows that a successful garment is born not only from inspiration but also from knowledge of anatomy, technology, ergonomics and the needs of society. The article also discusses the importance of design thinking in the education of young designers.

Keywords: fashion design, creativity, design thinking, concept, sketch, composition, collection, functionality, art education, innovation.

Introduction

Many people imagine a fashion designer as an artist who simply draws beautiful dresses. In reality, fashion design is a complex activity that unites art, science and technology. A designer must think like a painter, a sculptor, an engineer and a psychologist at the same time. As the design researcher Bryan Lawson argues, designers solve problems that are never fully defined in advance, so they constantly move between imagination and analysis.

The aim of this article is to show how creativity and thought complement each other in modern fashion and why this harmony is important for young designers.

Main part

1. Creativity: the artistic side of fashion. Creativity gives a garment its originality and emotional power. Sources of inspiration can be very different: nature, architecture, music, history, national ornaments or personal memories. For example, the domes of Samarkand, the mountain landscapes of Surkhandarya or the patterns of a grandmother's suzani can become the starting point of a whole collection. The psychologist Mihaly Csikszentmihalyi notes that creativity appears when a person deeply knows a field and is ready to look at it in a new way.

2. Thought: the analytical side of fashion. Thinking makes a creative idea real and wearable. A designer must consider:

- *the human body* — proportions, movement and comfort;
- *the material* — its weight, drape, elasticity and care;
- *the technology* — pattern making, cutting and sewing methods;

- *the consumer* — age, lifestyle, climate and budget;
- *the environment* — waste, resources and the life cycle of the garment.

Without this analysis, even the most beautiful sketch may turn into an uncomfortable or impractical garment.

3. The design process as a unity of both. In practice, creativity and thought alternate at every stage:

1. *Research* — studying trends, history, target consumers and materials (mainly analytical).
2. *Concept and mood board* — choosing the theme, colors and atmosphere of the collection (mainly creative).
3. *Sketching* — searching for silhouettes, details and compositions (creative, controlled by proportion rules).
4. *Technical drawing and pattern making* — precise measurements and construction (analytical).
5. *Prototype and fitting* — testing the idea on the body, correcting mistakes (both).
6. *Final collection and presentation* — styling, storytelling and evaluation of the result (both).

This cycle shows that inspiration and calculation are not opposites but partners.

4. Design thinking in art education. For students of specialized art schools, it is important to develop both abilities from the beginning. Drawing, composition and color theory train artistic vision, while pattern making, materials science and project work train logical thinking. Group projects, analysis of real consumer needs and creating garments from recycled materials teach students to find original and responsible solutions. Educational practice shows that a student's idea — for example, a small collection based on Surkhandarya ornaments — becomes strong only after many sketches, tests and corrections.

Conclusion

Modern fashion is a field where the heart and the mind work together. Creativity gives a garment beauty, emotion and identity, while thought gives it structure, comfort and meaning for society. A designer who unites these two qualities can create clothing that is both artistic and useful. Therefore, fashion education should equally develop imagination and analytical skills in young designers.

References

1. Lawson B. *How Designers Think: The Design Process Demystified.* 4th ed. Oxford: Architectural Press, 2006.

2. Csikszentmihalyi M. *Creativity: Flow and the Psychology of Discovery and Invention.* New York: HarperCollins, 1996.
3. Jones S.J. *Fashion Design.* 3rd ed. London: Laurence King, 2011.
4. Kawamura Y. *Fashion-ology: An Introduction to Fashion Studies.* Oxford: Berg, 2005.
5. Fletcher K. *Sustainable Fashion and Textiles: Design Journeys.* London: Earthscan, 2008.