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CONTENTS

PEDAGOGY

N.A. Abdikayumova, G.M. Madybekova, H. Kadayıfçı AI-supported learning in secondary chemistry education.....	17
A. Abdrassilov, K. Yeralin, M. Kassymov Methodological principles of using modern digital tools in teaching fine arts.....	30
M.S. Balganova, E.T. Adylbekova, H.I. Bulbul Pedagogical conditions for using blended learning methods in the training of information teachers.....	45
G.S. Bekenova, Zh.A. Abilbek, B.D. Zhumakayeva Using case method in teaching chemistry.....	67
A.M. Berdibek, A.M. Kudaibergenova Enhancing the effectiveness of professional training through the integration of case-study, a systemic approach, and positive psychology.....	80
D.A. Bildebayeva, R.U. Shanayev, K.N. Galay Active-productive reading in grade 7: epic prose of I. A. Odegov and G. K. Belger.....	95
K.N. Bulatbaeva, M.G. Smagulova Pedagogical foundations of training future foreign language teachers.....	110
Zh.B. Burayeva, D.S. Zharkinbayeva, K.K. Kabekeyeva Pedagogical conditions for ridding adolescents of internet addiction.....	130
D. Dauirbayeva, A. Bulshekbayeva Opportunities of multisensory methods in developing connected speech of middle preschool-aged children.....	145
N.N. Dildabekova, A.A. Kudysheva Research based teaching and its role in developing lifelong learning skills in South region of Kazakhstan.....	164
A.Zh. Dossanova, F.Z. Jaxylykova, S.K. Akhtanova The role of M.Zh. Kopeev's poem «Gibratnama» in education of youth in the fundamentals of a humanistic worldview.....	178

G. S. Yeshimbetova, G. Baitasheva, G. D. Yessentureyeva

Development and testing of qualimetric learning materials for measuring the effectiveness of field practice.....196

B.N. Igenbayeva, M.R. Smykova, Y.Zh. Shildibekov

Developing entrepreneurial learning through a society and industry challenges approach.....214

T. Igenbay, G. Apeyeva, Ali Ilgin

Application of digital and differentiated methods in inclusive teaching of literary texts in higher education.....244

B.D. Karbozova, N.N. Orazkhan, A.A. Rakulova

The importance of using artificial intelligence technologies in language learning.....258

Zh.A. Karimova, I.V. Safronova

Problems and prospects of studying literary serials in the educational process....273

G.M. Madybekova, T.B. Zabynbekova, K.Z. Kerimbayeva

The role of project-based learning technology in developing research skills of future chemistry teachers.....293

G.A. Nazarova, R.B. Zhandavletova, A.Zh. Berdenkulova

The potential of constructivist learning theory in mastering science education....307

A.K. Oralbekova, S.B. Begalieva, Zh.D. Abdullayeva

The influence of educational technologies on school–university interaction.....320

P. Pilten, G. Pilten, N. Şahinkaya

Evaluation of prospective teachers in terms of metacognitive thinking skills.....336

Tolkynbayeva A.K., Izmagambetova R.K., Baikulova A.M.

Review of scientific research articles on STEM education in Kazakhstan.....350

A.I. Shertser

Pedagogical conditions for the development of students’ research skills through the use of the case study method.....362

A. Shormakova, A. Utegenova, A. Almautova

Genre specifics of the diary and the relevance of his teaching.....373

N.T. Shyndaliev, A.S. Serikkazy, G.F. Nurbekova

The application of big data and artificial intelligence in education.....385

ECONOMICS

M.A. Aitkazina, E.A. Ruziyeva, N. E. Dabyltayeva Digitalization of financial instruments of state regulation in the green economy.....	397
S.N. Alpysbayeva, B.G. Mukan, A.I. Tazabekov Long-term macroeconomic trends in Kazakhstan: projection to regions.....	412
G.B. Bermukhamedova, A.B. Tlessova, Zh. Gabbassova The creative potential of the region's economy.....	426
F.K. Yerdavletova, G.N. Appakova, A.A. Mutaliyeva Digitalization of accounting: theory, practice, and impact on auditing.....	440
J. Juman, K.S. Mukhtarova, Zhang Liao China and Central Asia: prospects for economic cooperation in the context of global changes.....	454
E. Zhussipova, A. Aitymbetova, A. Dossaliyeva Improving financing mechanisms for public services in secondary education.....	472
A.K. Karbozova, T.S. Sokira, S. Manich Identification of core drivers of sustainable socio-economic development of Kazakhstan.....	489
M.O. Kenzhegul, Zh.K. Zhanabayeva, S.A. Azylkanova Innovative and digital technologies in human capital development: foreign experience.....	506
N. Kaparov, M. Zhamkeyeva, A. Kabieva Evolution of Kazakhstan's investment climate and the inflow of foreign direct investment into the real sector.....	521
D.A. Kulanova, K.K. Nurasheva, J.M. Seisenbayeva Formation of an innovative enterprise management structure in cotton processing using artificial intelligence.....	541
E. Maulenkulova, A.N. Aitymbetova, A.M. Appazova Prospects of using technical analysis methods in forecasting the dynamics of the Kazakhstan stock market.....	565

M.R. Salikhov, R.Sh. Takhtayeva

Analysis of the current economic state of the tourism industry in
East Kazakhstan region.....578

A.A. Satmurzaev, T.Zh. Niyazov, R.Zh. Duiskenova

Economic and social benefits of digitalization.....599

Z.K. Chulanova, M.Zh. Konyrbekov, A.A. Kireyeva

Integration of Kazakhstan's regions into R&D and the development
of their intellectual potential.....615

L. Shayakhmetova, A. Bekmagambetov, A. Koval

Occupational safety and social protection in harmful work conditions.....628

МАЗМҰНЫ

ПЕДАГОГИКА

Н.А. Абдикаюмова, Г.М. Мадыбекова, Х. Кадайифчи

Орта мектепте химияны жасанды интеллект қолдауымен оқыту.....17

А.И. Абдрасилов, Қ. Ералин, М. Касымов

Бейнелеу өнері пәнін оқытуда заманауи цифрлық құралдарды қолданудың әдістемелік негіздері.....30

М.С. Балганова, Э.Т. Адылбекова, Х.И. Булбул

Информатика мұғалімдерін даярлауда аралас оқыту модельдерін қолданудың педагогикалық шарттары.....45

Г.С. Бекенова, Ж.Ә. Әбілбек, Б.Ж. Жұмакаева

Химияны оқытуда кейс әдісін қолдану.....67

А.М. Бердібек, А.М. Кудайбергенова

Case-study, жүйелік тәсіл және позитивті психология интеграциясы арқылы кәсіби даярлықтың тиімділігін арттыру.....80

Д.А. Билдебаева, Р.У. Шанаев, К.Н. Галай

7-сыныптағы белсенді-өнімді оқу: И. А. Одегов пен Г. К. Бельгердің эпикалық прозасы.....95

К.Н. Булатбаева, М.Г. Смагулова

Болашақ шет тілі мұғалімдерін даярлаудың педагогикалық негіздері.....110

Ж.Б. Бұраева, Д.С. Жаркинбаева, К.К. Кабекеева

Жасөспірімдерді интернетке тәуелділіктен арылтудың педагогикалық шарттары.....130

Д.С. Дауірбаева, А.И. Бұлшекбаева

Мектеп жасына дейінгі ортаңғы топ балаларының байланыстырып сөйлеуін дамытудағы мультисенсорлық әдістердің мүмкіндіктері.....145

Н.Н. Дильдабекова, А.А.Кудышева

Қазақстанның Оңтүстік өңіріндегі зерттеуге негізделген оқыту және оның үздіксіз білім алуды дамытудағы рөлі.....164

А.Ж. Досанова, Ф.З. Джаксылыкова, С.К. Ахтанова

М.Ж. Көпеевтің «Ғибратнама» өлеңінің жастарды гуманистік дүниетаным негіздеріне тәрбиелеудегі орны.....178

Г.С. Ешимбетова, Г. Байташева, Г.Д. Есентуреева

Оқу-өндірістік практиканың тиімділігін өлшеуге арналған квалиметриялық оқу материалдарын әзірлеу және апробациясы.....196

Б.Н. Игенбаева, М.Р. Смыкова, Е.Ж. Шильдибеков

Қиындықтарға негізделген тәсілді әзірлеу арқылы кәсіпкерлік оқуды нығайту.....214

Т. Игенбай, Г. Апеева, Али Илгин

Жоғары оқу орындарында әдеби мәтіндерді инклюзивті оқытуда цифрлық және сараланған әдістерді қолдану.....244

Б.Д. Карбозова, Н.Н. Оразхан, А.А. Рахимкулова

Тіл үйренуде жасанды интеллект технологияларын қолданудың маңыздылығы.....258

Ж.А. Каримова, Л.В. Сафронова

Оқу үдерісінде әдеби сериалдарды зерделеудің өзекті мәселелері мен болашағы.....273

Г.М. Мадыбекова, Т.Б. Забынбекова, К.З. Керімбаева

Болашақ химия педагогтерінің зерттеу дағдыларын жетілдіруде жобалық оқыту технологиясының маңызы.....293

Г.А. Назарова, Р.Б. Жандавлетова, А.Ж. Берденкулова

Жаратылыстану білімін меңгертуде конструктивистік оқыту теориясының мүмкіндіктері.....307

А.К. Оралбекова, С.Б. Бегалиева, Ж.Д. Абдуллаева

Білім беру технологияларының мектеп пен университеттің өзара әрекеттесуіне әсері.....320

П. Пилтен, Г. Пилтен, Н. Шахинкаия

Болашақ мұғалімдерді метакогнитивті ойлау дағдылары тұрғысынан бағалау.....336

Ә.К. Толқынбаева, Р.К. Измагамбетова, А.М. Байкулова

STEM білім беру бойынша Қазақстандағы ғылыми зерттеу мақалаларына шолу.....350

А.И. Шерцер

Case study әдістемесін пайдалану арқылы оқушылардың зерттеу дағдыларын дамытудың педагогикалық шарттары.....362

А. Шормақова, А. Өтегенова, А. Алмаутова
Күнделіктің жанрлық ерекшелігі және оны оқытудың өзектілігі.....373

Н.Т. Шындалиев, Ә.С. Серікқазы, Г.Ф. Нурбекова
Білім беру саласында үлкен деректер мен жасанды интеллектті қолдану.....385

ЭКОНОМИКА

М.А. Айтказина, Э.А. Рузиева, Н.Е. Дабылтаева
Жасыл экономикадағы мемлекеттік реттеудің қаржылық құралдарын цифрландыру.....397

С.Н. Алпысбаева, Б.Ғ. Мұқан, А.И. Тазабеков
Қазақстанның ұзақмерзімді макроэкономикалық үрдістері: аймақтарға проекция.....411

Г.Б. Бермухамедова, А.Б. Тлесова, Ж.Ж. Габбасова
Аймақ экономикасының шығармашылық әлеуеті.....426

Ф.К. Ердавлетова, Г.Н. Аппакова, А.А. Муталиева
Бухгалтерлік есепті цифрландыру: теориясы, тәжірибесі және аудитке әсері.....440

Ж. Жұман, К.С. Мұхтарова, Liao Zhang
Қытай және Орталық Азия: жаһандық өзгерістер жағдайындағы экономикалық ынтымақтастықтың болашағы.....454

Э. Жусипова, А. Айтымбетова, Ә. Досалиева
Орта білім беру саласында мемлекеттік қызметтерді қаржыландыру тетіктерін жетілдіру.....472

А.К. Карбозова, Т.С. Сокира, С. Манич
Қазақстанның тұрақты әлеуметтік-экономикалық дамуының индикаторларын айқындау.....489

М.О. Кенжеғұл, Ж.К. Жанабаева, С.А. Азылқанова
Адам капиталын дамытудағы инновациялық және цифрлық технологиялар: шетел тәжірибесі.....506

Н.М. Қапаров, М.К. Жамкеева, А.Т. Кабиева
Қазақстанның инвестициялық климатының эволюциясы және шетелдік инвестициялардың тікелей нақты секторға келуі.....521

Д.А. Қуланова, К.К. Нурашева, Ж.М. Сейсенбаева

Жасанды интеллект көмегімен мақта өндеуде кәсіпорынды басқарудың
инновациялық құрылымын қалыптастыру.....541

Г.Е. Мауленкулова, А.Н. Айтымбетова, А.М. Аппазова

Қазақстанның қор нарығы акциясының динамикасын болжау кезінде
техникалық талдау әдістерін қолдану перспективалары.....565

М.Р. Салихов, Р.Ш. Тахтаева

Шығыс Қазақстан облысындағы туристік индустрияның қазіргі
экономикалық жағдайын талдау.....578

А.А. Сатмурзаев, Т.Ж. Ниязов, Р.Ж. Дүйскенова

Цифрландырудың экономикалық және әлеуметтік жағынан пайдалы
әсерлері.....599

З.К. Чуланова, М.Ж. Қонырбеков, А.А. Киреева

Қазақстан өңірлерінің ҒЗТКЖ-ға интеграциясы және олардың зияткерлік
әлеуетін дамыту.....615

Л.М. Шаяхметова, А.Б. Бекмагамбетов, А.П. Коваль

Зиянды еңбек жағдайларында еңбек қауіпсіздігі және әлеуметтік
қорғау.....628

СОДЕРЖАНИЕ

ПЕДАГОГИКА

Н.А. Абдикаюмова, Г.М. Мадыбекова, Х. Кадайифчи

Обучение химии в средней школе с поддержкой искусственного интеллекта.....17

А.И. Абдрасилов, К. Ералин, М. Касымов

Методические основы использования современных цифровых инструментов в преподавании изобразительного искусства.....30

М.С. Балганова, Э.Т. Адылбекова, Х.И. Булбул

Педагогические условия использования методов смешанного обучения при подготовке преподавателей информации.....45

Г.С. Бекенова, Ж.А. Абилбек, Б.Ж. Жумакаева

Использование кейс-метода в обучении химии.....67

А.М. Бердібек, А.М. Кудайбергенова

Повышение эффективности профессиональной подготовки интеграцией case-study, системного подхода и позитивной психологии.....80

Д.А. Билдебаева, Р.У. Шанаев, К.Н. Галай

Активно-продуктивное чтение в 7 классе: эпическая проза И.А. Одегова и Г.К. Бельгера.....95

К.Н. Булатбаева, М.Г. Смагулова

Педагогические основы подготовки будущих учителей иностранного языка.....110

Ж.Б. Бураева, Д.С. Жаркинбаева, К.К. Кабекеева

Педагогические условия преодоления интернет-зависимости подростков.....130

Д.С. Дауірбаева, А.И. Булшекбаева

Возможности мультисенсорных методов в развитии связной речи детей среднего дошкольного возраста.....145

Н.Н. Дильдабекова, А.А. Кудышева

Обучение на основе исследования и его роль в развитии навыков непрерывного образования в Южном регионе Казахстана.....164

А.Ж. Досанова, Ф.З. Джаксылыкова, С.К. Ахтанова

Гуманистическое мировоззрение М. Ж. Копеева в стихотворении
«Гибратнама» и его воспитательный потенциал для молодежи.....178

Г.С. Ешимбетова, Г. Байташева, Г.Д. Есентуреева

Разработка и апробация квалиметрических учебных материалов для
измерения эффективности учебно-полевой практики.....196

Б.Н. Игенбаева, М.Р. Смыкова, Е.Ж. Шильдибеков

Усиление предпринимательского обучения через развития подхода,
основанного на вызовах.....214

Т. Игенбай, Г. Апеева, Али Илгин

Применение цифровых и дифференцированных методов в инклюзивном
обучении литературных текстов в высших учебных заведениях.....244

Б.Д. Карбозова, Н.Н. Оразхан, А.А. Рахимкулова

Важность использования технологий искусственного интеллекта
при изучении языка.....258

Ж.А. Каримова, Л.В. Сафронова

Проблемы и перспективы изучения литературных сериалов в учебном
процессе.....273

Г.М. Мадыбекова, Т.Б. Забынбекова, К.З. Керимбаева

Значение технологии проектного обучения в развитии исследовательских
навыков будущих учителей химии.....293

Г.А. Назарова, Р.Б. Жандавлетова, А.Ж. Берден

Возможности конструктивистской теории обучения в освоении,
естественно-научного, образования.....307

А.К. Оралбекова, С.Б. Бегалиева, Ж.Д. Абдуллаева

Влияние образовательных технологий на взаимодействие школы
и университета.....320

П. Пилтен, Г. Пилтен, Н. Шахинкая

Оценка будущих учителей с точки зрения метакогнитивных навыков
мышления.....336

А.К. Толкынбаева, Р.К. Измагамбетова, А.М. Байкулова

Обзор научно-исследовательских статей по STEM-образованию
в Казахстане.....350

А.И. Шерцер

Педагогические условия развития исследовательских умений учащихся
через использование методики case study.....362

А. Шормасова, А. Утегенова, А. Алмаутова

Жанровая специфика дневника и актуальность его преподавания.....373

Н.Т. Шындалиев, А.С. Серикказы, Г.Ф. Нурбекова

Применение больших данных и искусственного интеллекта
в сфере образования.....385

ЭКОНОМИКА**М.А. Айтказина, Э.А. Рузиева, Н.Е. Дабылтаева**

Цифровизация финансовых инструментов государственного регулирования
в зелёной экономике.....397

С.Н. Алпысбаева, Б.Г. Мұқан, А.И. Тазабеков

Долгосрочные макроэкономические тренды Казахстана:
проекция на регионы.....411

Г.Б. Бермухамедова, А.Б. Тлесова, Ж.Ж. Габбасова

Креативный потенциал экономики региона.....426

Ф.К. Ердавлетова, Г.Н. Аппакова, А.А. Муталиева

Цифровизация бухгалтерского учета: теория, практика
и влияние на аудит.....440

Ж. Жуман, К.С. Мухтарова, Liao Zhang

Китай и Центральная Азия: перспективы экономического сотрудничества
в условиях глобальных перемен.....454

Э. Жусипова, А. Айтымбетова, А. Досалиева

Совершенствование механизмов финансирования государственных услуг
в сфере среднего образования.....472

А.К. Карбозова, Т.С. Сокира, С. Манич

Определение ядерных драйверов устойчивого социально-экономического
развития Казахстана.....489

М.О. Кенжегул, Ж.К. Жанабаева, С.А. Азылканова

Инновационные и цифровые технологии в развитии человеческого капитала:
зарубежный опыт.....506

Н.М. Капаров, М.К. Жамкеева, А.Т. Кабиева Эволюция инвестиционного климата Казахстана и приток иностранных инвестиций в реальный сектор.....	521
Д.А. Куланова, К.К. Нурашева, Ж.М. Сейсенбаева Формирование инновационной структуры управления предприятием по переработке хлопка с использованием искусственного интеллекта.....	541
Г.Е. Мауленкулова, А.Н. Айтымбетова, А.М. Аппазова Перспективы применения методов технического анализа при прогнозировании динамики акции фондового рынка казахстана.....	565
М.Р. Салихов, Р.Ш. Тахтаева Анализ текущего экономического состояния туристской индустрии в Восточно-Казахстанской области.....	578
А.А. Сатмурзаев, Т.Ж. Ниязов, Р.Ж. Дүйскенова Экономические и социальные преимущества цифровизации.....	599
З.К. Чуланова, М.Ж. Конырбеков, А.А. Киреева Интеграция регионов Казахстана в НИОКР и развитие их интеллектуального потенциала.....	615
Л.М. Шаяхметова, А.Б. Бекмагамбетов, А.П. Коваль Охрана труда и социальная защита работников с вредными условиями труда.....	628

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INNOVATIVE AND DIGITAL TECHNOLOGIES IN HUMAN CAPITAL DEVELOPMENT: FOREIGN EXPERIENCE

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Abstract. In the context of accelerating technological progress and global digital transformation, innovative and digital technologies are becoming key drivers of human capital development. Countries striving for sustainable economic growth increasingly view digital competencies as the foundation of the knowledge economy. This study is based on comparative analysis and synthesis of international experience to examine how different countries integrate digital technologies into human capital development. Official data from international organizations and statistical indicators were used, with a focus on OECD countries, Singapore, South Korea, Finland, and Kazakhstan. The analysis revealed that countries with a high level of digital readiness demonstrate significantly stronger human capital performance. Finland, Singapore, and South Korea actively implement digital learning platforms, develop flexible training models, and make substantial investments in lifelong learning programs. Kazakhstan demonstrates positive dynamics but faces challenges related to access, equity, and digital education infrastructure. The study confirms a direct relationship between investment in digital learning, the level of economic digitalization, and human capital development. It highlights the importance of institutional support, strategic policy coherence, and public–private partnerships in scaling digital skills. Successful international models can be adapted to national contexts with necessary

modifications. Future research may focus on assessing regional disparities in digital skills access, evaluating the long-term impact of AI and EdTech solutions on labor markets, and developing national frameworks for assessing digital human capital readiness.

Keywords: digitalization, innovation, human capital, digital economy, international experience, digital skills, sustainable development

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АДАМ КАПИТАЛЫН ДАМУДАҒЫ ИННОВАЦИЯЛЫҚ ЖӘНЕ ЦИФРЛЫҚ ТЕХНОЛОГИЯЛАР: ШЕТЕЛ ТӘЖІРИБЕСІ

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Аннотация. Жедел қарқынмен дамып келе жатқан технологиялық прогресс пен жаһандық цифрлық трансформация жағдайында инновациялық және цифрлық технологиялар адам капиталын дамытудың негізгі драйверлеріне айналууда. Тұрақты экономикалық өсуді мақсат еткен мемлекеттер цифрлық құзыреттіліктерді білімге негізделген экономиканың іргетасы ретінде қарастырады. Бұл зерттеу әртүрлі елдердің цифрлық технологияларды адам капиталын дамытуға қалай енгізетінін зерттеу үшін халықаралық тәжірибені салыстырмалы талдау мен синтездеуге негізделген. Зерттеуде халықаралық ұйымдардың ресми деректері мен статистикалық көрсеткіштері пайдаланылды, негізгі назар ОЭСР елдері, Сингапур, Оңтүстік Корея, Финляндия және Қазақстанға аударылды. Талдау нәтижелері цифрлық дайындық деңгейі жоғары мемлекеттердің адам капиталы индексі бойынша әлдеқайда жақсы көрсеткіштерге қол жеткізетінін көрсетті. Финляндия, Сингапур және Оңтүстік Корея цифрлық білім беру платформаларын кеңінен енгізіп, икемді оқыту модельдерін дамытып, үздіксіз білім беру бағдарламаларына ірі инвестициялар жұмсайды. Қазақстан оң серпін көрсеткенімен, цифрлық білім берудің қолжетімділігі, теңдігі және инфрақұрылымы бойынша бірқатар қиындықтарға тап болуда. Зерттеу цифрлық оқытуға салынатын инвестициялар көлемі, экономиканың цифрлану деңгейі және адам капиталының дамуы

арасында тікелей байланыс бар екенін растайды. Цифрлық дағдыларды кеңейту үшін институционалдық қолдаудың, стратегиялық саясаттың үйлесімділігінің және мемлекеттік-жекеменшік серіктестіктің маңыздылығы атап өтіледі. Халықаралық табысты модельдерді ұлттық контекстке бейімдеу мүмкін. Болашақ зерттеулерде өңірлер арасындағы цифрлық дағдыларға қолжетімділіктің айырмашылықтарын, жасанды интеллект пен EdTech шешімдерінің еңбек нарығына ұзақ мерзімді әсерін және адам капиталының цифрлық дайындық жүйелерін бағалаудың ұлттық модельдерін қарастыруға болады.

Түйін сөздер: цифрландыру, инновациялар, адам капиталы, цифрлық экономика, халықаралық тәжірибе, цифрлық дағдылар, тұрақты даму

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ИННОВАЦИОННЫЕ И ЦИФРОВЫЕ ТЕХНОЛОГИИ В РАЗВИТИИ ЧЕЛОВЕЧЕСКОГО КАПИТАЛА: ЗАРУБЕЖНЫЙ ОПЫТ

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Аннотация. *Актуальность исследования обусловлена ускоряющимся технологическим прогрессом и глобальной цифровой трансформацией, в условиях которых инновационные и цифровые технологии становятся ключевыми драйверами развития человеческого капитала и формирования экономики знаний. В современных условиях цифровые компетенции рассматриваются государствами как стратегический ресурс устойчивого экономического роста и повышения конкурентоспособности национальных экономик. Цель исследования заключается в сравнительном анализе международной практики интеграции цифровых технологий в развитие человеческого капитала и оценке взаимосвязи между уровнем цифровой готовности экономики, инвестициями в цифровое обучение и показателями человеческого капитала. Методы исследования включают сравнительный анализ, синтез международного опыта, анализ официальных статистических*

данных и индикаторов международных организаций. Эмпирическая база исследования охватывает страны ОЭСР, а также Сингапур, Южную Корею, Финляндию и Казахстан, что позволило выявить общие тенденции и национальные особенности цифрового развития человеческого капитала. *Результаты исследования* показали, что страны с высоким уровнем цифровой готовности демонстрируют более высокие значения индексов человеческого капитала. Финляндия, Сингапур и Южная Корея активно внедряют цифровые образовательные платформы, развивают гибкие модели обучения и инвестируют значительные ресурсы в системы непрерывного образования. Казахстан демонстрирует положительную динамику в развитии цифровых навыков, однако сталкивается с проблемами доступности, равенства и инфраструктурного обеспечения цифрового образования. Подтверждена прямая зависимость между объемом инвестиций в цифровое обучение, уровнем цифровизации экономики и качеством человеческого капитала. *Практическая значимость* исследования заключается в возможности использования полученных выводов при разработке национальных стратегий развития человеческого капитала, формировании политики цифровых навыков, а также адаптации успешных международных моделей с учетом национального контекста. Перспективы дальнейших исследований связаны с анализом региональных различий, оценкой долгосрочного влияния ИИ и EdTech-решений на рынок труда и разработкой систем оценки цифровой готовности человеческого капитала.

Ключевые слова: цифровизация, инновации, человеческий капитал, цифровая экономика, международный опыт, цифровые навыки, устойчивое развитие

Introduction. In the context of accelerating global technological transformation, digital and innovative technologies have become central drivers of socio-economic development, reshaping traditional models of production, education, and labor organization. As economies increasingly transit toward knowledge-based structures, the effectiveness of human capital development is closely tied to the ability of national systems to integrate digital competencies, innovative learning formats, and technology-driven institutional practices (World Economic Forum, 2023). According to recent assessments by the OECD (2022), more than 60 percent of new jobs emerging in developed economies require advanced digital skills, while the rapid diffusion of artificial intelligence, robotics, and data-driven technologies increases the demand for continuous reskilling and lifelong learning.

International experience demonstrates that technologically advanced countries such as Singapore, Finland, and South Korea have successfully embedded digitalization into national strategies for human capital development by investing in e-learning infrastructure, strengthening digital literacy across all age groups, and supporting systemic cooperation between the state, educational institutions, and private technology companies. These countries provide clear evidence that large-scale digital transformation is achievable only when supported by coordinated educational policies, strong institutional capacity, and sustained financial investments.

Despite similar strategic aspirations, the digital transformation of human capital in Kazakhstan remains uneven. Although national programs such as Digital Kazakhstan have accelerated the development of ICT infrastructure and online learning platforms, significant challenges persist, including regional disparities in digital access, insufficient readiness of teachers to integrate innovative technologies into the learning process, and limited diffusion of digital competencies among the adult population (UNESCO, 2023). These constraints reduce the country's ability to fully leverage digitalization as a catalyst for human capital modernization.

Given these trends, the comparative study of global practices becomes particularly relevant. Analyzing how technologically advanced countries design and implement digital strategies in human capital development provides valuable insights for Kazakhstan and other emerging digital economies. Such comparative analysis enables the identification of institutional models, policy mechanisms, and technological solutions that can be adapted to local conditions with appropriate modifications.

Therefore, the purpose of this study is to examine the role of innovative and digital technologies in human capital development, systematize foreign experience in this domain, and identify transferable policy approaches applicable to Kazakhstan. The research draws upon official data from the OECD, World Bank, WEF, and UNESCO, as well as peer-reviewed publications indexed in Scopus and Web of Science. The scientific novelty of the study lies in the integration of cross-country digital readiness indicators with human capital development metrics, offering a comprehensive analytical framework for assessing the impact of digital technologies on national human capital systems.

Literature review. The evolution of research on digital and innovative technologies in human capital development has progressed through several conceptual stages. Early works in the 2000s emphasized the transformation of knowledge-based economies and the need for new competencies in response to technological innovation. Authors such as Folke, Hahn, Olsson and Norberg (2005) highlighted the growing importance of adaptability and learning capacity as core components of human capital in dynamically changing socio-economic systems.

During the 2010s, attention shifted toward the digitalization of education and labor markets. Mission-oriented innovation policies, analyzed by Kattel and Mazzucato (2018), demonstrated how public-sector capabilities influence the integration of digital technologies into national development strategies. International organizations such as the World Bank (2019) and OECD (2021) further strengthened the analytical foundation by outlining how digital transformation reshapes skill requirements, employment structures and educational systems.

Research in the early 2020s increasingly focused on the widespread penetration of artificial intelligence, automation and platform-based learning. Green and Henseke (2021) examined the economic justification for state investment in digital skills training, stressing that digital competency had become universal prerequisites for labor market participation. In parallel, Bilan, Vasilyeva, Lyeonov and Cociug (2017)

demonstrated that the expansion of ICT in education can exacerbate inequalities in countries with uneven technological infrastructure, thus making digital inclusion a central topic of scholarly debate.

The literature on national digitalization models provides valuable insights into successful approaches to building digital human capital. Singapore's SkillsFuture initiative is widely recognized as a benchmark for integrating lifelong learning into national workforce strategies, providing citizens with universal access to digital training programs. South Korea's Digital New Deal, analyzed by Lee, Lee and Kim (2022), illustrates effective state-led investment in AI-driven learning platforms and high-speed digital infrastructure. Finland's long-standing emphasis on digital pedagogy and teacher digital competencies positions it among the global leaders in digital education.

In the post-Soviet and Central Asian context, researchers such as Altynbekova (2020) have identified institutional barriers that hinder the development of digital human capital, including insufficient coordination among government agencies, gaps in digital literacy and fragmented implementation of national digital programs. Kazakhstan's case appears particularly relevant, as the country has adopted progressive strategic documents but still faces challenges related to regional inequalities, low levels of adult digital skills and limited teacher readiness for digital transformation (UNESCO, 2023).

Recent studies also reveal concerns about the ethical and social dimensions of digitalization. Boldyrev (2021) and Naumov (2024) critique the tendency toward "technological dogmatism," warning that excessive reliance on digital tools without adequate human-centered governance may weaken the values of equity, sustainability and social cohesion. These concerns underscore the need for balanced policy design that integrates digital innovation with societal needs and inclusive development.

Overall, existing research highlights several key thematic directions:

- the digital transformation of education;
- the evolution of digital competencies in labor markets;
- national digital strategies and institutional reform;
- digital inequality and inclusion;
- the ethical and social implications of digitalization.

This diversity of scientific perspectives forms the conceptual basis for the present study and supports the comparative analysis of Finland, Singapore, South Korea and Kazakhstan. The literature reviewed suggests that successful digital human capital development requires not only technological modernization but also coordinated policy frameworks, institutional capacity and inclusive educational ecosystems.

Research Methods and materials. This study is based on a multi-dimensional methodological framework combining comparative, analytical and empirical approaches to assess the interaction between innovative digital technologies and human capital development across different national systems. The research relies on an integrative strategy that brings together theoretical literature, policy documents, international datasets and statistical indicators characterizing the digital economy, educational systems and workforce readiness.

A cross-country comparative method serves as the core of the analysis, allowing the identification of similarities and divergences in how Finland, Singapore, South Korea and Kazakhstan implement digital transformation in education and human capital development. The selection of these countries is justified by their distinct stages of digital maturity and the representativeness of their policy models for both advanced and emerging digital economies.

The methodological basis includes the synthesis of official reports from international organizations such as the OECD, World Bank, WEF and UNESCO, alongside peer-reviewed academic publications indexed in Scopus and Web of Science. These sources provide standardized metrics enabling the comparison of digital readiness, skill formation and innovation performance.

Quantitative analysis incorporates internationally recognized indicators, including the Human Capital Index, the Network Readiness Index, the Digital Economy and Society Index and the Global Talent Competitiveness Index. These indicators are used to measure the structural conditions influencing digital skill acquisition, institutional capacity and national competitiveness in the knowledge economy. Additional macro-level data are drawn from national strategic programs on digitalization and education, including Kazakhstan’s Digital Kazakhstan initiative and similar policy frameworks in the selected countries.

To strengthen the empirical dimension, the study employs correlation and regression analysis to examine the relationship between investments in digital learning, the level of digitalization of the economy and human capital performance. The inclusion of statistical trends from 2017 to 2024 enables the identification of long-term patterns and systemic changes in human capital development pathways.

The methodological approach concludes with a synthesizing analytical stage, in which qualitative insights from policy reviews and case studies are combined with quantitative indicators to construct an integrated cross-national assessment. This allows for the formulation of evidence-based conclusions and recommendations aimed at enhancing Kazakhstan’s digital human capital development in alignment with global best practices.

Results and Discussion. The analysis conducted in this study reveals substantial cross-country differences in digital readiness and human capital development, reflecting the influence of investments, institutional capacity, and educational digitalization. The comparative data presented in Table 1 demonstrate the structural divergence between advanced digital economies-Singapore, Finland, and South Korea-and an emerging digital ecosystem such as Kazakhstan.

Table 1. Digital and human capital development: a cross-country perspective (average figures for 2017–2024)

Country	Human capital index	Digital economy index	Digital Economy Index (%)	EdTech’s share in education (%)	Investments in digital learning (\$ billion)
Singapore	0.85	81.2	91	22.4	2.1
Finland	0.84	72.0	88	17.5	1.2

South Korea	0.82	75.4	86	19.1	1.8
Kazakhstan	0.71	49.6	62	8.3	0.24

* compiled by the authors based on the source: (WEF 2023; OECD 2021; European Commission 2023)

The data presented in Table 1 confirm substantial differences between advanced digital economies and countries with emerging digital ecosystems. These variations reflect not only disparities in investment volumes, but also the levels of institutional readiness and policy integration. To deepen the interpretation of cross-country disparities, it is necessary to examine how investment in digital learning translates into broader digital transformation outcomes. The relationship between these variables is illustrated in Figure 1, which demonstrates the degree to which national investment policies correlate with the expansion and maturity of the digital economy.

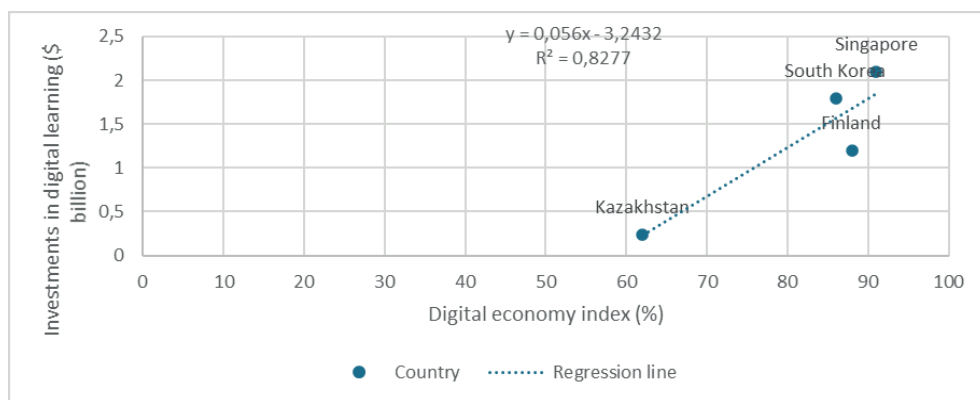


Figure 1 - The impact of investments in digital learning on the level of digitalization of the economy

The observed pattern suggests that investment in digital education serves as a structural driver of digital economy development. Countries such as Singapore, Finland and South Korea exhibit strong alignment between public spending on digital learning initiatives and the robustness of their digital ecosystems.

While Figure 1 highlights the foundational role of investment flows, an equally important dimension concerns the extent to which digitalization shapes the overall quality of human capital. Figure 2 provides a visual representation of this association, showing how greater digital economy maturity systematically contributes to higher human capital performance across countries.

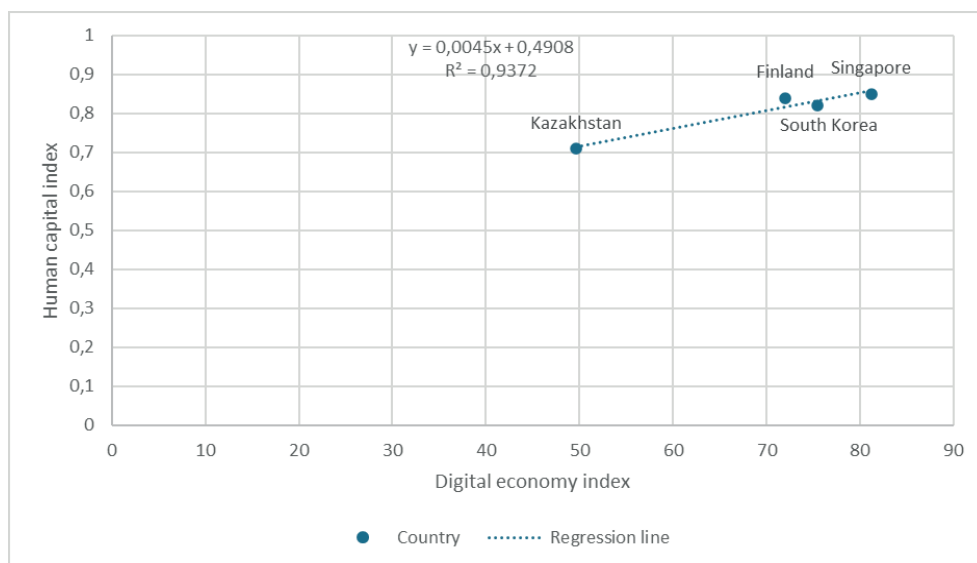


Figure 2 - The impact of the level of digitalization of the economy on the level of human capital

These relationships reveal a consistent trajectory: the more digitally advanced the national economy, the stronger its human capital base, owing to improved educational access, expanded digital competencies, and more dynamic labor market adaptability.

Singapore is the absolute leader in both investment intensity and the development of digital human capital. The country operates a comprehensive national strategy, SkillsFuture, which targets both youth and adults and is grounded in a unified state vision for lifelong digital learning. It combines learning vouchers, nationwide public-private digital platforms, centralized digital credentialing, and proactive data governance of skill demand and supply. As a result, more than 90% of adults possess foundational digital competencies, while annual EdTech investments exceed 2 billion USD, directly contributing to national productivity growth, digital inclusion, and labor market adaptability.

Finland demonstrates a similarly advanced model. Over the past decade, the country has been building personalized digital learning pathways, supported by the New Comprehensive School reform launched in 2016. Educational institutions are increasingly adopting hybrid learning models and modular online platforms, while digital upskilling is mandatory for educators. Annual public investment of approximately 1.2 billion USD sustains a digital literacy level of about 88% and reinforces the adaptability of the Finnish workforce amid rapid shifts in technological labor market demands.

South Korea has embedded digital education into the broader national innovation agenda known as the Digital New Deal. Its components include smart classrooms, government-funded digital academies, and large-scale implementation of 5G infrastructure in education. Since 2020, more than 3,000 schools across urban and rural territories have adopted interactive ICT-based learning platforms. Annual

digital learning investments amount to almost 1.8 billion USD, yielding a digital skills penetration rate of 86%. Korea's model is distinguished by strong institutional coordination and rapid technological scaling.

By contrast, Kazakhstan demonstrates a more modest level of digital maturity. Despite the adoption of the Digital Kazakhstan program, the implementation of digital education remains fragmented and uneven across regions. The Digital Economy Index remains at 49.6 points, reflecting limited integration of digital tools into public services and educational processes. Only 62% of the population possesses basic digital skills, and the share of EdTech in the education system is 8.3%. Annual investment in digital learning is approximately 240 million USD - more than seven times lower than in countries leading digital transformation. Furthermore, Kazakhstan does not yet have a unified national strategy for adult digital literacy, while the development of local e-learning platforms progresses slowly. Significant differences in the digital competencies of teachers further constrain national human capital modernization.

To strengthen the comparative analysis presented earlier, additional empirical data were collected to capture the broader system-level capacity of each country to develop digital human capital. While Table 1 focused on education-specific indicators and direct investment volumes, the next analytical step requires an examination of multidimensional indices that characterize talent competitiveness, economic complexity, innovation output, and overall human development. These indicators provide a holistic view of how effectively national ecosystems convert digital investments into productivity, technological innovation, and human capital growth. Table 2 presents this expanded framework, enabling a comparative assessment of Finland, Singapore, South Korea, and Kazakhstan not only in terms of educational inputs but also in terms of their systemic ability to nurture, attract, and retain digitally skilled talent.

Table 2. Comparative indicators of Human capital and Digital readiness (2023–2025).

Country	Human capital index	Global talent competitiveness index ranking	Digital readiness index (DESI/ECI)	Global innovation index (2023)	Human development index
Finland	0.81–0.83	Top 10	DESI – Top 3 EU	6th	0.94 (11th)
Singapore	0.88	2nd	ECI – 6th globally	5th	0.94 (12th)
South Korea	0.84	24th	ECI – 4th globally	Top 10 (regional)	0.925 (19th)
Kazakhstan	0.68 (estimated)	67th	ECI – 81st (26.7 pts)	Not listed	0.80–0.82 (70)

*compiled by the authors based on the source: (World Bank Human 2023; Global Talent Competitiveness Index 2023; UNDP, 2023)

The indicators in Table 2 reveal significant differences in structural readiness across the countries analyzed. Singapore demonstrates one of the highest Human Capital Index values globally and consistently ranks among the world leaders in

talent competitiveness, reflecting a highly coordinated education–innovation–labor market nexus. Finland maintains a strong position due to its advanced digital infrastructure, equitable education system, and long-standing investment in workforce development. South Korea's high economic complexity index reflects its technologically sophisticated export structure, supporting rapid diffusion of digital competences. Kazakhstan, however, ranks significantly lower across all dimensions - evidence of persistent structural gaps in innovation capacity, digital ecosystem development, and talent retention.

These findings underscore the need for Kazakhstan to develop a more integrated, well-funded, and institutionally supported strategy for digital human capital formation. The comparative evidence suggests that digital transformation becomes a productive driver of human capital growth only when investment, governance, technological readiness, and education reform operate in synergy.

Singapore demonstrates the highest value on the Human Capital Index, reaching approximately 0.88, which reflects its consistently superior performance across key indicators such as life expectancy, enrollment rates, educational attainment, and overall quality of educational governance. Finland and South Korea follow with scores of around 0.82 and 0.84, respectively. Both countries show sustained long-term investments in early childhood development, accessibility of education, continuous learning programs, and comprehensive healthcare systems that contribute to the formation of a resilient and adaptable workforce. In contrast, Kazakhstan's estimated Human Capital Index remains below 0.70, indicating enduring structural challenges related to the quality and effectiveness of education and healthcare, as well as disparities in access between urban and rural regions.

Additional insights into workforce development arise from the Global Talent Competitiveness Index. According to the 2023 INSEAD ranking, Singapore occupies the second position worldwide, reflecting effective national policies on talent attraction and retention, a flexible labor market, and a strong culture of lifelong learning. Finland maintains a stable position within the global top ten, reinforcing its long-standing commitment to human capital development through targeted talent management strategies. South Korea ranks 24th, demonstrating incremental improvement attributed to state-led innovation and workforce digitalization initiatives. Kazakhstan, ranked 67th, shows significant gaps in vocational education, digital skills training, and international talent retention, which collectively hinder the country's transition toward a knowledge-based economy.

Digital readiness, captured through the Digital Economy and Society Index and the Economic Complexity Index, further differentiates national digital ecosystems. Finland ranks among the EU leaders in DESI, supported by advanced broadband infrastructure, high digital literacy, and widespread digital public services. Singapore and South Korea occupy leading global positions in economic complexity, ranking sixth and fourth respectively, illustrating their strong integration into high-technology value chains and diversified export structures. By contrast, Kazakhstan ranks 81st on the Economic Complexity Index, revealing narrow specialization,

limited diversification of technology-driven industries, and low levels of digital knowledge exports. These disparities highlight fundamental structural weaknesses in Kazakhstan's digital economy and its capacity to produce sophisticated, innovation-intensive outputs.

A similar pattern emerges when examining the Global Innovation Index. Singapore and Finland consistently rank within the top ten globally, driven by substantial investments in research and development, advanced innovation infrastructure, and robust university–industry collaboration. South Korea also demonstrates strong innovation capacity at the regional and global levels, supported by high R&D expenditure and a dynamic technology sector. Kazakhstan's position outside the leading tiers of the index points to underdeveloped research infrastructure, weak commercialization mechanisms, and limited participation in global innovation networks.

These trends are further confirmed by the Human Development Index. Finland, Singapore, and South Korea maintain very high HDI values-ranging between 0.925 and 0.94-placing them among the world's most developed economies with strong institutional systems that support human capital accumulation. Kazakhstan, with an HDI estimated between 0.80 and 0.82, ranks near the 70th place globally. This comparatively lower score indicates persistent disparities in access to quality education, healthcare, and socio-economic opportunities, which collectively constrain the formation of competitive human capital.

Taken together, these indicators clearly demonstrate that the country's most successful in digital human capital development rely on coherent, long-term strategies that integrate educational reform, technological innovation, and inclusive institutional frameworks. In leading economies, digital transformation extends far beyond technological adoption. It encompasses curriculum modernization, the development of soft and transversal skills, the introduction of personalized and adaptive learning models, and the redefinition of the role of educators as facilitators and mentors in digitally enriched learning environments. This coordinated, systemic approach ensures that digitalization becomes a foundation not only for economic modernization but also for the sustainable development of human capital capable of adapting to ongoing global transformations.

Conclusion. This study reaffirms the critical and accelerating importance of innovative and digital technologies in shaping the trajectory of modern human capital development. In the context of profound socio-economic and technological change, digitalization emerges not merely as a technical upgrade but as a multidimensional transformative force that restructures education systems, redefines labor markets, and expands the adaptive capacity of individuals and societies. Its impact reaches far beyond the domains of ICT or economic modernization, embedding itself as a fundamental framework through which nations enhance productivity, competitiveness, and long-term resilience.

The cross-national analysis conducted in this study demonstrates a clear and consistent pattern: countries with advanced and coherent digital ecosystems - notably

Finland, Singapore, and South Korea - continuously outperform others across major indicators of human capital development. Their success is rooted in strategic integration of digitalization into national education agendas, workforce development frameworks, and innovation policies. These nations invest heavily in lifelong learning ecosystems, ensure inclusive access to digital skills, and institutionalize mechanisms that foster agility, adaptability, and the acquisition of competencies aligned with the needs of the digital economy.

Kazakhstan, despite its policy initiatives such as the Digital Kazakhstan program, continues to face systemic constraints that limit the scalability and sustainability of digital human capital development. Challenges include uneven digital literacy, insufficient EdTech infrastructure, limited investment intensity, regional disparities, and fragmented implementation across institutions. Addressing these barriers requires a unified national strategy anchored in interdepartmental coordination, strengthened public-private partnerships, and the development of measurable, outcomes-based approaches to digital skills formation.

The theoretical contribution of this study lies in substantiating the direct and measurable link between digital transformation and human capital competitiveness. The findings confirm that digital ecosystems function as an enabling platform through which emerging economies can advance toward knowledge-based development. The proposed strategic framework emphasizes the need to prioritize targeted investment, ensure inclusivity in digital education, and cultivate a workforce capable of thriving in technologically dynamic environments.

From a policy standpoint, the results provide valuable guidance for designing national and regional programs focused on digital learning, reskilling, and workforce modernization - particularly in the era of the Fourth Industrial Revolution, widespread automation, and rapid diffusion of artificial intelligence. Transitioning toward competence-based, technology-enhanced, and data-driven educational models will be essential for ensuring long-term adaptability and future-readiness.

Future research directions include examining the structural effects of artificial intelligence on human capital composition, assessing internal digital divides across socio-economic and geographic groups, developing national metrics for population-level digital competence, and evaluating the long-term impacts of EdTech interventions on labor market outcomes and social inclusion.

Ultimately, innovative and digital technologies should be understood not merely as instruments for optimizing educational or employment systems, but as foundational pillars in cultivating a new generation of human capital - one that is technologically proficient, socially adaptive, critically engaged, and resilient in conditions of continuous global disruption. The findings contribute to the expanding theoretical discourse on digital human capital and support the formulation of adaptive, future-oriented national strategies aimed at strengthening competitiveness and ensuring sustainable development.

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